1993

Quantity food production text and cognitive evaluation device development

Don Morgan Paulson Sr.

Iowa State University

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Quantity food production text and cognitive evaluation device development

Paulson, Don Morgan, Sr., Ph.D.
Iowa State University, 1993
Quantity food production text
and cognitive evaluation device development

by

Don Morgan Paulson, Sr.

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Departments: Hotel, Restaurant, and Institution Management
Professional Studies in Education
Co-majors: Hotel, Restaurant, and Institution Management
Education (Higher Education)

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Departments

Signature was redacted for privacy.

For the Education Major

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1993
DEDICATION

This dissertation is dedicated to my mother, Eva, and my son, Don, Jr., who provided the faith, encouragement, comfort, and sanctuary without which this attempt at scholarship would have languished.
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INTRODUCTION

With an ever increasing aged population in the United States and with the advent of the aging "baby boomers," nursing facilities will have an expanded need for a trained professional staff to provide quality care. Properly educated and trained staff members either directly or indirectly affect how this quality care is delivered. One of the major staff components of these nursing facilities professional personnel is the foodservice supervision/personnel. These foodservice supervisors are required to have "completed or are in the process of completing a minimum of ninety hours of approved training" (Iowa Inspection and Appeals Administrative Code 481, 1987, Chapter 58-24(2), p. 20, Department of Health and Human Services, State of Iowa). This educational requirement is often fulfilled by completing self-study courses.

A Quantity Foodservice Production Study (QFPS) guide was developed as part of a newly revised Food Production Study Course, 3rd edition: Quantity Preparation and Scientific Principles (Baltzer & Gilmore, 1992) to be taught by foodservice educators at community colleges and through self-directed home study to help these foodservice supervisors meet this state code. Parts of six chapters of this 3rd edition were initially written as the six chapters of the QFPS guide used for this research. Composition, style, and format of both the QFPS guide and the quantity food preparation course were developed to meet the new code requirements of Chapter 58 of the Iowa Rules and Regulations Setting Minimum Standards for Intermediate Care Facilities and Nursing Homes.
These adult foodservice supervisors were the target population for the instructional and evaluation devices developed for this study. Two population samples were selected. The samples consisted of 35 adult students enrolled in quantity food production courses at Iowa area community colleges located at Clinton and Ankeny, Iowa.

Often, these foodservice supervisors do not have the opportunity to obtain training to complete minimum and continuing education requirements using conventional classes currently only offered at selected Iowa area community colleges. As an alternative, a text similar to the QFPS guide could be used by these potential self-directed learners in a home study format to teach quantity food preparation and applicable principles of food science.

Often, self-directed adult learners need alternative teaching methods conducive to the learning styles of these self-directed adult learners, it is important to test the effectiveness of instruments similar to the QFPS guide. Parallel to this testing, it is necessary to determine if these adults' learning styles correlate to the effectiveness of the teaching method employed. In addition, this research may validate the relationships between learning style and instructional technique used by Kolb (1976), Marshall and Merritt (1985), Hsu (1989), Cole (1988), and Paulson (1987).

Paulson (1987) and Cole (1988) used two forms of self-directed instructional methods, programmed self-instruction and simulation, with samples from a population of Hotel, Restaurant, and Institution Management (HRIM) students similar to the target population of this research. Both
authors recommended further research with self-directed learning formats to investigate any significant relationships between cognitive achievement gain and learning style. Hsu (1989) also recommends further research to study the relationships between HRIM student learning styles and non-traditional educational methods often used by the self-directed learner.

Self-directed Learning

These self-directed formats employed by Paulson (1987) and Cole (1988) are not novel to the HRIM curricula. Self-directed learning has long been used to supplement the traditional lecture method frequently used in classrooms and laboratories. Depending on how self-directed learning is interpreted, its definition varies from organized learning under the direction of professionals (Cross, 1984) to "a process in which individuals take the initiative" (Knowles, 1975, p. 18). With or without the help of others, these individuals diagnose their learning needs, formulate learning goals, identify human and material resources for learning, choose and implement appropriate learning strategies, and evaluate learning outcomes.

Self-directed learning formats similar to the QFPS guide have often been used to supplement courses in HRIM at Iowa State University (Hsu, 1989). Courses using these supplements are purchasing, foodservice management information systems, quantity food production management, and foodservice management. Kim (1989) used a form of self-directed learning, programmed self-instruction (PSI), with an inventory control model to instruct students in HRIM and dietetic programs. In an earlier study
using PSI, Cole (1988) conducted research with students enrolled in Quantity Food Production Management Experience to determine the effectiveness of programmed self-instruction and simulation educational methods.

Although research in self-directed learning is extensive, most of the studies involved vocational, job, family, hobbies, and recreation related subjects (Cross, 1984). Stevens (1985) found that few of these studies investigated the process of how people learn. Instead, "the majority of studies were completed with children and laboratory animals." Adenuga (1989), Stevens (1985), and Cross (1984) studied adult learning in self-directed learning situations. Adenuga (1989) stated "research in self-directed learning has helped to redefine the conceptual boundaries of adult learning which has substantiated that many adult learners conduct self-directed learning projects" (p. 40).

Adenuga (1989) found demographic factors had both a direct and indirect influence on the respondent's openness to self-directed learning. He also reported that many studies about self-directed learning have investigated relationships between demographic variables and adult learning to identify adult students' predispositions and appropriate teaching strategies to increase effectiveness. In his own research he found the nationality of adult learners was the most critical factor in predicting readiness of an individual to engage in self-planned learning. Sabbagjoam (1979), Hassan (1981), and Brochett (1983) found that level of education was the only demographic variable that was significantly associated with readiness for self-directed learning.
Learning Style

Kolb (1976) added a dimension to theories of how adults learn by proposing that an individual learner of any age, approaches the learning process in one of the four ways he identified. Kolb referred to this approach to learning as the learning style. In his research of learning style of subjects as they process and receive information, Kolb (1976) developed the theory that the learning process involves a four-stage cycle. The cycle includes: (a) Concrete Experimenting (CE) in a learning situation, (b) Reflective Observation (RO) of relevant phenomena, (c) Abstract Conceptualization (AC) about the meaning of what has been observed, and (d) Active Experimenting (AE) with what has been experienced, observed, and conceptualized. Kolb's cycle consists of two bipolar scores derived by the algorithm: (a) AC score minus CE score (AC-CE) and (b) RO score minus AE score (AE-RO). The resulting scores indicate one of four learning styles: converger, diverger, assimilator, or accommodator. These learning styles can be used to design effective teaching formats for the learner.

Kolb differentiates between the four identified learning styles. The major strength of the converger is the application of ideas. The diverger has a strong imaginative ability. The assimilator is less interested in people and more concerned with abstract concepts. The accommodator's strengths are effecting plans and involving self in new experiences.

Dorsey and Pierson (1984) found age and prior work experience related to the preferred learning style more than sex and ethnicity. Kolb (1976, 1984) indicated the demographic variables of age, sex, occupation,
academic level, personality type, educational level, and prior work experience have significant correlations with an individual's learning styles. None of these studies investigated the learning styles of students in hotel, restaurant, and institution management (HRIM).

Berger (1983), Paulson (1987), Cole (1988), and Hsu (1989) used Kolb's LSI to investigate the learning style of HRIM subjects. Paulson (1987) and Cole (1988) attempted to determine if Kolb's LSI could be used to select the most effective method of instruction. Neither author found LSI to be correlated with academic success when on-the-job, programmed self-instruction, and simulation instructional techniques were used.

Many of the results regarding the relationships among and between instructional method, learning style, and selected demographic variables in the studies by Cole (1988) and Hsu (1989) were not conclusive. Cole (1988) recommended, and others concurred, that further research be conducted to "investigate what types of learning styles students in HRIM curricula possess and determine if these learning styles can be used to predict the most effective instructional method" (p. 54).

Cole (1988) and Kim's (1989) research samples employed students enrolled in HRIM courses for their population samples. As a result of their recommendations to do further studies on types of instruction with this population, students enrolled in quantity food production management were chosen as pilot test subjects and the Iowa State University HRIM research sample for the current study.

Hsu (1989) used Marshall and Merritt's Learning Style Questionnaire (LSQ), a refined form of Kolb's LSI, to measure HRIM managers' learning
style to investigate any relationships with instructional method preference. Hsu (1989) discovered that convergers, the predominant learning style of her respondents, preferred self-directed learning to the traditional classroom. This same Marshall and Merritt LSQ (1985) was used for the current research.

Need for the Study

Hsu (1989) recommended a variety of instruction methods be designed for convergers, the predominant learning style of her sample. Hsu further described this learning environment design by suggesting that laboratories, simulation, case study, and special projects be used as instruction techniques. This recommendation for a variety of instructional method reinforces the need for self-study programs like the QFPS guide as a viable alternative to traditional classroom instruction. This would be beneficial for all four learning styles identified by Kolb (1976).

In addition to the absence of research investigating the relationship between learning style as measured by the LSQ and instructional method effectiveness, no texts, manuals, or associated evaluation devices exist that relate the principles of food science to applicable topics discussed in quantity food preparation. Because of this void, it was presumed that the development of the quantity food preparation text, including related food science principles, would combine in a more useful way the information now only available in disparate texts and manuals. This new
text would assist in the instruction of future quantity food preparation students.

Research Problem

The development of the QFPS guide, a component of the broader study course, and the investigation of how a student's learning style is related to the effectiveness of the self-directed format became the focus of the current study. The six selected chapters of the study guide, Marshall and Merritt's (1985) LSQ, and relevant demographic characteristics were selected for investigation and several research questions were formulated.

To help ensure a quality foodservice is provided in health care facilities, foodservice managers are required by law to have "completed or are in the process of completing a minimum of ninety hours of approved training" (Iowa Inspection and Appeals Administrative Code 481, 1987, Chapter 58-24(2), p. 20, Department of Health and Human Services, State of Iowa). To fulfill part of this requirement, the Quantity Food Preparation Study Course, 2nd edition, was recently replaced by a 3rd edition. The QFPS guide was written to partially fill a void in existing texts integrating the principles of foodservice and quantity food production.

Research Questions

Many research questions were addressed by the current study. The cognitive change as measured by the final achievement test and the relationship to the respondents' learning styles and selected demographics
were major components of the research. Research questions relevant to the focus of the study were:

1. Is the developed text named the QFPS guide concurrent with the table of specifications for cognitive content? This table was derived from an analysis of six existing textbooks which included quantity food preparation subjects. Separate textbooks covered the principles of food science.

2. Does a significant relationship exist between cognitive gain, as measured by the cognitive achievement test, and time spent reading and studying the QFPS guide? In addition, do any significant relationships exist between and/or among cognitive gain, respondents' learning styles, learning style transformation dimension (AE-RO scores), and learning style prehension (AC-AE scores) as measured by Marshall and Merritt's (1985) LSQ?

3. Do any significant relationships exist between age, sex, level of education, and months of work experience, the outcome variables, learning style, and cognitive change?

Purpose of the Study

The purpose of the research was to develop a quantity food preparation study (QFPS) guide and a cognitive achievement pre- and posttest for foodservice supervisors in accordance with a table of specifications for cognitive content compiled from the cognitive levels of related topics in existing HRIM quantity food production and food science texts. In addition, learning styles of these adult self-directed students
were measured using Marshall and Merritt's (1985) LSQ for the purpose of investigating relationships that might assist in future development of effective institutional methods and cognitive test instruments.

Another purpose of the study was to create a study guide with acceptable content validity. In addition, a contemporary and accurate study guide is needed to replace outdated texts.

The purpose of the development of the demographic questionnaire was to investigate any relationships between/among age, gender, highest level of education attained, months of related foodservice experience, and cognitive change as measured by the 66-item achievement pre- and posttest. This cognitive change was also used to investigate any relationship to learning style as measured by Marshall and Merritt's (1985) Learning Style Questionnaire (LSQ).

Objectives of the Study

Specific objectives for the study included:

1. Determination of a table of specifications for selected chapters of the Quantity Food Preparation Study (QFPS) guide and the corresponding cognitive test.

2. Determination of the cognitive levels for selected chapters of the QFPS guide and the cognitive test.

3. Development of selected chapters of the QFPS guide based on the cognitive level and content specified.
4. Development of a cognitive test to measure cognitive change using a pre- and posttest design. Evaluation of this test for reliability and content validity.

5. Investigation of the relationship between cognitive change and time spent reading the QFPS guide.


7. Investigation of the relationship between cognitive change and the learning style transformation dimension, active experimentation (AE)-reflective observation (RO) scores, and prehension dimension of abstract conceptualization (AC)-concrete experience (CE) scores.

8. Comparison of learning styles as measured by Marshall and Merritt's (1985) Learning Style Questionnaire (LSQ) and cognitive change of the respondents across the selected demographic variables of age, gender, level of education, and months of related work experience.

Definition of Terms

Learning style: Learning styles are defined as the characteristic behaviors of the learner that serve as relatively stable indicators of how they perceive, interact with, and respond to the learning environment (Keefe, 1979). Holtzclaw (1985) states that learning style refers to a person's preferred, constant way or mode of responding to stimuli in the context of learning.
Self-directed learning: Self-directed learning is a process in which individuals take the initiative, with or without the help of others in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing, and implementing appropriate learning strategies and evaluating learning outcomes (Knowles, 1975).

Converger: Dominant learning abilities are abstract conceptualization and active experimentation. The major strength of convergers is the application of ideas (Berger, 1983).

Diverger: Major learning abilities are concrete experience and reflective observation. The strength of the diverger is imaginative ability (Berger, 1983).

Assimilator: Dominant learning abilities are abstract conceptualization and reflective observation. The subject is less interested in people and more concerned with abstract concepts (Berger, 1983).

Accommodator: Ability lies in concrete experience and active experimentation. Strengths are in effecting plans and involving self in new experiences (Berger, 1983).

Quantity Food Preparation Study guide: A study course to be used as a supplement in the classroom or as a training aid in self-directed study that incorporates recent knowledge of quantity food production and applicable principles of food science.
Assumptions

1. The research subjects will respond honestly to the learning style and demographic questionnaires.

2. The Learning Style Questionnaire (LSQ) developed by Marshall and Merritt (1985) is a valid instrument for measuring learning style preference.

3. The research respondents will, to the best of their ability, answer all cognitive test questions.

Variables

One dependent variable and multiple independent variables were used in the research. These variables include:

Dependent variable:

1. Cognitive change as measured by scores of the pre- and post-cognitive tests.

Independent variables:

1. Time spent reading the QFPS guide.

2. Learning style as measured by Marshall and Merritt’s (1985) Learning Style Questionnaire (LSQ). The LSQ is a 40-item semantic differential scale designed to assess an individual’s learning styles within the experiential learning cycle used originally by Kolb (1976). The LSQ measures the respondent’s preference for the four experiential learning modes of AC (abstract conceptualization), CE (concrete experience), AE (active experimentation), and RO (reflective observation). As stated by Adenuga (1989), learning style is a function of a combination
of the four modes derived by subtracting concrete experience scores from abstract conceptualization scores (AC-CE) and reflective observation from active experimentation (AE-RO). The two resulting scores representing the abstract-concrete and active-reflective were also used as independent variables in the study.

3. Demographics: age, gender, level of education, and months of related work experience.

Some of the demographic measurement scales were converted to facilitate statistical comparisons. Age was converted to an ordinal scale for all three treatment groups. The five categories were: less than 20, 20-30, 31-40, 41-50, and over 50 years. Level of education was also categorized to an ordinal scale of measurement. The categories were: eighth grade, high school, junior or community college, current enrollment year in a 4-year institution, and graduate school.

Hypotheses of the Study

In order to address the research questions and the objectives of this study, the following research hypotheses will be tested.

Hypothesis related to the relationship between cognitive change and time spent reading the OFPS guide (objective 5):

1. There is a positive correlation between the time spent reading the Quantity Food Production Study guide and the cognitive change as measured by the cognitive test.

Hypothesis related to the relationship between cognitive change and learning style of the respondents (objective 6):
1. There is a significant difference in cognitive change among the four learning styles as measured by the Learning Style Questionnaire (LSQ).

**Hypothesis related to the relationship between cognitive change and the learning style transformation and prehension dimensions** (objective 7):

1. The LSQ transformation dimension (AE-RO scores) will be significantly (p<.05) more predictive of cognitive change than the prehension or taking-in of information dimension (AC-CE scores).

**Hypotheses related to the relationship between learning style and cognitive change scores: and hypothesis related to the demographic variables of age, gender, months of work experience, and highest level of education attained with cognitive change scores** (objective 8):

1. The demographic variable of highest level of education attained will have a significant (p<.05) relationship with the LSQ categories and the cognitive change scores.

2. The demographic variables of age, gender, highest level of education attained, and months of work experience will not have a significant (p<.05) relationship with LSQ categories and cognitive change scores.

**Limitations of the Study**

1. Thirty-four students enrolled in the Spring 1991 semester of Quantity Food Production Management (HRI 380) at Iowa State University
and 35 students enrolled in the Spring 1991 Food Production Training Program at Des Moines Area Community College (DMACC), Ankeny, Iowa, and Clinton Community College, Clinton, Iowa were selected as the research sample. This sample was selected because of accessibility, homogeneity of class content, and cost. The findings of the study should be generalized only to students in similar foodservice courses.

2. The Learning Style Questionnaire (LSQ) developed by Marshall and Merritt (1985) does not assess the learning style of learners whose abstract-concrete and active-reflective scores fall on the borderline between the four learning style quadrants on the learning style grid developed by Kolb (1974). These scores were dropped from the study resulting in the possibility of reduced likelihood of finding statistical significance due to the smaller sample size.

3. The possible effects of interaction among cognitive test scores, learning style as measured by the LSQ, and demographic variables on the main effects were not incorporated into this research.

4. The extent to which inferences about the cognitive test and LSQ scores are limited to the effectiveness of those instruments.

5. Statistical comparisons were deemed significant at p<.05.

Significance

The study will add to the literature and body of knowledge pertaining to the effectiveness of self-instructional formats similar to those used in the study guide. Learning style integration with optimal cognitive growth also should be revealed.
An understanding of learning styles and the selected demographic factors could help in the construction of effective instructional designs for future students in hotel, restaurant, institution, and foodservice management. The ability of educators to identify inner-directed and outer-directed learners should help to broaden the understanding of factors influencing the effectiveness of the educational design.
REVIEW OF LITERATURE

Theories concerning how people learn have been investigated by numerous researchers and educators through the years. This chapter investigates theories relating to self-directed learning and learning style preference as conceptualized by Kolb (1976) and measured using Marshall and Merritt's Learning Style Questionnaire (LSQ) (1985). The review first investigates theories building up to contemporary efforts to report the most effective instructional designs used in self-directed educational formats. This is followed by the second part of the review that searches for those theories of how people learn; one particular element of this learning process investigated was that of learning style preference.

Self-directed Learning

Research in self-directed learning has helped to define why learners, especially adults, seek alternate instructional methods that substitute for or complement the traditional classroom. "There are hundreds of thousands of independent learners in America today, women and men, pursuing productive intellectual projects without affiliations" (Gross, 1982).

As reported in Adenuga (1989), these individuals vary in their approaches to learning. Attempts have been made by numerous researchers to understand, identify, and measure the multiple dimensions of adult

Brookfield (1984), Candy (1987), and Gerstner (1987) have written legions analyzing the meaning(s) of self-directed learning. All three authors agree that self-directed learning is an essential element in adult education.

Candy (1987) distinguished three meanings of self-directed learning: autonomy as a personal quality; autodidaxy as learning outside formal instruction; and learner-control. In these terms, Candy uses "self-directed learning" to refer to the degree of choice learners have within an instructional situation. Brochett (1983) used a similar definition. He viewed self-directed learning as "the activity where primary responsibility for planning, carrying out, and evaluating a learning endeavor is assumed by the individual learner" (p. 16). Such learning, according to Knowles (1975), can take place either with or without the assistance of others.

A staged self-directed learning model was developed by Grow (1991) to explore Candy's (1987) definition and expand Candy's concept to match the learner's stage of self-direction and prepare the learner to advance to higher stages. Table 1 lists Grow's four stages of staged self-directed learning from stage one, learners of low self-direction, to stage four, learners of high self-direction.

In reality, often teaching styles and the learning stages listed in Grow's model are not matched. The staged self-directed learning (SSDL) is
Table 1. The staged self-directed learning model

<table>
<thead>
<tr>
<th>Stage</th>
<th>Student</th>
<th>Teacher</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Dependent</td>
<td>Authority,</td>
<td>Coaching with immediate feedback. Drill. Informational lecture. Overcoming deficiencies and resistance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>coach</td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td>Interested</td>
<td>Motivator,</td>
<td>Inspiring lecture plus guided discussion. Goal-setting and learning strategies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>guide</td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td>Involved</td>
<td>Facilitator</td>
<td>Discussion facilitated by teacher who participates as equal. Seminar. Group projects.</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Self-directed</td>
<td>Consultant,</td>
<td>Internship, dissertation, individual work or self-directed study-group.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>delegator</td>
<td></td>
</tr>
</tbody>
</table>

rarely linear (Grow, 1991). Most classes will contain students at different stages of self-direction. However, an understanding of the student's learning stage will help teachers match instructional strategies, especially in autonomous learner setting.

However, before a complete analysis of research in self-directed learning can be completed, assumptions, similar to Grow's (1991), must be made:

1. The goal of the educational process is to produce self-directed, lifelong learners. Many current educational practices in public schools and universities, however, do more to perpetuate dependency than to create self-direction.
2. There is more than one way to teach well. With some exceptions, good teaching is situational—it varies in response to the learners.

3. The ability to be self-directed is situational in that one may be self-directed in one subject, a dependent learner in another. Self-direction, however, is not entirely situational; it is partly a personal trait analogous to maturity. Once developed, certain aspects of self-direction are transferrable to new situations.

4. Self-direction is advantageous in many settings and this model is built upon a strong belief in its value—but there is nothing inherently wrong with being a dependent learner, whether that dependency is temporary or permanent, limited to certain subjects or extending to all.

5. Just as dependency and helplessness can be learned, self-direction can be learned—and it can be taught.

6. A theory does not have to be right to be useful. Nearly every action we take results from a workable convergence of misconceptions. (p. 127)

In addition to Grow’s assumptions for self-directed learning, a number of basic skills are needed by learners. Tough (1971) and Knowles (1975) outline these basic skills as:

1. The ability to decide what knowledge and skills to learn.
2. The ability to diagnose learning needs realistically, with help from teachers and peers.
3. The ability to translate learning needs into learning objectives in a form that makes it possible for their accomplishments to be assessed.
4. The ability to relate to teachers as facilitators, helpers, or consultants and to take the initiative in making use of their resources.
5. The ability to relate to peers collaboratively, to see them as resources for learning.
6. The ability to identify human and material resources appropriate to different kinds of learning objectives.
7. The ability to select effective strategies skillfully and with initiative.
8. The ability to gain knowledge or skill from resources utilized.
9. The ability to evaluate one’s own work and get feedback from others about progress.
10. The ability to detect and cope with personal blocks to learning.
11. The ability to renew motivation for learning when motivation lags.

In order to foster this process of self-directed learning, Tough (1971) proposes major changes are needed in institutions of education. Tough suggests that educators must abandon the concept that "we know best; we are the pedestal; and we will do all the planning and decision making" (Tough, 1979, p. 11). As educators, we need to move toward instructors and students being equal as persons, increasing the students' choices of how and what they learn and providing assistance with self-planned learning (Tough, 1971).

A formal recommendation pertaining to this concept of self-directed learning in relation to the training of adult educators has been proposed by Hiemstra (1981). The author states that "in conjunction with their respective institutions, adult educators will encourage and utilize the theories and practices of self-directed learning in classroom contact and application efforts" (p. 17). He further identifies the need for adult educators to "recognize the needs of their students by applying self-directed learning techniques to their own classroom setting where applicable" (p. 18).

Other authors, Smith and Haverkamp (1977), agree with Tough and Hiemstra. They propose that "learning how to learn activities should be built into the design of courses and workshops" (p. 9). Knowles (1975) and Tough (1979) suggest one way to accomplish this objective; use the learning contract as part of the activities for all courses of study.

Most of early studies and research with learning has been completed using young children and laboratory animals. Little has been done in the
last 30 years to investigate how adults learn (Stevens, 1985). The major emphasis in these studies has been the comparison of learning preferences of pedagogical (young) subjects with andragogical (adult) subjects. Cross (1984) points out that most of this research has involved vocational or job-related subjects, home and family, and hobbies and recreation, in that order.

For the purpose of Stevens' (1985) study with hospitality industry management, pedagogical learning was associated with teacher-directed instruction, while andragogical learning was associated with self-directed learning. Daly (1980) defines pedagogy as "the art and science of teaching children" while Knowles (1978) defines andragogy as "the art and science of helping adults learn." According to Knowles, newly hypothesized adult learning theory is based more on uncontrolled observation and logical reference from real-world situations than on controlled, systematic manipulation, and experimentation.

Stevens (1985) proposed two major tenants in his study of adult learning theory. The author first suggests the adult is a product or extension of what he/she was as a child; and second, pedagogical (teacher-directed) learning is less effective with adults than with children. As mentioned in Stevens, Daly (1980) makes some critical comparisons between the basic assumptions and process elements of teacher-directed (pedagogical) and self-directed (andragogical) learning (see Tables 2 and 3).

Stevens' survey of hospitality industry management revealed that self-directed learning was preferred more by women than by men. Stevens associated andragogical and self-directed learning. The author found no
Table 2. A comparison of assumptions of teacher-directed (pedagogical) learning and self-directed (andragogical) learning

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Pedagogical</th>
<th>Andragogical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept of the learner</td>
<td>Dependent personality</td>
<td>Increasingly self-directed organism</td>
</tr>
<tr>
<td>Role of learner's experience</td>
<td>To be built on more than used</td>
<td>A rich resource for learning</td>
</tr>
<tr>
<td>Readiness to learn</td>
<td>Varies with levels of maturation</td>
<td>Develops from life tasks and problems</td>
</tr>
<tr>
<td>Orientation to learning</td>
<td>Subject-centered</td>
<td>Task or problem-centered</td>
</tr>
<tr>
<td>Motivation</td>
<td>External rewards and punishments</td>
<td>Internal incentives curiosity</td>
</tr>
</tbody>
</table>

*Source: Norene F. Daly, *Andragogy: Implications for Secondary and Adult Education Programs*, p. 5, as adapted from the Institute for Continuing Education, Adult Educators "Expansion" Workshops Handbook.

significant correlation resulted when comparing ethnic groups. Stevens found pedagogy to be better liked by those who had attended college. However, Stevens theorized this observation was most likely influenced by sample bias. Contrary to his expectations, Stevens' survey revealed younger managers preferred andragogical (self-directed) learning while older, more traditional managers preferred the pedagogical (teacher-oriented approach).

Adenuga's (1989) research revealed demographic factors affect both direct and indirect influence on the respondent's openness to self-
Table 3. A comparison of the processes of teacher-directed (pedagogical) learning and self-directed (andragogical) learning

<table>
<thead>
<tr>
<th>Process elements</th>
<th>Pedagogical</th>
<th>Andragogical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Formal authority-oriented, competitive, judgmental</td>
<td>Informal, mutually respectful, consensual, collaborative, supportive</td>
</tr>
<tr>
<td>Planning</td>
<td>Primarily by teacher</td>
<td>By participative decision-making</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Primarily by teacher</td>
<td>By mutual assessment</td>
</tr>
<tr>
<td>Setting goals</td>
<td>Primarily by teacher</td>
<td>By mutual negotiation</td>
</tr>
<tr>
<td>Designing a</td>
<td>Content units, course syllabus, logical sequence</td>
<td>Learning projects, learning content sequenced in terms of readiness</td>
</tr>
<tr>
<td>learning plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning</td>
<td>Transmittal techniques, assigned readings</td>
<td>Inquiry projects, independent study, experimental techniques</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Primarily by teacher</td>
<td>By mutual assessment of self-collected evidence</td>
</tr>
</tbody>
</table>

Source: Norene F. Daly, *Andragogy: Implications for Secondary and Adult Education Programs*, p. 6, as adapted from the Institute for Continuing Education, Adult Educators "Expansion" Workshops Handbook.

directed learning and its relationship to his subjects' learning were the primary investigations. Instead of finding no ethnic correlations as in Stevens' (1985) study, Adenuga discovered demographic variables (nationality and degree program) alone are more predictive of the learner's readiness for self-directed learning than learning styles.
However, ethnicity and nationality are not interchangeable terms in the two studies.

Additional research in Adenuga’s study revealed academic and years of prior work experience were indirect indicators of readiness for self-directed learning. Age, gender, and type of employment did not demonstrate any predictive capacity for either self-directed learning readiness or preference for experiential learning style.

Not all research studies have demonstrated a readiness for self-directed learning. Self-directed learning (learner-controlled) was not an effective strategy in Ross and Rakow’s (1981) study. The authors’ research indicated differential achievement resulted depending on the instructional strategy employed. The authors reported highest performance on achievement measures associated with adaptation of examples using program- or instruction-controlled treatments. Conversely, learner-controlled treatments were associated with lower performance levels.

Ross and Rakow attributed much of this lower performance to the learner-controlled reluctance to ask the proctor for examples, and failure to admit they needed additional practice. The authors also suggested the favorable attitude of respondents to control designs rather than the self-directed model might have involved the extra effort made in developing and organizing lessons rather than any intrinsic differences.

As reported by Adenuga (1989), in a summary of the various studies on self-directed learning, Cross (1984) found enough consensus to make several generalizations.

1. Participation in self-directed learning is almost universal; reports from studies show that from 79%
(Penland, 1977) to 100% (Coolican, 1974, 1975) of all adults carry out at least one learning project in a year.

2. Typically, an adult spends about 100 hours on each project and conducts about five projects per year for a total of 500 hours per year (Tough, 1978).

3. Most of the self-directed learning projects deal with vocational or job-related subjects, home and family, and hobbies and recreation, in that order.

4. About 75% of the learning projects are completely self-directed; about 10% are one-to-one learning situations, 3% use completely pre-programmed, non-human resources (tapes, programmed instruction, and television). Only 20% of all learning projects are planned by a paid, or institutionally designed professional (Tough, 1978).

5. The three methods most commonly used in learning projects are practice, reading, and discussion, in that order. (Coolican, 1974, 1975)

Through the investigation of the various researchers on the topic of self-directed learning, much of that effort has been directed toward obtaining a clear definition of the term. Many have asked whether self-direction is a presumption or a goal of adult education. "The appropriate answer seems to be that it is both" (Fellenz, 1982, p. 83). However, this does not assume they are properly trained to complete this process. As a result, the educator should make self-instruction as one of his/her goals in teaching. Autonomy, which means the learner assumes responsibility for his/her own learning (Wilson, 1980), is achieved only if there is, besides the will to learn, an awareness of the process of learning and existing norms.

Learning Styles Research

The second major literature review relates to student learning style. Many educators today have questioned the traditional structure of the classroom by inquiring how students learn (Cole, 1988). Approaches to
theory and the subsequent research vary both in number and context (Adenuga, 1989). This section will identify, discuss, and define these various theories relating to learning styles.

Many authors in the literature demonstrate diverse viewpoints—cognitive (Kolb, 1976; Kirby, 1979), affective (Messick, 1976), and psychological (Dunn & Price, 1979). However, many of these theories are multidimensional.

However, few studies on LSI, especially in hotel, restaurant, and institution management, exists in the literature. Hsu (1989) verified this by stating that "although research on learning style in journals of education is legion, there have been few empirical studies of learning style in the foodservice area" (p. 1).

Learning styles are defined by Keefe (1979) as the characteristic behaviors of learners that serve as indicators of perception, interaction, and response to the learning environment. Kolb (1974, 1976, 1984) proposed a model for examining these learning behaviors based on experiential learning theory conceived by Jung (1923). Jung explained learning in terms of the developmental stages people use to perceive and process information.

**Kolb's model**

Kolb's model, and the subsequent Learning Style Questionnaire (LSQ) developed by Marshall and Merritt (1985), describes the learning process as a four-stage cycle. The first stage is concrete experience; the second is reflective observation; the third is abstract conceptualization and
generalization; and the fourth is hypothesis testing leading to new experience. Geller (1979) summarized Kolb’s model by suggesting Kolb had proposed two primary dimensions of learning on the problem-solving process were exemplified by two combination scores computed by using Kolb’s Learning Style Inventory (LSI). "The first dimension represents the concrete experiencing of an event at one end and abstract conceptualization at the other. The other dimension has active experimentation at one extreme and reflective observation at the other. Thus in the process of learning, one moves in varying degrees from actor to observer, from specific involvement to analytic detachment" (p. 8).

However, it might be best for the researcher to view Kolb’s four learning styles as a three-dimensional instead of a two-dimensional model because the learner is seldom completely one learning style.

Kolb (1974) emphasizes learning styles can change as a result of experience. Kolb’s instrument was created with four design objectives. It first requires the subject to compare and resolve opposing tension of the various learning styles. Second, adjectives are used for self-description of an individual’s behavior. The LSI was designed with the intention it would accurately measure the four learning styles developed by Kolb. Finally, the instrument would be "brief and straightforward."

The Kolb (1976) model (see Figure 1) displays the four-stage cycle. Kolb described the learner’s introduction to the cycle by his/her immediate concrete experience, and involvement in the experiences leading to reflection from various perspectives. After these reflective
Concrete Experiences

<table>
<thead>
<tr>
<th>Accommodator</th>
<th>Diverger</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERCE</td>
<td></td>
</tr>
</tbody>
</table>

Testing Implications of Concepts in New Situations

<table>
<thead>
<tr>
<th>Converger</th>
<th>Assimilator</th>
</tr>
</thead>
<tbody>
<tr>
<td>I N V I G</td>
<td></td>
</tr>
</tbody>
</table>

Formation of Abstract Concepts and Generalizations

Figure 1. Kolb's model

observations, the learners engage in abstract conceptualization leading to the development of generalizations that assist in the integration of these observations into theories. Lastly, learners use their generalizations to direct them to further actions and active experimentation leading to new learning situations. Although drawn as a cycle, Kolb (1985) describes it as a helix where the additional experiences, reflections, and generalizations lead the learner into action at higher levels of complexity.

As noted in Figure 1, Kolb's four learning styles in his theory's model are: converger, diverger, assimilator, and accommodator. Berger (1983) defined each of the four learning styles more precisely. The converger's dominant learning abilities are abstract conceptualization and active experimentation. The major strength of the converger is the
application of ideas. The diverger's major learning abilities are concrete experience and reflective observation. The strength of the diverger is imaginative ability. The assimilator's dominant learning abilities are abstract conceptualization and reflective observation. He/she is less interested in people and more concerned with abstract concepts. Finally, the accommodator's learning abilities lie in concrete experience and active experimentation. Strengths are effecting plans and involving self in new experiences.

Kolb's (1976) experiential theory was later expanded. According to Kolb (1984), individuals grow and develop along four main dimensions: affectively (developing sensory and feelings skills), symbolically (developing cognitive or thinking skills), behaviorally (developing acting or behavior skills), and perceptually (developing skills). These growth dimensions correspond respectively with Kolb's model of concrete experience (CE), abstract conceptualization (AC), active experimentation (AE), and reflective observation (RO) of Kolb's original model. See Figure 1. Kolb's more recent model (Figure 2) combines the theories of experiential and human development. This three-dimensional theory may help to reduce the criticism that Kolb's experiential model is oversimplified.

Many research studies have been completed using Kolb's Learning Style Inventory (LSI). Plovnick (1975) administered the Kolb LSI to the fourth-year class at Boston University School of Medicine during the fall of 1973 in an attempt to determine whether people with different learning styles were attracted to specific career choices within the medical field.
Figure 2. Experiential learning and human development (Smith & Kolb, 1986)
Plovnick's research indicated the type of medical career chosen could be predicted from learning style. The careers of family medicine and primary care were selected most often by concrete learning styles, accommodators, and divergers. Medical subspecialties were chosen more often by convergers. Academic medicine and pathology were chosen most often by assimilators.

Atkinson (1988) used a Solomon Four-Group design to determine whether or not knowledge of Kolb's experiential learning theory influences change in respondents' scores on Kolb's (1985) LSI, which groups word descriptors for each of the four experiential dimensions in separate columns for ease in grading. Atkinson's research revealed knowledge of Kolb's experiential learning theory does influence changes in respondents' scores of the LSI on the concrete experience (CE), reflective observation (RO), and the transformation dimension (AE-RO). Atkinson concluded that the pretest effect present in the study was stronger than the treatment effect, knowledge of Kolb's experiential theory.

Berger (1983) used Kolb's original LSI with 241 students in a 4-year hospitality program, the faculty in that program, and graduates of the program working in management positions in the hospitality industry. In Berger's research, LSI scores were collected measuring Kolb's four learning skills: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Subsequently, these scores were used to categorize each subject according to one of Kolb's four learning styles of converger, diverger, assimilator, or accommodator. Most of the students in Berger's study were divergers (33%) and
accommodators (29%). The remainder were assimilators (19%) and convergers (19%). Hospitality professors were 42% convergers, 27% assimilators, 15% accommodators, and 15% divergers. Most of the hospitality managers were accommodators (32%) and convergers (32%). The remaining managers were divergers (26%) and assimilators (10%).

The Kolb LSI also was used in a study by Ferguson and Berger (1985) with 127 undergraduate students enrolled in the Cornell School of Hotel Administration. One of Ferguson and Berger's objectives was to examine if the existing educational system at Cornell University was graduating proportionally more creative learners than it was matriculating. The authors theorized those entering as creative learners would keep that style through graduation, and those entering as conventional learners would be encouraged by the system to move toward more creative methods. Like Geller (1979), Ferguson and Berger emphasized the LSI test developed by Kolb (1974) rates the learning style of each participant on two dimensions: concrete versus abstract and active versus reflective. Based upon this position along the two axes, each subject is categorized into one of four categories: converger (conventional learner), diverger (creative learner), accommodator, and assimilator.

In research conducted by Paulson, Baltzer, and Cole (1989), 147 students enrolled in a quantity food production management laboratory course were administered a pre- and post-LSI in conjunction with three instructional methods: on-the-job training, programmed self-instruction, and simulation. The Kolb LSI was administered to determine learning styles of subjects and if a relationship existed between learning style,
achievement, and teaching method. Overall, the posttest population contained 35% divergers, 38.6% assimilators, 20.7% accommodators, and 5.7% convergers.

Paulson, Baltzer, and Cole's (1989) study hypothesized the converger and accommodator styles would be more compatible with the cashier instruction based on Kolb's description of styles (1974). These styles indicated a task orientation with less emphasis on creativity and abstract concepts. The authors also stated Kolb (1974) described the learning styles as a characteristic of the individual which does not change in the short term. Based on this assumption, LSI scores should be consistent from pre- to posttest.

Among the 135 subjects in Paulson, Baltzer, and Cole's study completing both the pre- and post-LSI, 48.6% reported different learning styles from pre- to posttest. The research revealed the correlation of pretest LSI and increase in cognitive score from pre- to posttest was significant (r=0.189, p=.05i). Analysis of subjects with inconsistent LSI scores indicated a significant relationship with increase in cognitive scores (r=0.564, p=.001), but the authors suggested this might have been due to incorrect interpretation of the LSI instructions at one test administration.

Marshall and Merritt's Learning Style Questionnaire

Marshall and Merritt (1984, 1986) conducted two validation studies to determine the reliability and construct validity of the LSI and to examine these same measurement properties for an alternative assessment form. The
new Learning Style Questionnaire (LSQ) survey instrument was constructed which contained Kolb's original word list. However, respondents were asked to rate the degree to which each word was characteristic of their preferred learning style. The new LSQ questionnaire was congruent with that of the theoretical model, with scale reliabilities equal or higher than those in the original form.

Marshall and Merritt's (1985) Learning Style Questionnaire (LSQ) was used for the QFPS guide research. The LSQ is based on the experiential learning model developed by Kolb (1981) using cognitive theory derived from the social psychology of Bruner and Pinget. The core of the model is a learning cycle which reflects effective information processing. The four stages of this cycle are:

1. The learner has a concrete experience.
2. The concrete experience is the basis for observation and reflection.
3. The observations are assimilated into an idea or theory from which implications for action can be deducted.
4. These implications serve as a guide in acting to create new experiences.

Marshall and Merritt (1985) stated that the original Kolb Learning Style Inventory (LSI) had two specific problems:
1. Use of paired comparisons, an ipsative assessment approach.
2. Scale reliabilities which have been reported to fall within the .30s to .60s.
Equivalence of the two LSI instruments was determined by correlating the ipsative and normative scale reliabilities. The correlation ranged from 1.67 for the active experimentation scale to .491 for the abstract conceptualization scale. After adjustment for attenuation, the adjusted scale correlations ranged from .357 to .859, with three of the four coefficients above .50. The scale means for the normative form were consistently four points higher than the means for Kolb's ipsative form. The standard deviations for both forms were very similar.

Results from Marshall and Merritt's (1984) first study suggested both the ipsative and normative forms of the LSI were consistent with Kolb's original learning style model. The adjusted correlations between the reliability scales for both forms suggested at least a moderate level of concurrent validity. Alpha coefficients revealed low internal consistency reliability for the ipsative form and a moderately higher level of consistency for the normative form.

Marshall and Merritt's (1986) second study was conducted to cross-validate the normative form of the LSI pilot tested in the first study. Marshall and Merritt's Learning Style Questionnaire developed in 1985 contained 40 items in a semantic differential format using a 5-point response mode unlike Kolb's nine groups of only four words. Reliability estimates for Marshall and Merritt's LSQ's bi-polar dimensions were very high, above .90. The construct validity of these dimensions was demonstrated. Due to the normative format of the LSQ, the authors stated it could be used for both student diagnostics and statistical research.
Marshall and Merritt (1986) proposed that their revised 40-item LSQ could be used as a teaching tool in situations in which the focus of instruction is on teaching students how to investigate their learning processes by using multiple styles. Hsu (1989) conducted research into the learning styles of unit and district level restaurant managers using Marshall and Merritt's LSQ (1985). The research sample consisted of 14 program directors, 118 unit level managers, and 45 district level managers. Learning style scores for the unit and district level managers revealed 78% of the unit level managers and 76% of the district level managers have convergent learning styles. Because the majority of the managers in Hsu's study were convergers, the author found it unfortunate that the most commonly used instructional methods in current management development programs appear to match the learning preferences of assimilators, accommodators, and divergers. Assimilators enjoy the traditional classrooms; accommodators function by acting and testing experience; divergers function through social interaction, and convergers prefer to function interacting with things rather than people (McCarthy, 1981).

As mentioned by Adenuga (1989), many learning style multidimensional theories exist in the literature. DeBello (1989) compared 11 major learning style models. Kolb's Learning Style Inventory was among the 11 models discussed. Other models included Dunn and Dunn's Learning Style Inventory and Gregorc's Style Delineator.

Dunn and Dunn's (1978) model of learning style can be classified as multidimensional as noted in many of the models studied by Adenuga (1989).
Dunn and Dunn defined learning style in terms of conditions teachers can change rather than as variables that directly cause learning. The authors identified 21 elements that influence how individuals learn. These 21 elements have been categorized into five major groups: 1) environmental, 2) emotional, 3) sociological, 4) physiological, and 5) psychological.

The Dunns' model is the foundation for a diagnostic/prescriptive approach. DeBello (1989), a key importance to the theoretical structure of the model, is the tenet that individual styles must be assessed and that, if a learner is going to have the best opportunity to learn, instructional techniques must be employed that are harmonious with each student's style. The Learning Style Inventory associated with Dunns' model can be used with elementary level, secondary level, and adult learners.

Gregorc's (1979) research revealed the concept that people display a duality in learning, specifically, perception and ordering. The author found that people learn through concrete, random, and sequential proclivities.

Gregorc revealed that four distinct learning patterns are exhibited by everyone to some degree. The abstract/concrete and sequential/random dimensions are combined in one of the following:

1. Concrete Sequential. These learners acquire knowledge through direct hands-on experience. Order and step-by-step instructions are preferred.
2. Concrete Random. These learners display experimental attitudes and behaviors. Trial and error and intuitive approaches are preferred.

3. Abstract Sequential. These learners have decoding abilities with written, verbal, and image symbols. They prefer rational and sequential learning.

4. Abstract Random. These learners are attentive to human behavior. They prefer learning in an unstructured manner in discussions and activities that involve multisensory experiences.

Gregorc developed the Gregorc Style Delineator to measure the two mediation traits, perception and ordering, from which abstractness and concreteness emerge (Gregorc, 1979). The author emphasizes the matching of instructional materials and methods to meet individual preferences.

Campbell (1989), using Gregorc's (1979) delineation, pilot-tested 102 students in business communication at Memphis State University to study the relationship between teachers' and students' learning styles and students' achievement in business communication. Campbell discovered no significant difference (p<.05) in student achievement in a business communication course when categorized according to learning style. Likewise, no significant difference (p<.05) existed when learning style was matched to teaching style of the instructor.

Summary

Kolb, Marshall and Merritt, Dunn and Dunn, and Gregorc all developed learning style measurement instruments. In the development of their
respective theories and instruments, there has been a degree of overlap. Both Kolb and Gregorc developed learning style inventories to assess the cognitive component of learning style. Dunn and Dunn developed an inventory to measure affective and physiological elements of learning style. As summarized by DeBello (1989), these "multidimensional models would seem to offer a more thorough, encompassing, and responsive approach to the complexity of diversified differences in how students actually attend to, absorb, and retain new and difficult material." The final issue existing in the learning style theory is whether to teach to students' strengths or whether to expand their styles.
This research was designed to measure the cognitive effect of studying selected chapters of newly revised Food Preparation Study Course: Quantity Preparation and Scientific Principles (Baltzer & Gilmore, 1992). A 66-item cognitive test was employed to measure the cognitive effect. Learning style was also investigated employing Marshall and Merritt's Learning Style Questionnaire (LSQ) (1985). A demographic questionnaire was developed and administered to provide descriptive statistics to the study. The study design and procedures will be presented in chronological order. Selected chapters used for the research were named Quantity Food Preparation Study guide (QFPS guide) (Appendix A).

The research used two samples, one consisting of undergraduate students enrolled in Hotel, Restaurant, and Institution Management (HRIM) 380 Quantity Food Production Management at Iowa State University; and the other consisting of adults enrolled in quantity food preparation courses, part of the Foodservice Supervisor training program, at two Iowa community colleges. Research testing using the QFPS guide, cognitive achievement test, LSQ, and the demographic questionnaire occurred in Spring 1991.

Development of the Study Guide

The published Food Preparation Study Course consists of 13 chapters, 212 pages (Baltzer & Gilmore, 1992). The 13 chapters include the following topics: recipe standardization; fruits; vegetables; salads; starches, sauces, soups, cereals, and pastas; milk and cheese; meats,
poultry, fish, and entrees; eggs and egg products; doughs, batters, and pastries; beverage and convenience foods; microwave cooking; menu planning; and food purchasing, receiving, and storing. In addition to the text, each chapter includes learning exercises and review questions, some of which were originally written for the 66-item cognitive test developed for use with the QFPS guide. Six of the 13 chapters of the study course used for this research were drafted by the researcher. Authorization for collaboration in composition of the study course was granted by the authors, Baltzer and Gilmore, HRIM educators. These six chapters were: vegetables; fruits; salads; meats, poultry, fish, and entrees; bakery products, dough, pastry, and batters; and beverages and convenience foods. To expand existing knowledge on selected topics, approximately 85% of the text of each of the six chapters of the QFPS guide was added to this third edition.

Cognitive objectives

Prior to the development of the Food Preparation Study Course: Quantity Preparation and Scientific Principles (Baltzer & Gilmore, 1992), specific cognitive objectives were identified by the researcher and approved by the authors of the Food Preparation Study Course. The seven objectives were:

The student will . . .

1. Understand the basic principles of food science as they apply to quantity food preparation.
2. Understand the quality standards for foodservice products in quality foodservice operations.

3. Understand how to identify foodservice production failures during all phases of product development.

4. Understand how to make adjustments during the production process to ensure desirable outcomes.

5. Demonstrate through written exercises, comprehension of the material in the text.

6. Be able to apply the principles of food science to a quality foodservice operation.

7. Be able to evaluate a quantity foodservice operation compliance with acceptable food quality standards.

The preceding cognitive objectives that did not require observation to complete the evaluation process were selected for the research project. All seven objectives were reviewed by two experts in dietetics and foodservice management at Iowa State University for application to approve the study guide used with the research samples. Each expert was given a list of the proposed objectives from which deletions and additions were eventually agreed upon.

**QFPPS guide content**

The six chapters used for this research included in the Quantity Food Preparation Study (QFPS) guide are listed in Table 4.

The six topics used as chapters in the QFPS guide were chosen for applicability, importance, and potential length of subject matter. These
Table 4. Quantity Food Preparation Study (QFPS) guide chapters

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Length in pages</th>
<th>Percent of content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vegetables</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Fruits</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Salads</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Meats, Poultry, Fish, and Entrees</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Bakery Products, Dough, Pastry, and Batters</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>Beverages and Convenience Foods</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>76</td>
<td>100</td>
</tr>
</tbody>
</table>

six topics also were selected based on the time table for the project. In the final published study course by Baltzer and Gilmore (1992), these chapters composed approximately 44% of the text.

These six topics were used in the research to measure cognitive change and relationships between and among learning style and selected demographic data. Much of the demographic data of helpfulness of the information in the study guide, ease of understanding of this information, helpfulness with work on other course assignments, appropriateness of time spent reading the study guide, and percentage of each chapter read were used to add qualitative dimensions to the study.

This research employed the draft of the selected six chapters of the QFPS guide (see QFPS guide Table of Contents, Appendix A). These were
reviewed for accuracy, depth, and usability by a panel of four educators familiar with the previous edition. Their suggestions and comments were incorporated into the final draft of the QFPS guide. Some of the content for the QFPS guide was based on information included in the Quantity Food Preparation Study Course, second edition. Other material was added to enhance the depth and breadth of understanding of quantity food production and its interrelationship with food science principles. All this material was proofed by an English composition educator to verify the reading level of the QFPS guide did not exceed the sixth grade level.

The authors of the third edition, Baltzer and Gilmore, consulted users of the previous editions to determine which topics should be added, modified, revised, and expanded for use in their publication. The content was also reviewed for its appropriate use as a supplement for instructing quantity food preparation students enrolled at Iowa State University. Baltzer and Gilmore were used to verify the cognitive level of information included in the text, learning exercises, and review questions for the six chapters.

Each of the six chapters included in the QFPS guide was developed to assure the cognitive objectives were met. The respective size, breadth, and depth of each chapter's content were based on similar existing texts, a survey of users of previous editions, and the judgment of the experts who currently teach courses in HRIM.

The Iowa Dietetic Association was another source of recommendations and confirmation of content. Members of the Iowa Dietetic Association Publications Review Board were given copies of one chapter for format and
content approval. The Iowa Dietetic Association was the grantor providing financial support for the publication of the third edition.

Cognitive levels for the QFPS guide were based on those found in existing literature using Bloom's (1956) Taxonomy of Educational Objectives as a guide. The four cognitive levels included in other published tests were knowledge, comprehension, application, and evaluation. The average percentages discovered in existing texts in the Iowa State University library and HRIM department for each of four cognitive levels are listed in Table 5. These percentages were calculated by totaling the pages on each chapter devoted to each of the six topics and dividing this total into the number of pages of information, review questions, and exercises related to each of the four cognitive levels. An HRIM educator was used to collaborate these cognitive level percentages.

Table 5. Cognitive level matrix of existing textbooks

<table>
<thead>
<tr>
<th>Topic</th>
<th>Knowledge (%)</th>
<th>Comprehension (%)</th>
<th>Application (%)</th>
<th>Evaluation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>60</td>
<td>30</td>
<td>9</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Fruit</td>
<td>57</td>
<td>34</td>
<td>9</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Salads</td>
<td>55</td>
<td>36</td>
<td>9</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Meats</td>
<td>62</td>
<td>30</td>
<td>8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Bakery</td>
<td>64</td>
<td>28</td>
<td>8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Beverages</td>
<td>62</td>
<td>31</td>
<td>7</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Mean</td>
<td>60</td>
<td>31.5</td>
<td>8.3</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>
The selected content of the study guide included chapters on fruits, vegetables, and salads. These chapters contributed 54% to the final version of the study guide and 28% of the published study course. These chapters described the structure of the foods, how they were purchased, and preparation guidelines used in quantity food production. The subsections for each of the six chapters are listed in the QFPS guide's table of contents in Appendix A.

A separate section was devoted to salads. The 13% of the QFPS guide discussing salads identified the role of salads on the menu, set standards for salads, and discussed major parts of a salad. The remainder of the chapter specified types of salads, salad preparation, and salad service. A section on salad garnishes and salad dressings also were included.

Another major section of the QFPS guide was meat and meat products. This chapter contained 18% of the content of the study guide and 9% of the published study course. The chapter included information on general meat purchasing and preparation guidelines, as well as specific content on beef, pork, poultry, fish, and other meat entrees.

The chapter devoted to bakery products contributed 21% to the QFPS guide. As a result of recommendations from the Iowa Dietetic Association Publications Board, new material was added on cake and muffin mixes.

Only 10% of the QFPS guide was devoted to beverages and convenience foods. This chapter presented material about nonalcoholic and hot and cold beverages. Because of the common use of convenience foods in contemporary quantity foodservice operations, the final section of this
chapter of the QFPS guide presented the application of these foods in quantity food production.

Because the integration of principles of food science and quantity food preparation is unique to the QFPS guide, a content and cognitive matrix was created by the researcher to assist in the analyses of the depth and breadth of cognitive levels of published material, as shown in Table 6. After the content was selected, the cognitive level appropriate to each topic was identified. These cognitive levels were verified by an HRIM educator.

During the analyses of existing texts for cognitive level content and the composition of the QFPS guide, Bloom’s (1956) Taxonomy levels were

<table>
<thead>
<tr>
<th>Topic</th>
<th>Knowledge (%)</th>
<th>Comprehension (%)</th>
<th>Application (%)</th>
<th>Evaluation (%)</th>
<th>Percent of total content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>50</td>
<td>40</td>
<td>10</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Fruits</td>
<td>53</td>
<td>38</td>
<td>8</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Salads</td>
<td>55</td>
<td>35</td>
<td>10</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Meats</td>
<td>51</td>
<td>37</td>
<td>11</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Bakery Products</td>
<td>49</td>
<td>40</td>
<td>9</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>Beverages and Convenience Foods</td>
<td>60</td>
<td>35</td>
<td>5</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Percent of QFPS guide</td>
<td>53</td>
<td>38</td>
<td>9</td>
<td>&lt;1</td>
<td>100</td>
</tr>
</tbody>
</table>
applied. The four levels of Bloom's Taxonomy used were: knowledge, comprehension, application, and evaluation. Knowledge here as defined by Bloom included "those behaviors and test situations which emphasized the remembering, either by recognition or recall, of ideas, material, or phenomena" (Bloom, 1956, p. 62). Bloom's definition of comprehension included "those objectives, behaviors, or responses that represented an understanding of the literal message contained in a communication" (Bloom, 1956, p. 89). In the differentiation between comprehension and application, Bloom stated: "A demonstration of comprehension shows that the student can use the abstraction when it is specified. A demonstration of application shows that he/she will use it correctly, given an appropriate situation in which no mode of solution is specified" (Bloom, 1956, p. 120). Finally, although very little evaluation was discovered in existing foodservice texts, its definition would have paralleled Bloom's definition: "The making of judgments involves some combination of knowledge, comprehension, application, analysis, and synthesis" (Bloom, 1956, p. 185).

Two experts in the field of dietetics and foodservice management verified the QFPS guide content met the objectives 1 through 5 and the requirements of the content cognitive matrix. Each subsequent draft of each of the six chapters, review questions, and learning exercises were reviewed by the same two experts. Each made recommendations for deletion, expansion, and changes for all revisions. The sections of the research study guide relating directly to the cognitive level of application were found in review questions, learning exercises, and case studies written to
accompany the research study guide. Many of the review questions and learning exercises were used in the final study course. In addition, an expert in test design also was used to validate predominant cognitive levels commonly found in published texts. This information was assimilated and employed during the formulation of the cognitive matrix shown in Table 5.

After completion of the first draft of the section discussing vegetables, fruits, and salads, a copy was submitted to the Iowa Dietetic Association Publications Board for approval of content and format. During the summer of 1991, the remaining sections of the QFPS guide were completed and approved. Copies of the completed study guide were sent to a panel of four reviewers who were dietitians experienced in teaching the content of the study course to the target audience. Their comments and recommendations were combined and incorporated when they did not conflict and/or were not contradictory with the verified content. The changes were included in the content cognitive matrix. Minimal changes and additions were made. The cognitive/content matrix percentages did not change significantly.

One particular suggestion by the panel of dietitians was to add content relating to muffin and cake mixes. Because of the predominant use of these mixes in contemporary quantity foodservices, this information was added to the existing content categories in the Bakery Products chapter.

Another suggestion was incorporated into the Meats chapter. A section was added to the subsection on chicken to discuss how fried chicken could be tested for doneness.
Achievement Test Development

**Preliminary evaluation of achievement test**

The cognitive test design selected was multiple choice. This form was chosen for its usability, simplicity in administration, and scoring. Questions from each of the major six topics of the QFPS guide were developed simultaneously with the writing of the QFPS guide. A bank of questions was composed.

The table of specifications listed in Table 7 was used to develop the 132 test questions. The table of specifications was based on the content cognitive matrix displayed in Table 5.

<table>
<thead>
<tr>
<th>Cognitive domain</th>
<th>Percent of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>59</td>
</tr>
<tr>
<td>Comprehension</td>
<td>37</td>
</tr>
<tr>
<td>Application</td>
<td>4</td>
</tr>
<tr>
<td>Evaluation</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

**Pilot Test**

In addition to the composition of the QFPS guide, the second major component of the research was the development of a cognitive achievement test. This second goal was achieved through two tests that could be used as a source for the final cognitive test form. A bank of 132 questions was written by the researcher and divided into two 66-item tests, forms A
and B, to meet the recommendations of Green (1963) that one multiple choice response could be expected every minute. Gronlund (1988) agreed that, as a rule, high school and college students should be able to answer one multiple-choice or short-answer item per minute. The readability and time required per test item were evaluated. Test questions were randomly assigned to each test instrument. These tests are found in Appendix C. Each question’s cognitive level and content source in the QFPS guide are listed in Tables B.1 and B.2 in Appendix B.

Test questions not related to information contained in the final version of the QFPS guide were omitted by the researcher with confirmation from an HRIM educator. Other questions that all subjects answered correctly and questions no one answered correctly on the original 132-item test had distractors changed, were rewritten, or were omitted. Three faculty members in Hotel, Restaurant, and Institution Management were consulted about the usability, content, design, and length of the test.

Ten students enrolled in the HRIM course during Summer 1990 completed the 132-item achievement test. These students were selected based on their accessibility; yet, they would not be included in the research samples. Use of research subjects was approved by the Iowa State University Human Subjects Committee. See Appendix F.

Certain test design standards relating to stem and distractor construction were met. Following the preliminary test administration, several items were modified to improve distractor effectiveness and parallelism of distractors. Some test question stems were rewritten for easier readability.
Pilot Test Administration

The pilot test was conducted with 49 students enrolled in HRIM (380), Quantity Food Production Management course at Iowa State University during Fall 1990. Although not a mandate of the research, the HRIM 380 class instructor required participation in the pilot test by all class members in attendance.

The target for the Kuder-Richardson Reliability Estimate (KR-20) standard of .80 or greater was adopted. The desired difficulty level range of 30 to 70% was also targeted. This score corresponded to the number of students answering the question correctly. Item discrimination desired in the design of the distractors was between .20 and .39 (Iowa State University Testing and Evaluation Services, 1985).

After administration of the pilot test, many test items were improved to increase the distractors' effectiveness. Distractors selected by less than 2% of the pilot test group were rewritten to improve their plausibility. Others had stems clarified to bring items within the desired standards. Those distractors with clue words relating to the correct response for the stem were redesigned. Distractors were also reviewed to ensure they were similar in length and had parallel construction. Figure 3 presents one test item from the pilot test that was subsequently improved.

Although the difficulty level for this question was 67%, within the acceptable limits of 30 to 70%, many of those students performing best on the test chose the incorrect response of either A, B, or C as evidenced by a discrimination index of -.02. By changing distractor D, the difficulty
Test A Question: To maintain the quality of canned fruit in a quantity foodservice operation, which of the following is NOT true?

A. Canned fruit should be stored in a dry environment not to exceed 85°F.

B. A dry, cool, dark storage area should be provided.

C. Cases of canned fruit should be stored and used on a first-in, first-out basis.

D. Canned fruit should be removed from the can and placed in plastic storage containers.

Figure 3. Sample original unchanged test question and distractors

level of the question decreased to 58%; but the item discrimination changed from -.02 to +.47, well within a more acceptable range of +.20 or above.

Distractor D, for example, in Figure 3 follows:

D. Opened canned fruit should be stored in its container.

Item discrimination improved by rewriting the entire distractor.

To obtain a valid, reliable, and usable research device, 132 questions were developed from which 66 were selected for test forms A and B. The content source and cognitive level for each of these 132 questions are listed in Tables B.1 and B.2 in Appendix B.

Pilot Test Procedures

Test instructions were developed for the pilot HRIM 380 class sample. These instructions were used in conjunction with the two 66-item
achievement tests A and B, a consent form, and Marshall and Merritt's Learning Style Questionnaire (LSQ). These materials can be found in Appendix C.

Marshall and Merritt's LSQ was modified to improve respondent understanding of the directions for the questionnaire. None of the instrument measurements was changed. All grading calculations were completed in accordance with Marshall and Merritt's copyrighted instructions. Only the directions used in the questionnaire example were simplified for reader comprehension. Improved questionnaire understanding was hoped to improve the accuracy of the learning style measurements.

Written instructions for the pilot test were composed to help ensure standardization of instructions later administered to Research Samples 1 and 2. Achievement test forms A and B, the LSQ, and a consent form were distributed. Sixty minutes was allowed for the completion of all instruments. The earliest completion time was 30 minutes. Only three students required the full 60 minutes allowed.

Research subjects were instructed to mark their responses directly on the measurement instruments. Later, these responses were transferred to General Purpose NCS Answer Sheets for scoring by the Iowa State University Test and Evaluation Services. Achievement test scores were posted by the last four digits of each subject's social security number on the HRIM departmental bulletin board.
Final Achievement Test

To achieve the research goal of producing a cognitive instrument students could complete in 60 minutes, the final achievement test length consisted of 66 test items (Appendix C). The overall percentages of test questions for this final form used the table of test specifications as listed in Table 8. The percentages of the final test for knowledge, comprehension, and application were 50, 42, and 8, respectively. This compared to the original achievement test table of specifications percentages of 59, 37, and 4. In addition, less than 1% was specified for evaluation (see p. 34).

Table 8. Test question distribution by cognitive level

<table>
<thead>
<tr>
<th>Content</th>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Evaluation</th>
<th>Percent of final test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>10.6</td>
</tr>
<tr>
<td>Fruit</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>9.1</td>
</tr>
<tr>
<td>Salads</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>7.6</td>
</tr>
<tr>
<td>Meats</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>27.2</td>
</tr>
<tr>
<td>Bakery Products</td>
<td>8</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>30.3</td>
</tr>
<tr>
<td>Convenience and Beverages</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>15.1</td>
</tr>
<tr>
<td><strong>Total number of questions</strong></td>
<td><strong>32</strong></td>
<td><strong>28</strong></td>
<td><strong>5</strong></td>
<td><strong>1</strong></td>
<td><strong>66</strong></td>
</tr>
<tr>
<td><strong>Percent of final test</strong></td>
<td><strong>48.5%</strong></td>
<td><strong>42.4%</strong></td>
<td><strong>7.5%</strong></td>
<td><strong>1.5%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Research Sample 1

Research Sample 1 was conducted with 31 students enrolled in HRIM 380 Quantity Food Production Management course at Iowa State University during Spring 1991. This sample was selected for its accessibility and similarity to the research target population.

Although the class instructor required all students enrolled in HRIM 380 to participate in completing the test instrument, participation in the research was voluntary. This was done to influence participation in advance. Although students were unfamiliar with the research, they were told the research measurements and the study guide were related to course content. They also were asked to not make a judgment until after their experience with the research.

Students were informed that two complete copies of the QFPS guide were located in the reserve section of the Iowa State University library. To improve accessibility, another was placed in the HRIM reading room.

To provide incentive and increase participation of the subjects with the reading of the QFPS guide, four sets of review questions were developed (Appendix D). All subjects had an opportunity to earn five additional grade points for each review exercise. Answer keys (Appendix D) and each subject's respective scores for each exercise were listed by the last four social security digits and posted on the HRIM departmental bulletin board. Participation was also enhanced through an announcement at mid-term by the course instructor reminding the subjects of the benefits of increased knowledge, improved comprehension of course content, and additional grade points.
Pretest administration

Pretest instructions were developed for the HRIM 380 sample. These instructions were used in conjunction with a written consent form, the 66-item cognitive achievement test, and Marshall and Merritt's LSQ. These materials can be found in Appendices B and C. One hour was allowed for the completion of all research instruments. The pretest was administered during the second week of classes.

The subjects were instructed to mark their responses directly on the test instrument. Omitting answer sheets reduced testing time required and allowed the completion of the other instruments within the 1 hour specified. Subjects were directed not to leave any questions blank. If they did not know the answer to a question, they were asked to mark their best guess. All subjects completed all research instruments.

Achievement tests were scored by transferring the respondent's choices from the test instrument to General Purpose NCS Answer Sheets. LSQ scoring was completed manually using Marshall and Merritt's copyrighted procedures. Both achievement test and LSQ scores were coded and recorded on Fortran forms and entered using the SPSS Statistical Package (SPSS User's Guide, 1990). Achievement test scores were posted on the HRIM departmental bulletin board.

Posttest administration

Posttests were administered approximately 3 months after the pretest. Posttests for the HRIM 380 Sample 1 included the 66-item achievement test, the LSQ, and a demographic questionnaire (Appendix C).
Unlike the pretest, the demographic questionnaire was administered to obtain additional research subject data later used for qualitative and quantitative comparisons. The demographic questionnaire was designed to determine the independent variables of: age, sex, educational level, time spent reading the QFPS guide, percentage of the QFPS guide read, and population sample. These independent variables also were used to investigate any statistical relationships that existed between and among them and the dependent variable, cognitive change as measured by the cognitive achievement test.

The following qualitative questions were added to the HRIM 380 Sample 1 demographic questionnaire:

1. Was the study guide easy to understand?
2. Did you find the information in the study guide helpful as a supplement to other HRIM 380 assignments?
3. How do you feel about the time you spent reading the study guide?
4. How much of each chapter did you read?
5. What suggestions do you have for improving the study guide?

Scoring procedures for the achievement test and the LSQ were the same as done for the pretest. Scores and demographic responses were transferred to the same Fortran coding forms. Each research subject was assigned a random number to ensure anonymity. Only the posted achievement scores were listed by the last four digits of each subject’s social security number.
Research Sample 2

Concurrent with the undergraduate study of 41 HRIM students, a second sample group was selected and research implemented with the target population of the final study course developed by Baltzer and Gilmore (1992). This second sample consisted of adults enrolled in quantity food production courses for foodservice supervisors at two Iowa area community colleges located at Clinton and Ankeny.

During the first week of classes, personal copies of the QFPS guide were distributed to all research subjects. Although both sample course instructors at each community college did not require students to read the study guide as a course prerequisite, both instructors did recommend all students use the guide as a supplemental resource for their weekly assignments. Similar to the HRIM 380 sample, these instructors reminded the students of the benefits of increased knowledge and improved comprehension resulting from reading the QFPS guide. Participation in the research was voluntary.

A series of case studies (Appendix E) was developed to ensure research subjects were using the QFPS guide. These case studies were discussed in class under the direction of the instructor. Participation also was enhanced through a verbal reminder concerning the benefits in reading the QFPS guide.

Pretest administration

Separate pretest instructions (Appendix C) were developed for the community college Research Sample 2. Simplified instructions were used to
reduce test anxiety and to improve research instrument accuracy due to enhanced understanding of the directions. These instructions were used in conjunction with a written consent form, the 66-item cognitive achievement test, and Marshall and Merritt's LSQ. These materials are in Appendix C. The pretest was administered during the first week of the 4-week course.

The research subjects were instructed to make their responses directly on all instruments. Omitting answer sheets reduced testing time, anxiety, and inaccuracy resulting from unfamiliarity with computer compatible answer sheets.

One hour was allowed for the completion of all pretest instruments. All subjects finished within the allowed 1-hour period.

Subjects were instructed not to leave any questions blank. If they did not know the answer to a question, they were asked to make their best guess.

As with Sample 1, achievement tests were scored by transferring the respondents' choices from the research instrument to General Purpose NCS Answer Sheets. LSQ scoring was completed manually using Marshall and Merritt's copyrighted procedures. Both scores were coded and recorded on Fortran forms. These results were entered into data files using the SPSS Statistical Package (SPSS User's Guide, 1990).

Posttest administration

Posttests were administered the last week of the study course, approximately four weeks later. Posttests included the 66-item achievement test, the LSQ, and a demographic questionnaire.
The demographic questionnaire was used to obtain additional research subject data later used for qualitative and quantitative comparisons. The descriptive data were the same as those used for HRIM 380 Sample 1. The following questions were designed to add a qualitative dimension to the research:

1. Was the study guide easy to understand?
2. Did you find the information in the study guide useful for class or at work?
3. How do you feel about the time you spent reading the study guide?
4. How much of each chapter did you read?
5. What suggestions do you have for improving the study guide?

Scoring procedures for the achievement test and the LSQ were the same as those explained for HRIM 380 Sample 1. Sample 2 research subjects also were assigned a random number to ensure anonymity.

A note of thanks and achievement pretest and posttest scores were mailed to community college Sample 2 respondents in envelopes that had been attached to the posttest package. Only those respondents who requested their results were directed to fill in their names and addresses on these envelopes.

Cognitive achievement test length

The original bank of 132 test questions was written to ensure sufficient numbers of questions existed to proportionately represent each of the six topics. This bank was used as the source for the final 66-item achievement test used as the pilot test with HRIM 380 students. The 132
test questions were divided into two test forms A and B with equal distribution of questions for each topic.

The 66-item achievement test used with the research samples selected questions from these two test forms with the difficulty values nearest the acceptable range of 30 to 70% and preferred discrimination values above .20. No questions with negative discrimination values were used. Some question stems and distractors were rewritten to improve difficulty and discrimination values. The number of questions by topic and each question's cognitive level are listed in Table 9.

Five educators familiar with the target population of the quantity food production courses were surveyed to obtain data concerning the ideal

Table 9. Achievement test question cognitive distribution

<table>
<thead>
<tr>
<th>Topic</th>
<th>Cognitive level</th>
<th>Total number of questions</th>
<th>Percent of test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K^a</td>
<td>C^b</td>
<td>A^c</td>
</tr>
<tr>
<td>Vegetables</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Fruits</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Salads</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Meats</td>
<td>8</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Bakery</td>
<td>8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Beverages and convenience foods</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>28</td>
<td>5</td>
</tr>
</tbody>
</table>

^aKnowledge.
^bComprehension.
^cApplication.
^dEvaluation.
length of the final cognitive achievement test. Their opinions are summarized in the findings.

To develop the final test, content topics were analyzed with the objective of creating an ideal test and table of specifications. To refine and verify the quality of the table of specifications, six educators from Iowa State University and Iowa community colleges completed a questionnaire (see Appendix D). Respondents were asked to rank order and list the relative importance of each food group topic: complexity of the topic, cost control of the food group, nutritive retentive importance in the food, and overall value of education about the food group.

Statistical Analyses

After all data had been entered, variable and value labeling was completed. The first statistical analysis was the completion of a frequency distribution of the data. This facilitated identification of missing or improperly coded data as well as summarizing demographic data. Statistical analyses and variables are listed in Figure 4.

Variables in the study included both continuous and categorical measures. As a result, some coding and/or recoding was required before statistical computations and hypotheses testing.

Age, measured in years, was converted to an ordinal scale. The five categories were: less than 20, 20-30, 31-40, 41-50, and over 50 years. Gender was measured as two categories, male and female. Highest level of education was categorized into the ordinal scale measures of: eighth grade, high school, junior or community college, current enrollment year
<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Cognitive Change</td>
<td>Time Spent Reading</td>
<td>Pearson-r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Study Guide</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td>Cognitive Chg.</td>
<td>Learning Style</td>
<td>ANOVA</td>
</tr>
<tr>
<td>#3</td>
<td>Cognitive Change</td>
<td>Learning Style</td>
<td>Pearson-r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transformation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cognitive Change</td>
<td>Learning Style</td>
<td>Pearson-r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prehension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimension</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>Cognitive Chg.</td>
<td>Level of Education</td>
<td>Chi-2</td>
</tr>
<tr>
<td>#5</td>
<td>LSQ</td>
<td>Level of Education</td>
<td>ANOVA</td>
</tr>
<tr>
<td></td>
<td>Cognitive Chg.</td>
<td>Age</td>
<td>ANOVA</td>
</tr>
<tr>
<td></td>
<td>Cognitive Chg.</td>
<td>Gender</td>
<td>ANOVA</td>
</tr>
<tr>
<td></td>
<td>Cognitive Chg.</td>
<td>Work Experience</td>
<td>Pearson-r</td>
</tr>
<tr>
<td></td>
<td>Learning Style</td>
<td>Age</td>
<td>Chi-2</td>
</tr>
<tr>
<td></td>
<td>Learning Style</td>
<td>Gender</td>
<td>Chi-2</td>
</tr>
<tr>
<td></td>
<td>Learning Style</td>
<td>Work Experience</td>
<td>ANOVA</td>
</tr>
</tbody>
</table>

Figure 4. Statistical analyses completed

in a 4-year institution, and graduate school. Related work experience was measured in a continuous scale of months. Numerical values were assigned to all categories of nominal and ordinal data. Continuous measures were used for cognitive achievement, test scores, months of related work experience, and learning style inventory raw scores. The four learning styles nominal measures were given numerical values.
The Learning Style Questionnaire (LSQ) raw scores were used to calculate the dominant learning style of the respondents following the confidential instructions of Marshall and Merritt (1985). The LSQ is a 40-item semantic differential scale designed to assess an individual's learning style within the experiential modes of AC (abstract conceptualization), CE (concrete experiences), AE (active experimentation), and RO (reflective observation) as described by Kolb (1976). The learning orientation scores were calculated from the values of AC, CE, AE, and RO. The following formulas were used to calculate the orientation scores: concrete-abstract (AC-CE scores) and active-reflective (AE-RO scores). The resulting scores indicate the degree to which the respondents prefer the abstract over concrete or action over reflection.

Respondents who scored lower than the sample median on both AC-CE and AE-RO dimensions were classified divergers. Those with higher than median scores were classified convergers. Individuals with lower than median AC-CE scores, but higher than median AE-RO scores, were classified accommodators. Those with higher than median AC-CE scores and lower than median AE-RO scores were classified assimilators. The LSQ AC-CE and AE-RO scores, those abstract-concrete and active-reflective scores, were used as independent variables to estimate their predictability of cognitive change as measured by the achievement test.

The Statistical Package for Social Sciences (SPSS) (1990) was used for the research statistical analyses. Descriptive statistics were completed for all variables.
Hypothesis #1: There is a positive correlation between the time spent reading the Quantity Food Production Study guide and the cognitive change as measured by the cognitive test, was tested using a Pearson product moment correlation.

Hypothesis #2: There is a significant difference in cognitive change among the four learning styles as measured by Marshall and Merritt's LSQ, was addressed in part by completing variable frequencies to determine the predominant learning style. These learning style frequencies were subsequently used to test Hypothesis #2 employing a one-way ANOVA.

One-way analysis of variance (ANOVA) "involves the analysis of one independent variable with two or more levels" (Hinkle et al., 1988, p. 329). Interpretation of results of the ANOVA is based on the F-statistic which represents the ratio of the mean squares between to those mean squares within group variance estimates.

The raw AE, RO, AC, and CE scores were used to calculate the LSQ transformation dimension score (AE-RO) and the LSQ prehension dimension score (AC-CE). Two separate Pearson product moment correlations were completed to test Hypothesis #3: The LSQ transformation dimension (AE-RO scores) will be significantly (p<.05) more predictive of cognitive change than the prehension or taking-in of information dimension (AC-CE scores).

Hypothesis #4: The demographic variable of level of education will have a significant (p<.05) relationship with the LSQ categories and the cognitive change scores, was tested using two separate statistical tests. The relationship between level of education and cognitive change was
measured using chi-square. The second relationship between level of education and LSQ learning style was measured using a one-way ANOVA.

Numerous statistical analyses were made to test Hypothesis #5: The demographic variables of age, gender, and months of work experience will not have a significant (p<.05) relationship with LSQ scores and cognitive change scores. A one-way ANOVA was used to test the relationships between age and cognitive change, gender and cognitive change, and work experience and learning style. Chi-square was used to test the relationships between age and learning style, and gender and learning style. The Pearson product moment correlation was used to test for a significant relationship between work experience and cognitive change. The results of these statistical analyses are contained in the next chapter on findings.
FINDINGS

This research was designed to develop a quantity food preparation study guide of selected topics combining the basic knowledge in the purchasing, production, and storage of foods and the related principles of food science. A 66-item cognitive achievement test was developed to measure cognitive change. Marshall and Merritt's (1985) Learning Style Questionnaire (LSQ) was used to investigate the relationship between respondents' learning styles and cognitive change between pre- and posttest administrations. Statistical analyses were completed to research relationships between and among cognitive change, learning style, and selected demographic data: age, gender, time spent reading the study guide, months of work experience, and highest attained level of education.

This chapter presents a description of the demographic data and results of selected statistical tests of the hypotheses of the study. The findings are reported in four major sections:

1. Description of research respondents and frequency distributions of learning style, cognitive pre- and posttest scores, cognitive change, age, gender, highest level of education attained, time spent reading the study guide, and months of work experience.

2. Cognitive achievement test development and instrument Kuder-Richardson reliability estimates, difficulty levels, and discrimination values.

3. Statistical analyses and hypotheses testing.
4. Summary of qualitative data collected from respondent questionnaires and quantity food production educators.

Demographics

Table 10 summarizes the data related to the respondents' gender, age, and highest level of education attained. Both community college samples, containing many foodservice supervisors from the target population, were combined for the analyses.

Table 10. Gender, age, and education frequencies by type of institution

<table>
<thead>
<tr>
<th></th>
<th>ISU</th>
<th></th>
<th>Community colleges</th>
<th></th>
<th>Combined groups</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14</td>
<td>45.2</td>
<td>3</td>
<td>8.6</td>
<td>17</td>
<td>25.8</td>
</tr>
<tr>
<td>Female</td>
<td>17</td>
<td>54.8</td>
<td>32</td>
<td>91.4</td>
<td>49</td>
<td>74.2</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>100.0</td>
<td>35</td>
<td>100.0</td>
<td>66</td>
<td>100.0</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>31</td>
<td>100.0</td>
<td>6</td>
<td>17.7</td>
<td>37</td>
<td>56.1</td>
</tr>
<tr>
<td>30-39</td>
<td>0</td>
<td>--</td>
<td>13</td>
<td>37.1</td>
<td>13</td>
<td>19.7</td>
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<tr>
<td>40+ and above</td>
<td>0</td>
<td>--</td>
<td>16</td>
<td>45.7</td>
<td>16</td>
<td>24.2</td>
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<tr>
<td>Missing</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>100.0</td>
<td>35</td>
<td>100.0</td>
<td>66</td>
<td>100.0</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>0</td>
<td>--</td>
<td>25</td>
<td>71.4</td>
<td>25</td>
<td>37.9</td>
</tr>
<tr>
<td>Junior college</td>
<td>0</td>
<td>--</td>
<td>9</td>
<td>25.7</td>
<td>9</td>
<td>13.6</td>
</tr>
<tr>
<td>College sophomore</td>
<td>2</td>
<td>6.4</td>
<td>0</td>
<td>--</td>
<td>2</td>
<td>3.0</td>
</tr>
<tr>
<td>College junior</td>
<td>11</td>
<td>35.5</td>
<td>0</td>
<td>--</td>
<td>11</td>
<td>16.7</td>
</tr>
<tr>
<td>College senior</td>
<td>14</td>
<td>45.2</td>
<td>0</td>
<td>--</td>
<td>14</td>
<td>21.2</td>
</tr>
<tr>
<td>Graduate master’s</td>
<td>3</td>
<td>9.7</td>
<td>1</td>
<td>2.9</td>
<td>4</td>
<td>6.1</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>3.2</td>
<td>0</td>
<td>--</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>100.0</td>
<td>35</td>
<td>100.0</td>
<td>66</td>
<td>100.0</td>
</tr>
</tbody>
</table>
The majority, 91.4%, of the respondents in the community college samples were female. Only 8.6% were male. In contrast, the Iowa State University sample contained a more even distribution of 54.8% female, and 45.2% male.

Almost half, 45.7%, of the community college samples were 40 years old and above. Most of the remainder, 37.1%, were between 30 and 39 years. Only 17.2% were between 20 and 29 years. Because the majority of the foodservice supervisors' (71.4%) highest educational level was high school, it can be assumed these individuals have been promoted to the supervisory level based on work performance and longevity. Therefore, it is plausible to assume these subjects would be 30 years old or older. The Iowa State sample respondents were all between the ages of 20 to 29, a range expected to contain most college students enrolled in a junior-level course like HRIM 380.

Only one of the research subjects, a graduate student, in the community college sample had completed education above the junior college level. As expected, because the community college program was only part of a 90-hour continuing education course, the majority, 71.4%, of the respondents listed high school as their highest level completed. The remaining 25.7% specified having pursued a junior college education.

The similarity of the community college research sample subjects, primarily females over 30 years, compound the comparisons to the ISU sample. ISU research subjects were more evenly distributed males and females under 30 years.
Time spent reading study guide

Table 11 summarizes QFPS guide data related to the respondents, including time voluntarily spent reading the study guide, ease of understanding the study guide, usefulness of the guide as applied to work or class, appropriateness of the time spent reading the study guide, and the number of chapters of the study guide completed rounded to the nearest half chapter.

The number of minutes community college respondents spent reading the study guide ranged from 60 minutes to 600 minutes, 1 to 10 hours. The mean was 3 hours 10 minutes, with a standard deviation of 2 hours 14

Table 11. QFPS guide evaluation response means and standard deviations

<table>
<thead>
<tr>
<th></th>
<th>ISU (N=31)</th>
<th></th>
<th>Community colleges (N=35)</th>
<th></th>
<th>Combined groups (N=66)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>QFPS guide:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minutes reading</td>
<td>123.23</td>
<td>122.10</td>
<td>191.54</td>
<td>128.92</td>
<td>157.17</td>
<td>134.07</td>
</tr>
<tr>
<td>Ease of understanding a</td>
<td>4.17</td>
<td>.81</td>
<td>4.34</td>
<td>.78</td>
<td>4.27</td>
<td>.78</td>
</tr>
<tr>
<td>Usefulness to work or class b</td>
<td>3.31</td>
<td>1.17</td>
<td>3.74</td>
<td>1.07</td>
<td>3.54</td>
<td>1.12</td>
</tr>
<tr>
<td>Appropriateness of reading time c</td>
<td>2.23</td>
<td>.59</td>
<td>2.07</td>
<td>.69</td>
<td>2.15</td>
<td>.72</td>
</tr>
<tr>
<td>Number of chapters read</td>
<td>3.24</td>
<td>1.43</td>
<td>4.71</td>
<td>1.80</td>
<td>4.03</td>
<td>1.78</td>
</tr>
</tbody>
</table>

a1=Difficult to understand; 5=Easy to understand.

b1=Very little help; 5=Very helpful.

c1=Too much time; 2=Correct amount; 3=Less than expected.
minutes. In comparison, the Iowa State University sample ranged from 0 to 600 minutes, 0 to 10 hours. The mean was 2 hours 3 minutes, with a standard deviation of 2 hours 2 minutes. The Iowa State University sample spent on the average 1 hour less time than the community college samples reading the study guide. This might have been influenced by reinforcement and emphases the community college instructor made to encourage reading the QFPS guide, reading speed of participants, and that course enrollment was required for the ISU sample and voluntary for the foodservice supervisors. The lower educational reading level and reading speed of community college research subjects could have extended reading time. In community college samples each subject was given a personal copy of the QFPS guide, creating an accessibility advantage. ISU sample subjects were required to share three copies of the QFPS guide, resulting in some accessibility conflicts and subsequent reduced reading time.

Ease of understanding the QFPS guide

Ease of understanding of the QFPS guide was measured using a Likert-type scale from 1 to 5 with "1" representing difficult to understand and "5" representing easy to understand. The community college respondent ratings ranged from 2 to 5, with a mean of 4.34 and a standard deviation of 0.78. Iowa State University respondent's Likert-type scores ranged the same as the community college samples from 2 to 5 with a mean of 4.17 and a standard deviation of 0.81. Respondents' overall grouping mean of 4.27 demonstrated the guide was relatively easy to understand. This was also
reinforced with many of the written comments at the end of the demographic questionnaire.

Usefulness of the QFPS guide

Similar to the understanding of the manual scoring, the Likert-type scale was used to measure respondents' rating for how useful the QFPS guide was at work or with class, "1" representing the guide was of very little help and "5" representing very helpful. No one in any of the groups rated the usefulness of the QFPS guide as "1," very little help. The community college samples' mean score of 3.74 with a standard deviation of 1.07 was very similar to the Iowa State University sample mean of 3.31 with a standard deviation of 1.17. The overall mean of 3.54 and a standard deviation of 1.12 for combined groups demonstrates respondents found the study guide somewhat useful.

Appropriateness of study time

A Likert-type scale rating from 1 to 3 was used to rate the appropriateness of the time spent reading the QFPS guide. "1" represented too much time; "2" represented the correct amount of time; and "3" represented less time than expected. The mean for community college respondents was 2.07 with a standard deviation of .69. The Iowa State University sample was similar with a mean score of 2.23 and a standard deviation at .59. The resulting consensus was that the majority of respondents stated the time spent reading the QFPS was an appropriate length.
Chapters of the OFPS guide read

A scale was designed to represent the number of chapters read. The 0 to 12 scale was used to round to the nearest half chapter read by the respondents. The community college samples' mean score was 4.75 chapters read, with a standard deviation of 1.78. The Iowa State University sample mean score was 3.24 chapters, with a standard deviation of 1.43. This one and one-half chapter difference might have been caused by a number of factors: perception of the importance of the OFPS guide, applicability to course assignment, time available to study the guide, course and work loads, and instructor reinforcement of supplemental reading assignments for case studies and learning exercises.

Months of related foodservice experience

The number of months of related foodservice work experience for the community college research samples ranged from 24 to 720 months, 2 to 60 years. The mean was 172.53 months, approximately 14.40 years, with a standard deviation of 143.02. In contrast, the Iowa State University sample ranged from 2 to 80 months, 2 months to 6.70 years, with a mean of 30.63 months, 2.50 years, and a standard deviation of 25.85. Because most of the respondents in the community college samples were older with many years of experience in foodservice, the disparity of those two means was anticipated.

Learning Style

Learning style prehension (taking-in) and transformation (processing) dimension scores for the combined groups were used in statistical analyses
to investigate if one dimension is more predictable of cognitive change. The learning style prehension dimension scores for the combined research samples: abstract conceptualization (AC) minus concrete experience (CE) scores; and the transformation dimension scores: active experimentation (AE) minus reflective observation (RO) scores are listed in Table 12.

Table 12. Results of combined group respondents' pre- and posttest Learning Style Questionnaire measurements

| Learning Style Questionnaire dimensions | Pretest | | | Posttest | | |
|----------------------------------------|---------|---------|---------|
|                                        | Mean    | Mode    | S.D.    | Mean    | Mode    | S.D.    |
| Abstract conceptualization (AC)        | 22.44   | 27.00   | 6.75    | 21.48   | 21.00   | 6.19    |
| Concrete experience (CE)               | 21.46   | 31.00   | 9.44    | 17.92   | 20.00   | 6.15    |
| Active experimentation (AE)             | 24.33   | 18.00   | 6.65    | 24.87   | 29.00   | 7.18    |
| Reflective observation (RO)            | 20.21   | 10.00   | 10.59   | 15.81   | 10.00   | 7.73    |
| Prehension dimension (AC-CE)           | .99     | .00     | 12.60   | 3.56    | 4.00    | 10.64   |
| Transformation dimension (AE-RO)       | 4.12    | -2.00   | 15.27   | 9.06    | .00     | 14.06   |

AC, in the prehension dimension with a pretest mean of 22.44 and a standard deviation of 6.75, was the higher mode value. In the posttest, AC, with a mean score of 21.48 and a standard deviation of 6.19, was also the higher prehension mode value. The transformation predominant pretest domain was AE, with a mean of 24.33 and a standard deviation of 6.65. AE was also the higher transformation mode value in the posttest with a mean of 24.87 and a standard deviation of 7.18. The higher mode values of AC and AE in the prehension and transformation dimensions of learning style, respectively, supports similar findings reported by Adenuga (1989).
The transformation dimension (processing) pretest and posttest means of 4.12 and 9.06, respectively, are further from the theoretical center of Kolb's learning style matrix than the pretest and posttest prehension dimension (taking-in) means of .99 and 3.56. This indicates a preference for the prehension experience dimension of learning style theory that is between the abstract and experimentation elements for the subjects in the combined research samples.

Research subjects' learning styles are listed in Table 13. Learning style pretest and posttest scores are plotted in Figures 5 and 6, respectively, to display any clustering and possible outliers. Marshall and Merritt's (1985) median of (0,0) was adopted for the research sample and is displayed in these two scatterplots as the intersection of the transformation and prehension axes.

The predominant style for all research samples in pre- and posttests was the diverger. The second most frequent learning style was that of

Table 13. Respondents' pre- and posttest learning styles

<table>
<thead>
<tr>
<th>Style</th>
<th>ISU Pre</th>
<th>ISU Post</th>
<th>Community colleges Pre</th>
<th>Community colleges Post</th>
<th>Combined groups Pre</th>
<th>Combined groups Post</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Accommodator</td>
<td>4</td>
<td>12.9</td>
<td>3</td>
<td>9.7</td>
<td>7</td>
<td>20.0</td>
</tr>
<tr>
<td>Converger</td>
<td>4</td>
<td>12.9</td>
<td>3</td>
<td>9.7</td>
<td>15</td>
<td>42.6</td>
</tr>
<tr>
<td>Diverger</td>
<td>16</td>
<td>51.6</td>
<td>17</td>
<td>54.8</td>
<td>5</td>
<td>14.3</td>
</tr>
<tr>
<td>Assimilator</td>
<td>6</td>
<td>19.4</td>
<td>6</td>
<td>19.4</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>3.2</td>
<td>2</td>
<td>6.5</td>
<td>5</td>
<td>14.3</td>
</tr>
<tr>
<td>N</td>
<td>31</td>
<td>100.0</td>
<td>31</td>
<td>100.0</td>
<td>35</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Figure 5. Pretest learning style score scatterplot
Figure 6. Posttest learning style score scatterplot
converger. Convergers were the predominant style in the pretest community college combined samples.

Studies with HRIM research subjects conducted by Hsu (1989) and Paulson, Baltzer, and Cole (1989) reported convergers as the predominant learning style. Although the diverger is described by Kolb (1976) as having strong imaginative ability, this trait could also be related to the application of abstract ideas of the converger. The major difference between the two styles relates to how they process and assimilate information. The diverger's major learning abilities are concrete experience and reflective observation. In contrast, the converger's dominant learning abilities are abstract conceptualization and active experimentation.

Cognitive Achievement Test Development

One of the original goals of the research was to develop a 50- to 55-item cognitive achievement test usable in a 50- to 60-minute class period. The findings of Green (1968) and Gronlund (1988) recommend an expected response rate at one multiple choice question per minute.

The questions and cognitive level selected from the original bank of 132 questions developed for the 66-item and the subsequent 55- and 30-item tests are summarized in Table 14. The questions were selected to ensure the number of test questions met cognitive levels in the table of specifications.

Six HRIM educators familiar with students similar to the research respondents were surveyed to obtain data concerning the ideal length of
Table 14. Cognitive level comparisons of the 66-, 55-, and 30-item tests

<table>
<thead>
<tr>
<th>Cognitive level</th>
<th>Questions per chapter</th>
<th>Cognitive tables</th>
<th>Bev./Convenience</th>
<th>Total</th>
<th>%</th>
<th>Original</th>
<th>Revised</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vegetable</td>
<td>Fruits</td>
<td>Salads</td>
<td>Meats</td>
<td>Bakery</td>
<td>Convenience</td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66-item test</td>
<td>3 4.5</td>
<td>3 4.5</td>
<td>2 3.0</td>
<td>8 12.1</td>
<td>8 12.1</td>
<td>8 12.1</td>
<td>8 12.1</td>
</tr>
<tr>
<td>55-item test</td>
<td>3 5.5</td>
<td>3 5.5</td>
<td>2 3.6</td>
<td>5 9.0</td>
<td>7 12.7</td>
<td>7 12.7</td>
<td>7 12.7</td>
</tr>
<tr>
<td>30-item test</td>
<td>1 3.3</td>
<td>2 6.7</td>
<td>1 3.3</td>
<td>4 13.3</td>
<td>4 13.3</td>
<td>3 10.0</td>
<td>3 10.0</td>
</tr>
<tr>
<td>Comprehension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66-item test</td>
<td>4 6.0</td>
<td>2 3.0</td>
<td>3 3.0</td>
<td>8 13.6</td>
<td>10 15.1</td>
<td>1 1.5</td>
<td>28</td>
</tr>
<tr>
<td>55-item test</td>
<td>4 7.3</td>
<td>2 3.6</td>
<td>2 3.6</td>
<td>6 10.9</td>
<td>8 14.5</td>
<td>1 1.8</td>
<td>23</td>
</tr>
<tr>
<td>30-item test</td>
<td>1 3.3</td>
<td>1 3.3</td>
<td>1 3.3</td>
<td>3 10.0</td>
<td>4 13.3</td>
<td>1 3.3</td>
<td>10</td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66-item test</td>
<td>0 0.0</td>
<td>1 1.5</td>
<td>0 0.0</td>
<td>1 1.5</td>
<td>2 3.0</td>
<td>1 1.5</td>
<td>5 7.6</td>
</tr>
<tr>
<td>55-item test</td>
<td>0 0.0</td>
<td>1 1.8</td>
<td>0 0.0</td>
<td>1 1.8</td>
<td>1 1.8</td>
<td>1 1.8</td>
<td>4 7.3</td>
</tr>
<tr>
<td>30-item test</td>
<td>0 0.0</td>
<td>1 3.3</td>
<td>0 0.0</td>
<td>1 3.3</td>
<td>1 3.3</td>
<td>1 3.3</td>
<td>4 13.4</td>
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<td>Evaluation</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66-item test</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>1 1.5</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
</tr>
<tr>
<td>55-item test</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>1 1.8</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
</tr>
<tr>
<td>30-item test</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>1 3.3</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>0 0.0</td>
</tr>
</tbody>
</table>
the final cognitive achievement test. All six educators specifically identified the ideal testing time to be 30 minutes to 1 hour. They concurred with Green (1968) and Gronlund (1988) that the respondents could complete an average of one multiple choice or short-answer question per minute. All instructors identified multiple-choice questions as a test design option most frequently used. Based on these surveys and the subsequent recommendations, a 30-item final cognitive achievement test was developed (see Appendix C).

During the development of the final test, content topics were analyzed with the objective of creating an ideal test and table of specifications. Six educators from Iowa State University completed a questionnaire (see Appendix D) to assist in refining and verifying the test's table of specifications. Respondents were asked to rank order and list the relative importance percentages for each food group topic (chapter) on complexity of the topic, cost control of the food group, nutritive retention importance in the food, and overall value of education about the food group (see Table 15).

Because the rank of the overall category percentages were similar to the ranks of the three categories of nutritive retention, controlling cost, and complexity averaged together, these overall percentages were used to determine the number of questions selected from each of the six topics of the QFPS guide for the 30-item cognitive test. These percentages were used to create a cognitive test table of specifications. See Appendix D for the letter and ranking form used by six foodservice educators.
Table 15. Educators' rank and weight of importance converted to percent for QFPS guide topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Nutritive retention</th>
<th>Controlling cost</th>
<th>Complexity</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank mean</td>
<td>Relative importance (Converted to %)</td>
<td>Rank mean</td>
<td>Relative importance (Converted to %)</td>
</tr>
<tr>
<td>Vegetables</td>
<td>1.5</td>
<td>25.8</td>
<td>4.5</td>
<td>13.3</td>
</tr>
<tr>
<td>Salads</td>
<td>3.8</td>
<td>16.1</td>
<td>4.2</td>
<td>12.5</td>
</tr>
<tr>
<td>Fruits</td>
<td>2.2</td>
<td>21.6</td>
<td>3.3</td>
<td>13.2</td>
</tr>
<tr>
<td>Meats</td>
<td>2.5</td>
<td>20.5</td>
<td>1.0</td>
<td>33.3</td>
</tr>
<tr>
<td>Bakery</td>
<td>5.0</td>
<td>9.2</td>
<td>4.6</td>
<td>10.0</td>
</tr>
<tr>
<td>Beverages and convenience food</td>
<td>6.0</td>
<td>6.7/99.9</td>
<td>3.3</td>
<td>17.7/100.0</td>
</tr>
</tbody>
</table>
During the condensation of the 66-item cognitive test into the subsequent 55-item and 30-item tests, questions with a negative discrimination value and/or those with two or more distractors not chosen by any of the respondents were eliminated. A copy of each test is in Appendix C. Some questions were redesigned to include only three distractors. Costin (1972) stated that three distractors for multiple-choice test design is an acceptable alternative to one with four or more distractors.

The final achievement test was designed to rank respondents in order of achievement. A wide spread of scores was desired. The 66-item, 55-item, and 30-item test designs all displayed scores within a normal distribution curve and respective ranges of 18 to 54, 17 to 46, and 7 to 24, respectively. These normal distributions are demonstrated in Figure 7.

High difficulty value test items indicated the questions were too easy to answer correctly. Desired difficulty values were based on Gronlund's (1988) recommendation of an average difficulty score of 63 percent. Questions with discrimination values of .20 or less were either rewritten or deleted. Negative discrimination values indicated respondents who scored well overall on the test missed the question.

Kuder-Richardson reliability estimates ranged from .64 for the 66-item pretest to .77 for the posttest. A KR-20 reliability goal for the cognitive achievement test was ≥.80. However, Morris, Fitz-Gibbon, and Lindheim (1987) specified a KR-20 ≥.70 was an acceptable reliability estimate. The 66-item test was refined into a 55-item test. Questions
66-Item Cognitive Test

Mean: 36.70
Standard Deviation: 7.48
Average Test Score: 56%
K-R Reliability Estimate: 0.77

55-Item Cognitive Test

Mean: 28.80
Standard Deviation: 6.68
Average Test Score: 52%
KR-20 Reliability Estimate: 0.75
30-Item Cognitive Test

No.

10 -

5 -

7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

(Test Score)

Mean: 15.50
Standard Deviation: 3.77
KR-20 Reliability Estimate: 0.57

Average Test Score: 52%

Figure 7. 66-item, 55-item, and 30-item test score distribution for combined groups (66 respondents)
with two or more distractors not selected by respondents, those with low or negative discrimination values, and those with difficulty scores above 90 percent were either rewritten or deleted from the final test version. The KR-20 reliability estimate on the 55-item test was .75. The KR-20 reliability estimates for all three are found in Table 16.

The 30-item achievement test's Kuder-Richardson-20 reliability score was .57. However, as noted by Grönlund (1988), item analysis data from small samples are highly tentative, vary from group to group, and reduce the possible range of variability. The more reliable test recommended by six educators would be the 55-item achievement test.

If given only 30 minutes testing time, the 30-item test might be an appropriate substitute. In addition to being the appropriate length for the time allowed, this test was written to reflect the rank and weightings

---

**Table 16. Cognitive achievement Kuder-Richardson-20 reliability estimates**

<table>
<thead>
<tr>
<th>Test</th>
<th>Sample</th>
<th>KR-20</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>66-item pretest</td>
<td>ISU</td>
<td>.64</td>
<td>34.8</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Clinton</td>
<td>.59</td>
<td>31.2</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>Ankeny</td>
<td>.53</td>
<td>32.3</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>Combined groups</td>
<td>.64</td>
<td>32.8</td>
<td>5.4</td>
</tr>
<tr>
<td>66-item posttest</td>
<td>ISU</td>
<td>.76</td>
<td>37.9</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Clinton</td>
<td>.73</td>
<td>36.5</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Ankeny</td>
<td>.77</td>
<td>34.9</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Combined groups</td>
<td>.77</td>
<td>36.7</td>
<td>7.5</td>
</tr>
<tr>
<td>55-item condensed posttest</td>
<td>Combined groups</td>
<td>.75</td>
<td>28.8</td>
<td>6.7</td>
</tr>
<tr>
<td>30-item achievement test</td>
<td>Combined groups</td>
<td>.57</td>
<td>15.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>
of five HRIM educators of the various topics of the QFPS guide. It adhered as closely as possible to the original cognitive table of specification percentages listed in Table 7. Further development of test items and/or use with larger samples would result in a more definitive reliability estimate.

The mean cognitive pretest score for the ISU sample was 34.55 out of a possible 66 with a standard deviation of 5.96. The same group's posttest mean score was slightly higher with a mean of 36.97 and a standard deviation of 8.01. The mean cognitive change was 2.42 with a standard deviation of 6.04. (See Table 17.)

As indicated in Table 17, the ISU sample demonstrated a smaller gain than the gain of the community college combined sample. However, it should be noted that the ISU sample pretest and posttests were slightly higher than the community college group. Contrary to the foodservice supervisors, many subjects in the ISU sample had already received some education in quantity food preparation on related prerequisites resulting in a higher level of knowledge.

Table 17. Cognitive achievement test scores and cognitive change

<table>
<thead>
<tr>
<th></th>
<th>ISU</th>
<th>Community colleges</th>
<th>Combined groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
</tr>
<tr>
<td>Pretest score</td>
<td>34.55</td>
<td>5.96</td>
<td>31.86</td>
</tr>
<tr>
<td>Posttest score</td>
<td>36.97</td>
<td>8.01</td>
<td>35.61</td>
</tr>
<tr>
<td>Cognitive change</td>
<td>2.42</td>
<td>6.04</td>
<td>3.76</td>
</tr>
</tbody>
</table>
Several factors could have been attributable to the slightly larger community college combined sample cognitive gain:

- less prior knowledge and lower educational level
- more available study time
- lower pretest scores
- voluntary enrollment
- no previous food science instruction as had been received by ISU subjects.

In addition, active foodservice supervisor practitioners might see the importance of the QFPS guide material to the application in class and at work.

The community colleges' sample cognitive pretest mean was 31.86 out of a possible 66 with a mean of 5.18. The posttest mean score was 35.61 with a standard deviation of 7.21. The mean cognitive change was 3.76 with a standard deviation of 5.16.

For the combined groups the pretest scores ranged from a low of 18 to a high of 49 out of a possible 66. The range of posttest scores improved only slightly, 19 to 53. The mean pretest score was 33.1 with a standard deviation of 5.7. The mean posttest score was 36.3 with a standard deviation of 7.5. The mean cognitive change score was 3.2 with a standard deviation of 5.7.

**Empirical Testing of Hypotheses**

This section is organized by each research hypothesis and the respective statistical testing used to establish whether statistically
significant linear and/or relationships exist between the respondents' learning style transformation (AE-RO) andprehension (AC-CE) dimensions and learning style, as measured by Marshall and Merritt's (1985) Learning Style Questionnaire (LSQ) with respondents' cognitive change between pre- and posttest. In addition, demographic variables of group, sex, age, highest level of education attained, months of foodservice-related work experience, and minutes spent reading the study guide were used to investigate any statistically significant linear and/or predictive relationships among learning style, pre- and posttest scores, and cognitive change.

A Pearson correlation procedure was employed to investigate whether or not there was a relationship between learning style transformation (AE-RO) andprehension (AC-CE) learning style dimensions, continuous demographic variables, pre- and posttest scores, and cognitive change. A correlation matrix (see Table 18) was completed to evaluate bivariate relationships between these continuous variables. A cursory evaluation of the correlation matrix indicates that, as expected from the data, cognitive change (CHANGE) is positively correlated with posttest scores ($r = .660, p < .01$). Minutes spent reading the QFPS guide (MINRD) is positively correlated with posttest (PSTTST) scores ($r = .289, p < .05$); 43.6% of cognitive change is attributable to the posttest score. As expected, pretest and posttest scores are positively correlated ($r = .662, p < .01$). Significant correlation coefficients are summarized in Table 19.

The pretest transformation andprehension dimension score of learning style are positively correlated ($r = .397, p < .01$). As anticipated, pretest
Table 18. Correlation coefficients matrix between demographic variables, pre- and posttest scores, learning style transformation (AE-RO) andprehension (AC-CE) dimensions, and cognitive change

<table>
<thead>
<tr>
<th></th>
<th>MINRD&lt;sup&gt;a&lt;/sup&gt; (R)</th>
<th>WKEXP&lt;sup&gt;b&lt;/sup&gt; (R)</th>
<th>PRETEST&lt;sup&gt;c&lt;/sup&gt; (R)</th>
<th>PSTTST&lt;sup&gt;d&lt;/sup&gt; (R)</th>
<th>PREHN1&lt;sup&gt;e&lt;/sup&gt; (R)</th>
<th>TRANS1&lt;sup&gt;f&lt;/sup&gt; (R)</th>
<th>PREHN2&lt;sup&gt;g&lt;/sup&gt; (R)</th>
<th>TRANS2&lt;sup&gt;h&lt;/sup&gt; (R)</th>
<th>CHANGE&lt;sup&gt;i&lt;/sup&gt; (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINRD</td>
<td>1.0000</td>
<td>.1080</td>
<td>.1549</td>
<td>.2890&lt;sup&gt;*&lt;/sup&gt;</td>
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<td>-.0767</td>
<td>-.1261</td>
<td>-.1404</td>
<td>.2424</td>
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<tr>
<td>WKEXP</td>
<td>.1080</td>
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<td>-.0390</td>
<td>-.0159</td>
<td>-.0473</td>
<td>-.2648</td>
<td>-.0910</td>
<td>-.2144</td>
<td>-.0197</td>
</tr>
<tr>
<td>PRETEST</td>
<td>.1549</td>
<td>-.0390</td>
<td>1.0000</td>
<td>.6624**</td>
<td>.1132</td>
<td>-.0267</td>
<td>1.918</td>
<td>.0686</td>
<td>-.1251</td>
</tr>
<tr>
<td>PSTTST</td>
<td>.2890&lt;sup&gt;*&lt;/sup&gt;</td>
<td>-.0159</td>
<td>.6624**</td>
<td>1.0000</td>
<td>.1773</td>
<td>.0612</td>
<td>1.690</td>
<td>-.0863</td>
<td>.6604**</td>
</tr>
<tr>
<td>PREHN1</td>
<td>-.0817</td>
<td>-.0473</td>
<td>.1132</td>
<td>.1773</td>
<td>1.0000</td>
<td>.3966**</td>
<td>.5572**</td>
<td>.2087</td>
<td>.1212</td>
</tr>
<tr>
<td>TRANS1</td>
<td>-.0767</td>
<td>-.2648</td>
<td>-.0247</td>
<td>.0612</td>
<td>.3966**</td>
<td>1.0000</td>
<td>.1639</td>
<td>.5881**</td>
<td>.1058</td>
</tr>
<tr>
<td>PREHN2</td>
<td>-.1261</td>
<td>-.0910</td>
<td>.1918</td>
<td>.1690</td>
<td>.5572**</td>
<td>.1639</td>
<td>1.0000</td>
<td>.1843</td>
<td>.0328</td>
</tr>
<tr>
<td>TRANS2</td>
<td>-.1404</td>
<td>-.2144</td>
<td>.0686</td>
<td>-.0863</td>
<td>.2087</td>
<td>.5881**</td>
<td>.1843</td>
<td>1.0000</td>
<td>-.1827</td>
</tr>
<tr>
<td>CHANGE</td>
<td>.2424</td>
<td>.0197</td>
<td>-.1251</td>
<td>.6604**</td>
<td>.1212</td>
<td>.1058</td>
<td>.0328</td>
<td>-.1827</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

<sup>a</sup>Minutes reading study guide.
<sup>b</sup>Months of related foodservice experience.
<sup>c</sup>Pretest score.
<sup>d</sup>Posttest score.
<sup>e</sup>LSQ pretest prehension (AC-CE) score.
<sup>f</sup>LSQ pretest transformation (AE-RO) score.
<sup>g</sup>LSQ posttest prehension (AC-CE) score.
<sup>h</sup>LSQ posttest transformation (AE-RO) score.
<sup>i</sup>Cognitive change score.
<sup>*</sup>Significant ≤.05.
<sup>**</sup>Significant ≤.01.
Table 19. Significant correlation coefficients

<table>
<thead>
<tr>
<th>Variables</th>
<th>(R)</th>
<th>(R²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest score/Posttest score</td>
<td>.6624**</td>
<td>.439</td>
</tr>
<tr>
<td>Change score/Posttest score</td>
<td>.6604**</td>
<td>.436</td>
</tr>
<tr>
<td>Pretest transformation^\textsuperscript{a}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest transformation^\textsuperscript{b}</td>
<td>.5881**</td>
<td>.346</td>
</tr>
<tr>
<td>Pretest prehension^\textsuperscript{c}/Posttest prehension^\textsuperscript{d}</td>
<td>.5572**</td>
<td>.310</td>
</tr>
<tr>
<td>Pretest prehension^\textsuperscript{e}/Pretest transformation^\textsuperscript{a}</td>
<td>.3966**</td>
<td>.157</td>
</tr>
<tr>
<td>Posttest score/Minutes reading guide</td>
<td>.2890*</td>
<td>.084</td>
</tr>
</tbody>
</table>

\^\textsuperscript{a}LSQ pretest transformation (AE-RO) score.
\^\textsuperscript{b}LSQ posttest transformation (AE-RO) score.
\^\textsuperscript{c}LSQ pretest prehension (AC-CE) score.
\^\textsuperscript{d}LSQ posttest prehension (AC-CE) score.
\*Significant ≤ .05.
\**Significant ≤ .01.

and posttest transformation and prehension scores are positively correlated (r = .588, p ≤ .01) and (r = .557, p ≤ .01), respectively.

**Hypothesis 1**

Null hypothesis related to the relationship between cognitive change and time spent reading the QFPS guide (objective 5): There is no positive correlation between the time spent reading the QFPS guide (MINRD) and the cognitive change score as measured by the cognitive test.

This hypothesis was addressed using a Pearson correlation coefficient test. As indicated by the correlation matrix (Table 18), the cognitive change score demonstrates a positive correlation of .242 with the time
spent reading the QFPS guide. This correlation is not statistically significant ($p<.05$). However, the minutes spent reading the study guide (MINRD) and posttest score demonstrates a statistically significant positive correlation ($r=.289$, $p<.05$).

**Hypothesis 2**

Null hypothesis related to the relationship between cognitive change and learning style of the respondents (objective 6): There is no significant difference in cognitive change among the four posttest learning styles as measured by the Learning Style Questionnaire.

A single classification (one-way) analysis of variance was completed to compare respondents' means on cognitive change score by the four learning styles: assimilator, diverger, converger, and accommodator. Because the null hypothesis was not rejected ($F=.71$, $p<.548$) with 3 degrees of freedom, there is no significant difference in cognitive change among the four learning styles. See Table 20. The accommodator demonstrated the largest mean cognitive change, 6.00, with a standard deviation of 6.90. See Table 21.

**Table 20. One-way analysis of variance of cognitive change scores by posttest learning styles**

<table>
<thead>
<tr>
<th>Source</th>
<th>D.F.</th>
<th>Sum of squares</th>
<th>Mean squares</th>
<th>$F$ ratio</th>
<th>$F$ prod.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>3</td>
<td>77.074</td>
<td>25.691</td>
<td>.714</td>
<td>.548</td>
</tr>
<tr>
<td>Within groups</td>
<td>54</td>
<td>1942.857</td>
<td>35.979</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>2019.931</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aNo two groups are significantly different at the 0.050 level.*
Table 21. Cognitive change by posttest learning style

<table>
<thead>
<tr>
<th>Learning style</th>
<th>Pretest n</th>
<th>Posttest n</th>
<th>Mean</th>
<th>Change</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodator</td>
<td>11</td>
<td>7</td>
<td>6.00</td>
<td>6.90</td>
<td></td>
</tr>
<tr>
<td>Converger</td>
<td>19</td>
<td>5</td>
<td>2.00</td>
<td>6.93</td>
<td></td>
</tr>
<tr>
<td>Diverger</td>
<td>21</td>
<td>32</td>
<td>2.75</td>
<td>5.81</td>
<td></td>
</tr>
<tr>
<td>Assimilator</td>
<td>9</td>
<td>14</td>
<td>2.29</td>
<td>5.66</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>58</td>
<td>2.97</td>
<td>5.95</td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis 3

Null hypothesis related to the relationship between cognitive change and learning style transformation (TRANS) and prehension (PREHN) dimensions (objective 7): The LSQ transformation dimension (AE-RO) scores will not be significantly (p<.05) more predictive of cognitive change than the prehension or taking-in of information dimension (AC-CE) scores. This hypothesis was addressed using a Pearson correlation coefficient test. As indicated by the correlation matrix (Table 18), the pretest and posttest prehension scores (PREHN1 and PREHN2) were correlated (r=.121 and r=.033) with cognitive change scores, but neither was significant at a p<.05 level. Similar to the prehension scores, the pretest transformation scores are somewhat positively correlated (.106) with cognitive change scores, but not at a significant p<.05 level. A slightly negative correlation (r=-.183) was revealed between the posttest transformation scores and cognitive change scores. Again, no significant (p<.05) level was reported. It can be relatively safe to assume the null hypothesis cannot be rejected based on these statistical data. Therefore, the LSQ
transformation dimension (AE-RO) scores are not significantly (p≤.05) more predictive of cognitive change than the prehension or taking-in of information dimension (AC-CE) scores.

**Hypotheses 4 and 5**

Null hypotheses 4 and 5 are related to the relationship between/among learning style and cognitive change, and selected demographic variables: age, gender, months of related foodservice experience, and highest level of education attained:

4. The demographic variable, highest level of education attained (EDUC) will have no significant (p≤.05) relationship with learning style and cognitive change scores.

5. The demographic variables of age, gender, and months of work experience will not have a significant (p≤.05) relationship with LSQ scores and cognitive change scores.

A single classification (one-way) analysis of variance was completed to compare subjects' means on cognitive change by the highest level of education attained: high school, junior college, four-year university, and graduate school.

4. The null hypothesis that the demographic variable of level of education will not have a significant (p≤.05) relationship with the cognitive change was not rejected (F=.977, p≤.410) with 3 degrees of freedom. See Table 22. Research subjects, 37.9% (n=25), with only a high school education demonstrated the largest cognitive change, 4.20 with a standard deviation of 5.24. See Table 23.
A chi-square goodness of fit statistical analysis was completed to ascertain whether the level of education and learning style scores are homogeneous. Because the chi-square pretest score of 12.612 with 9 degrees of freedom at the .006 significance level exceeds the critical value of 11.345 (see Table 24), the null hypothesis that the highest level of education attained and learning style scores are the same is rejected. Therefore, in the pretest the highest level of education attained did have a significant effect at the p<.05 level on subject learning style. Posttest chi-square results were not significant at the p<.05 level. Tables 25 and 26 display the distribution of pre- and posttest learning styles by highest level of education attained.

5. The demographic variables of age, gender, and months of related foodservice experience were used to investigate any significant relationships between/among learning style and cognitive change scores. Chi-square distribution, Pearson correlation, and one-way analysis of variance were completed.

A chi-square goodness of fit statistical analysis was completed to investigate whether or not age and gender were predictive of learning style. See Table 24. The pretest chi-square values of 9.816 exceed the critical value for $X^2$ of 7.815. The null hypothesis that the pretest level of education will not have a significant (p<.05) relationship with learning style was rejected. The pretest level of education was predictive of learning style. The posttest chi-square test for homogeneity of age and learning style did not exceed the critical value for $X^2$ of 7.815 with 3 degrees of freedom. The null hypothesis is not
Table 22. One-way analysis of variance of cognitive change scores by highest level of education attained*

<table>
<thead>
<tr>
<th>Source</th>
<th>D.F.</th>
<th>Sum of squares</th>
<th>Mean squares</th>
<th>F ratio</th>
<th>F prod.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>3</td>
<td>93.080</td>
<td>31.027</td>
<td>.977</td>
<td>.410</td>
</tr>
<tr>
<td>Within groups</td>
<td>61</td>
<td>1937.935</td>
<td>31.769</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>2031.015</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*No two groups are significantly different at the .05 level.

Table 23. Cognitive change by highest level of education attained

<table>
<thead>
<tr>
<th>Level of education</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school</td>
<td>25</td>
<td>4.20</td>
<td>5.24</td>
</tr>
<tr>
<td>Junior college</td>
<td>9</td>
<td>3.56</td>
<td>5.55</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>27</td>
<td>1.96</td>
<td>5.71</td>
</tr>
<tr>
<td>Graduate</td>
<td>4</td>
<td>5.75</td>
<td>7.80</td>
</tr>
<tr>
<td>N</td>
<td>65</td>
<td>3.28</td>
<td></td>
</tr>
</tbody>
</table>

Table 24. Chi-square analysis of learning style with age, gender, and highest level of education attained

<table>
<thead>
<tr>
<th>x² Pretest Posttest LSQ D.F. Pretest Posttest LSQ Significance Pretest Posttest LSQ Critical x² value (.05)</th>
<th>Critical x² value (.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>9.816 1.657 3 3 .020 .647 7.815</td>
</tr>
<tr>
<td>Gender</td>
<td>9.970 5.449 3 3 .019 .142 7.815</td>
</tr>
</tbody>
</table>
Table 25. Pretest learning style by highest level of education attained

<table>
<thead>
<tr>
<th>Learning style</th>
<th>High school</th>
<th>Junior college</th>
<th>Undergraduate</th>
<th>Graduate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodator</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>n=10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.9%</td>
</tr>
<tr>
<td>Converger</td>
<td>11</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>n=19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>32.2%</td>
</tr>
<tr>
<td>Diverger</td>
<td>5</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>n=21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35.6%</td>
</tr>
<tr>
<td>Assimilator</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>n=9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.3%</td>
</tr>
<tr>
<td>Total</td>
<td>n=22</td>
<td>n=7</td>
<td>n=27</td>
<td>n=3</td>
<td>N=59</td>
</tr>
<tr>
<td></td>
<td>37.3%</td>
<td>11.9%</td>
<td>45.8%</td>
<td>5.1%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 26. Posttest learning style by highest level of education attained

<table>
<thead>
<tr>
<th>Learning style</th>
<th>High school</th>
<th>Junior college</th>
<th>Undergraduate</th>
<th>Graduate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodator</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>n=7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.3%</td>
</tr>
<tr>
<td>Converger</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>n=5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.8%</td>
</tr>
<tr>
<td>Diverger</td>
<td>11</td>
<td>3</td>
<td>16</td>
<td>1</td>
<td>n=31</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>54.4%</td>
</tr>
<tr>
<td>Assimilator</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>n=14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.6%</td>
</tr>
<tr>
<td>Total</td>
<td>n=22</td>
<td>n=6</td>
<td>n=25</td>
<td>n=4</td>
<td>N=57</td>
</tr>
<tr>
<td></td>
<td>38.6%</td>
<td>10.5%</td>
<td>43.9%</td>
<td>7.0%</td>
<td>100%</td>
</tr>
</tbody>
</table>
rejected, and the conclusion is that no significant (p<.05) relationship exists between posttest respondent age and learning style. Tables 27 and 28 display the distribution of pre- and posttest learning styles by age.

The chi-square analysis of gender with learning style demonstrated more significant results. See Table 24. The pretest chi-square value of 9.970 with 3 degrees of freedom exceeded critical value of $X^2$ of 7.815 at the .019 significance level. Therefore, the null hypothesis is rejected, and the conclusion is that subjects' gender and pretest learning styles are not homogeneous. Gender was predictable of respondent pretest learning style.

Posttest results did not confirm pretest chi-square findings when comparing gender and learning style. The $X^2$ value did not exceed the critical value of $X^2$ with 3 degrees of freedom at a significance level of p<.05. The null hypothesis is not rejected in this example; the respondents' gender and learning style appear to be the same. Tables 29 and 30 display the distribution of pre- and posttest learning styles by gender.

A Pearson correlation coefficient test was used to investigate the predictability of cognitive change by months of related foodservice work experience. As indicated by the correlation matrix (Table 18), the relatively weak positive correlation of .0197 was not significant at the p<.05 level. Therefore, the null hypothesis is not rejected, and the conclusion is that the respondents' cognitive change is not predictable based on months of related foodservice work experience.
Table 27. Pretest learning style by age

<table>
<thead>
<tr>
<th>Learning style</th>
<th>20-29 years</th>
<th>30-39 years</th>
<th>40 years and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodator</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>n=11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.3%</td>
</tr>
<tr>
<td>Converger</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>n=19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.7%</td>
</tr>
<tr>
<td>Diverger</td>
<td>16</td>
<td>2</td>
<td>3</td>
<td>n=21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35.0%</td>
</tr>
<tr>
<td>Assimilator</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>n=9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.0%</td>
</tr>
<tr>
<td>Total</td>
<td>n=35</td>
<td>n=11</td>
<td>n=14</td>
<td>N=60</td>
</tr>
<tr>
<td></td>
<td>58.3%</td>
<td>18.3%</td>
<td>23.3%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 28. Posttest learning style by age

<table>
<thead>
<tr>
<th>Learning style</th>
<th>20-29 years</th>
<th>30-39 years</th>
<th>40 years and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodator</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>n=7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.1%</td>
</tr>
<tr>
<td>Converger</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>n=5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.6%</td>
</tr>
<tr>
<td>Diverger</td>
<td>18</td>
<td>7</td>
<td>7</td>
<td>n=32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>55.2%</td>
</tr>
<tr>
<td>Assimilator</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>n=14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.1%</td>
</tr>
<tr>
<td>Total</td>
<td>n=33</td>
<td>n=11</td>
<td>n=14</td>
<td>N=58</td>
</tr>
<tr>
<td></td>
<td>56.9%</td>
<td>19.0%</td>
<td>24.1%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 29. Pretest learning style by gender

<table>
<thead>
<tr>
<th>Learning style</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accommodator</td>
<td></td>
<td>1</td>
<td>10</td>
<td>n-11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.3%</td>
</tr>
<tr>
<td>Converger</td>
<td></td>
<td>2</td>
<td>17</td>
<td>n-19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.7%</td>
</tr>
<tr>
<td>Diverger</td>
<td></td>
<td>10</td>
<td>11</td>
<td>n-21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35.0%</td>
</tr>
<tr>
<td>Assimilator</td>
<td></td>
<td>4</td>
<td>5</td>
<td>n-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.0%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>n-17</td>
<td>n-43</td>
<td>N=60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.3%</td>
<td>71.7%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 30. Posttest learning style by gender

<table>
<thead>
<tr>
<th>Learning style</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accommodator</td>
<td></td>
<td>0</td>
<td>7</td>
<td>n-7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.1%</td>
</tr>
<tr>
<td>Converger</td>
<td></td>
<td>0</td>
<td>5</td>
<td>n-5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.6%</td>
</tr>
<tr>
<td>Diverger</td>
<td></td>
<td>11</td>
<td>21</td>
<td>n-32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>55.2%</td>
</tr>
<tr>
<td>Assimilator</td>
<td></td>
<td>4</td>
<td>10</td>
<td>n-14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.1%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>n-15</td>
<td>n-43</td>
<td>N=58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.9%</td>
<td>74.1%</td>
<td>100%</td>
</tr>
</tbody>
</table>
A single classification (one-way) analysis of variance was completed to compare respondents' means on cognitive change by age, cognitive change by gender, and learning style by months of related foodservice work experience. The results for these three analyses are listed in Tables 31, 32, and 33. The means and standard deviations for the variables in these three (one-way) analyses of variance are located in Table 34.

The null hypothesis that the demographic variable of age will not have a significant (p<.05) relationship with cognitive change scores was not rejected (F=1.521, p<.226). See Table 31.

Table 31. One-way analysis of variance of cognitive change by age

<table>
<thead>
<tr>
<th>Source</th>
<th>D.F.</th>
<th>Sum of squares</th>
<th>Mean squares</th>
<th>F ratio</th>
<th>F prod.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>2</td>
<td>96.659</td>
<td>48.329</td>
<td>1.5210</td>
<td>.2264</td>
</tr>
<tr>
<td>Within groups</td>
<td>63</td>
<td>2001.825</td>
<td>31.775</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>2098.484</td>
<td>31.775</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*No two groups are significantly different at the .05 level.*

Table 32. One-way analysis of variance of cognitive change by gender

<table>
<thead>
<tr>
<th>Source</th>
<th>D.F.</th>
<th>Sum of squares</th>
<th>Mean squares</th>
<th>F ratio</th>
<th>F prod.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>18.849</td>
<td>18.849</td>
<td>.5801</td>
<td>.4491</td>
</tr>
<tr>
<td>Within groups</td>
<td>64</td>
<td>2079.635</td>
<td>32.494</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>2098.484</td>
<td>31.775</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 33. Pre- and posttest learning style by months of related food-service experience

<table>
<thead>
<tr>
<th>Learning style</th>
<th>n</th>
<th>%</th>
<th>Months of related foodservice experience mean</th>
<th>S.D. (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-</td>
<td>Post-</td>
<td>Pre-</td>
<td>Post-</td>
</tr>
<tr>
<td>Accommodator</td>
<td>7</td>
<td>5</td>
<td>14.9</td>
<td>11.6</td>
</tr>
<tr>
<td>Converger</td>
<td>11</td>
<td>4</td>
<td>23.4</td>
<td>9.3</td>
</tr>
<tr>
<td>Diverger</td>
<td>20</td>
<td>24</td>
<td>42.6</td>
<td>55.8</td>
</tr>
<tr>
<td>Assimilator</td>
<td>9</td>
<td>10</td>
<td>19.1</td>
<td>23.3</td>
</tr>
<tr>
<td>Combined (N)</td>
<td>47</td>
<td>43</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 34. Cognitive change by age and gender

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>%</th>
<th>Cognitive change mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29 years</td>
<td>37</td>
<td>56.1</td>
<td>2.243</td>
<td>5.804</td>
</tr>
<tr>
<td>30-39 years</td>
<td>13</td>
<td>19.7</td>
<td>5.385</td>
<td>5.576</td>
</tr>
<tr>
<td>40 years and over</td>
<td>16</td>
<td>24.2</td>
<td>3.438</td>
<td>5.266</td>
</tr>
<tr>
<td>N=66</td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>n</th>
<th>%</th>
<th>Cognitive change mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>17</td>
<td>25.8</td>
<td>4.059</td>
<td>6.447</td>
</tr>
<tr>
<td>Female</td>
<td>49</td>
<td>74.2</td>
<td>2.837</td>
<td>5.429</td>
</tr>
<tr>
<td>N=66</td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The null hypothesis that the demographic variable of gender will not have a significant (p≤.05) relationship with cognitive change scores was not rejected (F=.580, p≤.449). See Table 32.

The null hypothesis that the demographic variable of months of related foodservice work experience will not have a significant (p≤.05) relationship with pretest learning style was not rejected (F=2.59, p≤.065). See Table 35. Likewise, the null hypothesis that the demographic variable of months of related foodservice work experience will not have a significant (p≤.05) relationship with posttest learning style was not rejected (F=1.419, p≤.252).

Qualitative Data

The last section of the demographic questionnaire solicited additional evaluation information about the QFPS guide and cognitive achievement test. The five most frequent comments from the Iowa State University and community college samples are listed in Table 36.
Table 35. One-way analysis of variance of pretest and posttest learning style by months of related foodservice experience

<table>
<thead>
<tr>
<th>Source</th>
<th>D.F. Pre</th>
<th>Sum of squares Pre</th>
<th>Mean squares Pre</th>
<th>F ratio Pre</th>
<th>F prob Pre</th>
<th>D.F. Post</th>
<th>Sum of squares Post</th>
<th>Mean squares Post</th>
<th>F ratio Post</th>
<th>F prob Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>3</td>
<td>118595.315</td>
<td>39531.771</td>
<td>2.593</td>
<td>.065</td>
<td>3</td>
<td>65699.723</td>
<td>21899.907</td>
<td>1.419</td>
<td>.252</td>
</tr>
<tr>
<td>Within groups</td>
<td>43</td>
<td>655609.620</td>
<td>15246.735</td>
<td></td>
<td></td>
<td>39</td>
<td>601994.183</td>
<td>15435.748</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>774204.936</td>
<td>15435.748</td>
<td></td>
<td></td>
<td>42</td>
<td>667693.907</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*No two groups are significantly different at the .05 level.*
Table 36. Additional written comments from demographic questionnaire

<table>
<thead>
<tr>
<th>Iowa State University:</th>
<th>No. of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to understand</td>
<td>10</td>
</tr>
<tr>
<td>Make it more simple</td>
<td>8</td>
</tr>
<tr>
<td>Needs to be more detailed</td>
<td>6</td>
</tr>
<tr>
<td>Better suited to food and nutrition courses</td>
<td>6</td>
</tr>
<tr>
<td>Answers to class assignments not in study guide</td>
<td>2</td>
</tr>
<tr>
<td>Good reference material</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total = 33</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Community Colleges:</th>
<th>No. of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to understand</td>
<td>16</td>
</tr>
<tr>
<td>Helpful at work</td>
<td>13</td>
</tr>
<tr>
<td>Useful information</td>
<td>6</td>
</tr>
<tr>
<td>It was interesting</td>
<td>5</td>
</tr>
<tr>
<td>Not enough time to read thoroughly</td>
<td>5</td>
</tr>
<tr>
<td>Everything grouped nicely</td>
<td>1</td>
</tr>
<tr>
<td>Assignments helped to make me read the study guide</td>
<td>1</td>
</tr>
<tr>
<td>Not related to our class assignments</td>
<td>1</td>
</tr>
<tr>
<td>Diabetic and special diets should have been discussed</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total = 49</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Total exceeds sample size because some questionnaires contained more than one comment.*
SUMMARY, DISCUSSION, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Overview

This chapter is divided into five sections. The first section reviews the purpose, justification, and procedures of the research. The second section discusses the major findings of the study based on the objectives of the study. In the third section, conclusions are drawn from research findings. These are followed by implications for practical use and to existing theory. The last section makes recommendations for further research.

The purpose of the study was to develop a Quantity Food Preparation Study (QFPS) guide and a cognitive achievement pre- and posttest for foodservice supervisors in accordance with a table of specifications based on the cognitive level of related topics in existing Hotel, Restaurant, and Institution Management (HRIM) texts. In addition, learning styles of these adult self-directed students were measured using Marshall and Merritt’s (1985) Learning Style Questionnaire (LSQ) for the purpose of investigating relationships that might assist in future development of effective institutional methods and cognitive test instruments.

Another purpose of the study addressed the issue of content validity and accuracy of the study guide. This was accomplished by the researcher and two experts in HRIM.

A demographic questionnaire was developed to investigate any relationships between and/or among age, gender, highest level of education attained, months of related foodservice experience, and cognitive change.
as measured by the 66-item achievement pre- and posttest. This cognitive change was also used to investigate any relationship to learning style as measured by Marshall and Merritt's (1985) LSQ.

The QFPS guide was used as part of a newly revised Food Production Study Course, 3rd edition: Quantity Preparation and Scientific Principles (Baltzer & Gilmore, 1992). Parts of six chapters of this 3rd edition were initially written as the six chapters of the Quantity Food Preparation Study (QFPS) guide used for this research. The QFPS guide and the quantity food preparation course were developed to meet the new code requirements of Chapter 58 of the Iowa Rules and Regulations Setting Minimum Standards for Intermediate Care Facilities and Nursing Homes.

Often foodservice supervisors do not have the opportunity to obtain a minimum of 90 hours of training and continuing education established by this code. When this occurs, a home study guide similar to the QFPS guide could be used by the foodservice supervisors learning in a self-directed format.

In addition to the need to develop a new study guide combining the principles of food science and quantity food preparation not found in current manuals and texts, learning styles were investigated to ascertain if relationships existed between these self-directed learners and their cognitive achievement measured by a 66-item cognitive test developed for the research. Parallel to the cognitive testing, the learning styles of these adults were investigated as they related to the effectiveness of teaching method to validate the findings of Kolb (1976), Marshall and Merritt (1985), Hsu (1989), and others.
Food service supervisors from intermediate and extended care facilities were the target population for the instructional and evaluation devices developed for the study. The two target population samples consisted of 35 adult students enrolled in quantity food production courses at Iowa area community colleges located at Clinton and Ankeny, Iowa.

Self-directed learning formats similar to the QFPS guide have been used to supplement courses in HRIM at Iowa State University (Hsu, 1989), such as purchasing, foodservice management information systems, quantity food production management, and foodservice management. Although research in self-directed learning is extensive in other disciplines, most of the studies involved vocational, job, family, hobbies, and recreation related subjects (Cross, 1984).

Using programmed self-instruction, Cole (1988) conducted research with students enrolled in Quantity Food Production Management Experience to determine the effectiveness of programmed self-instruction and simulation educational methods. In this research, Cole (1988) recommended, and others concurred, that further research be conducted to "investigate what types of learning styles students in HRIM curricula possess and determine if these learning styles can be used to predict the most effective instructional method" (p. 54). Cole used Kolb's (1976) Learning Style Inventory (LSI), and later Hsu (1989) used Marshall and Merritt's (1985) LSQ to measure respondents' learning style. Marshall and Merritt's LSQ is a refined form of Kolb's LSI. Hsu's recommendation for further investigation to validate the LSQ as a measurement of learning
style for use in research to predict the most effective instructional method became a major component of the current research.

The development of the QFPS guide and related cognitive achievement device, a component of the broader study course, and the investigation of how a student's learning style is related to the effectiveness of the self-directed format became a major focus of the current study. The six selected chapters of the study guide, Marshall and Merritt's (1985) LSQ, and relevant demographic characteristics were selected for investigation and several research questions were formulated. See page 8, Chapter I.

Summary of Findings

The most predominant learning style for the combined groups pretest and posttest was diverger, 31.8% and 48.5%, respectively. The predominant pretest learning style for the community college target population sample was converger, 42.6%. The predominant posttest learning style for this same sample was the diverger, 42.6%. The Iowa State University pretest and posttest samples were both predominantly divergers, 51.6% and 54.8%, respectively.

This change in learning style from converger to diverger for the community college combined samples could have resulted from the improved comfort level of the research subjects. Both instructors acknowledged that most of the students initially were not accustomed to being within a structured classroom environment. This reduction in anxiety could have improved the accuracy of subjects' responses on the LSQ. Technically, as
proposed by Kolb (1976), subject learning style should not change between short pre- and posttest time intervals.

Cognitive change and test scores for the combined groups, the pretest scores ranged from a low of 18 to a high of 49 out of a possible 66. The range of posttest scores improved only slightly, 19 to 53. The mean pretest score was 33.1 with a standard deviation of 5.7. The mean posttest score was 36.3 with a standard deviation of 7.5. The mean cognitive change score was 3.2 with a standard deviation of 5.7. Cognitive change is positively correlated with posttest scores ($r=.660$, $p<.01$).

**Cognitive change and time spent reading QFPS guide**

Minutes spent reading the QFPS guide is positively correlated with posttest scores ($r=.289$, $p<.05$); 8.35% of the cognitive change is attributable to posttest score. Pretest and posttest scores are positively correlated ($r=.662$, $p<.01$).

There is no significant ($p<.05$) correlation between the time spent studying the QFPS guide and the cognitive change score as measured by the cognitive test. There is a positive correlation ($r=.289$, $p<.05$) between the minutes spent reading the study guide and posttest scores.

**Cognitive change and learning style**

There is no significant difference in cognitive change score by the four learning styles ($F=.71$, $p<.548$). Pretest transformation (processing) and prehension dimension (taking-in) scores of learning styles are
positively correlated ($r = .397, p < .01$). Pretest and posttest transformation andprehension scores are positively correlated ($r = .588, p < .01$) and ($r = .557, p < .01$), respectively. Pretest and posttestprehension (taking-in) scores are somewhat positively correlated ($r = .121$ and $r = .034$) withcognitive change scores, but neither was significant at a $p < .05$ level. Similar to theprehension scores, the pretest transformation scores (processing) are somewhat positively correlated ($r = .106$) with cognitive change scores, but not at a significant $p < .05$ level. A slightly negatives correlation ($r = -.183$) was revealed between the posttest transformation and cognitive change scores. Again, no significant ($p < .05$) level was reported. In summary, the LSQ transformation dimension (AE-RO) scores are not significantly ($p < .05$) more predictive of cognitive change than theprehension or taking-in of information dimension (AC-CE) scores.

**Learning style with level of education**

Pretest combined groups level of education does have a significant effect at the $p < .05$ level on subject learning style. No similar significant results were demonstrated with posttest chi-square statistics.

**Learning style with age, gender, and work experience**

Pretest learning style was not predictable based on the respondent's age. Posttest results did not confirm this finding at a $p < .05$ level of significance. Gender demonstrated predictability when compared to pretest learning style. Posttest results did not confirm this predictability at a
significance level of $p \leq 0.05$. Learning style was not predictable based on months of related foodservice work experience ($F = 2.593, p \leq 0.065$).

Cognitive change with age, gender

Age does not have a significant ($p \leq 0.05$) relationship with cognitive change scores. Likewise, gender does not have a significant ($p \leq 0.05$) relationship with cognitive change scores.

Test reliability

Finally, the 66-item cognitive achievement test demonstrates a Kuder-Richardson-20 reliability estimate of 0.77. The refined 55-item and 30-item cognitive Kuder-Richardson-20 scores are 0.75 and 0.57, respectively.

Discussion of Results

The foodservice supervisor target population was 8.6% male ($n=3$) and 91.4% female ($n=32$). The plurality of respondents, 45.7%, were 40 years and above. The highest level of education attained was high school, 71.4%.

The mean time community college respondents spent reading the study guide mean was 3 hours 10 minutes, with a standard deviation of 2 hours 4 minutes. The mean time for the ISU sample was only 2 hours 3 minutes. This low reading time mean for the Iowa State University research sample with the QFPS guide might have been partially due to the fact that students knew their participation was voluntary. Many expressed dissatisfaction that the additional required reading was not equitable to
extra credit points offered as an incentive for participation in the research.

Both the Iowa State University and community college samples rated the QFPS ease of understanding with a mean of 4.17 and 4.32, respectively. Therefore, since "1" represented difficult to understand and "5" represented easy to understand, the majority of subjects judged the QFPS relatively easy to understand.

Similarly, a Likert-type scale was used to measure respondents' rating for how helpful the QFPS guide was at work or with class. A rating of "1" represented the QFPS guide was of little help and "5" represented the guide was very helpful. The overall mean of 3.54 was very near the mean of the two research samples. This indicates the respondents were relatively neutral on their opinion of usefulness of the guide.

Both samples were asked if they felt the time they spent reading the QFPS guide was appropriate. A Likert-type scale using "1" represented too much time, "2" represented correct amount of time, and "3" represented took less time than expected. A mean of 2.23 for the combined samples indicated the majority of respondents felt the time spent reading the guide was appropriate.

When asked how many chapters of the guide were read, the community college sample read a mean of 4.75 chapters, while the Iowa State University sample read 3.25 chapters, one and one-half chapters less. This difference might have been caused by a number of factors: perception of the importance of the QFPS guide, course and work loads, and
instruction reinforcement of supplemental reading assignments for case studies and learning exercises.

As expected, the older community college respondent had a higher related foodservice work experience mean, 14.40 years, compared to the college-age Iowa State University student mean of 2.50 years.

Learning style prehension and transformation dimensions

Learning style prehension (taking-in) and transforming (processing) scores for the combined groups were used in statistical analysis to increase sample size and reliability of results. Active conceptualization (AC) with a pretest measure of 22 and a posttest measure of 21 was the dominant mode of prehension. Active experimentation (AE) with a pretest mean of 22 and a posttest mean of 21 was the dominant mode in the transformation dimension. This dominance of AC and AE in the prehension and transformation dimensions supports similar findings reported by Adenuga (1989). Possibly AC and AE should be related to each other on opposite poles of the abstract/concrete continuum originally proposed by Kolb (1976), instead of the AC-CE and AE-RO proposed formulas. A further analysis would assist in revealing the degree of this relationship. The AC and AE measure and standard deviations are listed in Table 12.

The pretest and posttest mean LSQ scores of 4.4 and 9.5, respectively, of the transformation dimension is further from the theoretical median of Kolb's learning style matrix than was found for the prehension results. The prehension (taking in) pretest and posttest mean scores of 1 and 4, respectively, being closer to the theoretical center,
indicated the prehension experience was more often midway between abstract
and experimentation for the subjects in the combined research samples.

The change in predominance of learning styles from converger to
diverger was surprising due to the fact that the time between pretest and
posttest was only 4 weeks compared to the 3 month period for the Iowa
State University sample. Kolb (1976) often justified respondents
obtaining similar style scores for short interval test, retest periods as
being attributable to the subjects' recall of previous responses. This
was not validated by the community college sample.

As a result of these findings, similarities and differences according
to Kolb (1976) were investigated using Marshall and Merritt's LSQ. Kolb
describes the diverger as having a strong imaginative ability; this trait
could also be related to the application of abstract ideas of the
converger. The major differences between the two styles relates to how
they process and assimilate information. The diverger's major learning
abilities are concrete experience and reflective observation. In
contrast, the converger's dominant learning abilities are abstract,
conceptualization and active experimentation.

Pretest, posttest, and cognitive change scores

The first objective of the study listed in chapter one, determination
of specifications for selected chapters of the Quantity Food Preparation
Study (QFPS) guide and the corresponding cognitive test are found in
Tables 4 and 6. The initial 66-item test was reduced to 55 and 30 items
for use in varying testing time periods. Six educators familiar with the
target population, intermediate care and nursing home foodservice supervisors, suggested a span of attention for testing ranging from 30 minutes to 1.5 hours. As supported by Gronlund (1988), students with a high school education can be expected to answer one multiple-choice question per minute, the test format selected for all three cognitive achievement devices used in the research.

Objective 2, relating to the cognitive level of selected chapters of QFPS guide, was addressed by investigating the cognitive level composition of existing texts in quantity food preparation and principles of food science at Iowa State University and the second edition of Quantity Food Preparation Study Course. The original and revised cognitive tables of specifications are listed in Table 22.

The QFPS guide (Appendix A) was developed to meet the requirements of objective 3 based on the table of specifications (Table 6). The researcher and two HRIM experts determined chapter topics and format.

The development of a cognitive pre- and posttest established by objective 4 used a bank of 132 original questions. These questions and their respective cognitive level, verified by a testing expert, are in Tables B.1 and B.2 in Appendix B. The Kuder-Richardson reliability estimates were: .77, .75, and .57 for the 66-item, 55-item, and 30-item cognitive tests, respectively, for the combined group of 66 respondents.

Hypothesis 1

The null Hypothesis 1, related to the fifth objective, was rejected. There is no correlation between the time spent reading the QFPS guide and
the cognitive change as measured by the cognitive test. Using a Pearson correlation procedure, the correlation coefficient matrix (Table 15) demonstrates that minutes spent reading the QFPS guide (MINRD) is positively correlated with posttest (PSTTST) scores ($r = .289$, $p < .05$); 8.35% of the cognitive change score is attributable to the posttest score. As expected, cognitive change (CHANGE) is positively correlated with posttest scores ($r = .660$, $p < .01$). Pretest and posttest scores are also positively correlated ($r = .662$, $p < .01$). The mean pretest score for the combined groups is 33 with a standard deviation of 6. The mean posttest score is slightly higher, 36, with a standard deviation of 8. The mean cognitive change score is 3.2 with a standard deviation of 6. Plotted scores demonstrate a normal distribution curve. See Figure 7.

Relating to objective 6, the predominant learning style for all research samples in pre- and posttests was the diverger, 32% of pretest and 48.5% of posttest respondents. The second predominant style for pretest subjects was the converger, 29%, while the assimilator, 21%, was second for the posttest. This contrasted to Paulson (1987), Cole (1988), and Hsu (1989), whose respondents from a similar HRIM background were primarily convergers. However, when pretest and posttest samples were analyzed separately, the predominant learning style for the community college pretest sample was the converger, 43%. However, in the posttest sample, the convergers represented only 29%, while the divergers were 31.8% of the sample. In both the pretest and posttest, the Iowa State University sample was predominantly divergers, 52% and 55%, respectively.
Hypothesis 2

Null Hypothesis 2, related to objective 6—There is no significant difference in cognitive change among the four learning styles as measured by the Learning Style Questionnaire (LSQ)—was not rejected. A one-way analysis of variance shown in Table 16 failed to reject the null hypothesis that there is no significant difference in cognitive change among the four learning styles ($F=.71, p<.548$).

Hypothesis 3

Null Hypothesis 3, related to objective 7, the LSQ transformation dimension (AE-RO) scores) will not be significantly ($p<.05$) more predictive of cognitive change than the prehension or taking-in of information dimension (AC-CE) scores was not rejected. Using a Pearson correlation coefficient test, the correlation matrix (Table 15) indicates the pretest and posttest prehension scores (PREHN1 and PREHN2) were somewhat positively correlated ($r=.121$ and $r=.033$) with cognitive change scores, but neither was significant at a $p<.05$ level. Similar to the prehension, the pretest transformation scores were somewhat positively correlated ($r=.106$) with cognitive change scores, but not at a significant $p<.05$ level. A slightly negative correlation ($r=-.183$) was revealed between the posttest transformation scores and cognitive change scores. Again, no significant ($p<.05$) level was reported. Therefore, it can be relatively safe to assume the null hypothesis cannot be rejected based on these statistical data. The LSQ transformation dimension (AE-RO) scores
are not significantly \((p < 0.05)\) more predictive of cognitive change than the prehension or taking-in of information dimension (AC-CE) scores.

**Hypothesis 4**

Null Hypothesis 4, related to objective 8--The demographic variable of level of education will not have a significant \((p < 0.05)\) relationship with LSQ categories and the cognitive change scores related to objective 8--was tested using a single classification (one-way) analysis of variance and chi-square goodness of fit. In the one-way analysis of variance, the null hypothesis that the demographic variable of level of education will not have a significant \((p < 0.05)\) relationship with the cognitive change was not rejected \((F = 0.977, p < 0.410)\). See Table 17.

A chi-square goodness of fit statistical analysis was completed to ascertain whether the level of education and learning style scores are homogeneous. Since the chi-square pretest score of 12.612 with 3 degrees of freedom at the \(0.006\) significance level exceeds the critical value of 7.815 (see Table 18), the null hypothesis that the level of education and learning style scores are the same is rejected. Therefore, in the pretest combined groups, the level of education does have a significant effect at the \(0.01\) level on subject learning style. Posttest chi-square results were not significant at the \(p < 0.05\) level demonstrating no significant relationship existed between level of education and posttest learning styles.
Hypothesis 5

Null Hypothesis 5, related to objective 8--The demographic variables of age, gender, highest level of education attained, and months of work experience will not have a significant (p≤.05) relationship with LSQ scores and cognitive change scores--was tested using chi-square distribution, Pearson correlation, and one-way analysis of variance statistical tests.

A chi-square goodness of fit statistical analysis was completed to investigate whether or not age and gender were predictive of learning style. The pretest chi-square value of 9.816 exceeded the critical value for $X^2$ of 7.815 resulting in rejection of the null hypothesis. Therefore, in the combined research pretest samples, age was predictive of learning style. The posttest chi-square value of 1.657 for homogeneity of age and learning style did not exceed the critical value for $X^2$ of 7.815 with 3 degrees of freedom. The null hypothesis is not rejected, and the conclusion is that the posttest age and learning style of the respondents are the same (homogeneous). The data supported only pretest predictability of learning style based on subject age.

The chi-square analysis of gender with learning style demonstrated more significant results. The pretest chi-square value of 9.970 with 3 degrees of freedom exceeded critical value for $X^2$ of 7.815 at the .019 significance level. Therefore, the null hypothesis is rejected. Gender demonstrated predictability for learning style.

Posttest results did not confirm pretest chi-square findings when comparing gender and learning style. The $X^2$ value did not exceed the
critical value of $X^2$ with 3 degrees of freedom at a significance level of $p \leq .05$. The null hypothesis is not rejected in this example; gender did not demonstrate predictability for learning style. The pretest results indicating gender is predictable of learning style might have been due to the fact that the predominant gender of the community college samples was female with the converger learning style—the second most frequent learning style after the diverger.

A Pearson correlation coefficient test was used to investigate the predictability of cognitive change by months of related foodservice work experience. As indicated by the correlation matrix (Table 15), the relatively weak positive correlation of .020 was not significant at the $p \leq .05$ level. Therefore, the null hypothesis is not rejected, and the conclusion is that the respondents' learning style is not predictable based on months of related foodservice work experience.

A single classification (one-way) analysis of variance was completed to compare respondents' means on cognitive change by age, cognitive change by gender, and learning style by months of related foodservice work experience. The null hypothesis that the demographic variable of age will not have a significant ($p \leq .05$) relationship with cognitive change scores was not rejected. The null hypothesis that the demographic variable of gender will not have a significant ($p \leq .05$) relationship with cognitive change scores was not rejected. The null hypothesis that the demographic variable of months of related foodservice work experience will not have a significant ($p \leq .05$) relationship with pretest learning style was not rejected. Likewise, the null hypothesis that the demographic variable of
months of related foodservice work experience will not have a significant (p<.05) relationship with posttest learning style was not rejected.

Implications

Results of the research indicate that the demographic variables of age, gender, highest level of education attained, and months of related foodservice work experience are not significantly related to respondent learning style. Only in the pretest combined group sample does the one variable, highest level of education, have a significant effect at the p<.05 level on the subjects' learning style. Other authors, Paulson (1987), Cole (1988), and Hsu (1989), have investigated similar relationships to reveal if demographic factors are good predictors of learning style. None of the researchers discovered any significant relationships.

Pretest transformation and prehension dimension scores of respondents' learning style are positively correlated (r=.397, p<.01). This correlation might indicate the (AE-RO) elements of the transformation dimension might be correlated to the (AC-CE) elements of the prehension dimension. If this is true, these formulas may require modification to more accurately reflect these element interrelationships.

However, none of these implications is made to circumvent the need, especially for adult self-directed learners, to select instructional methods proven to be effective with their particular learning style (Hsu, 1989). Effective learners, according to Kolb (1984), must be able to reflect experiences (RO) from concrete experiences (CE); from concepts
that integrate observations; and from theories (AC), use these theories to
resolve problems (AE).

The alternate format of Kolb's Learning Style Inventory (LSI),
Marshall and Merritt's Learning Style Questionnaire (LSQ), was used to
investigate if the refined instrument revealed similar results to previous
studies with students in foodservice-related disciplines. Previous
studies by Paulson (1987), Cole (1988), and Hsu (1989) revealed convergers
as the predominant learning style among similar population samples. Hsu,
using Marshall and Merritt's LSQ, was of particular interest to the
current research to investigate any similarities and contradictions of
research results.

The current study concurred with Hsu's finding of predominant
converger learning style among her sample of foodservice managers and
regional directors. However, this occurred only with the pretest
community college sample. Posttest predominance with the same sample was
the diverger learning style--the same style predominant with the pre- and
posttest Iowa State University sample. The change of the community
college learning style might have been partially due to a reduction in
test anxiety, bias due to the short test, re-test interval, and
familiarity with the LSQ testing device.

The current research did not demonstrate a significant relationship
of learning style with cognitive change. However, the positive cognitive
change experienced by the research respondents and the acceptable Kuder-
Richardson-20 reliability estimate for the cognitive achievement test
indicate the QFPS guide and 66-item test are viable instructional
supplements. It can be concluded that the QFPS guide would be an acceptable teaching method among other nontraditional methods Hsu (1989) suggested to be used with a foodservice audience.

Although the minutes spent reading the study guide was positively correlated \( r = .289, p < .05 \) with posttest scores, this relationship might have been stronger if the reading of the QFPS guide had been a mandatory requirement for each student in both samples. The mean cognitive change score of 2 with a standard deviation of 6 and 4 with a standard deviation of 5 for the Iowa State University and community college samples, respectively, might have been higher with the required reading. The Iowa State University sample's low cognitive change might also have been due to other course workloads, limited time, awareness that the reading of the QFPS was voluntary, and instructor reinforcement of the importance and applicability of the material.

In the investigation of the demographic variables—age, gender, highest level of education attained, and months of related foodservice experience with pretest learning style revealed three significant relationships using a chi-square goodness of fit analysis. Pretest subjects' gender, age, and highest level of education attained demonstrated predictability when compared to learning style.

However, none of the demographic variables—age, gender, highest level of education attained, and months of related foodservice experience—demonstrated any significant relationship with posttest learning style.
Finally, the 66-item and 55-item cognitive tests were deemed acceptable with Kuder-Richardson reliability estimates of .77 and .75, respectively. Morris, Fitz-Gibbon, and Lindheim (1987) specified a KR-20 ≤.70 was an acceptable reliability estimate. The 30-item achievement test's KR-20 was only .57. However, as noted by Gronlund (1988), item analysis data from small samples are highly tentative and vary from group to group.

Recommendations for Further Research

Based on this study, several areas of learning style and self-directed instructional methods need further investigation.

1. Further learning style studies need to be conducted with larger samples of foodservice students to verify if convergers or divergers are the predominant norm.

2. Further research is necessary to investigate the relationships between learning styles and cognitive gain with other self-directed instructional methods: computer-assisted instruction, conventional classroom, and home-study programs similar to the Food Preparation Study Course: Quantity Preparation and Scientific Principles (3rd edition), (Baltzer & Gilmore, 1992).

3. Longitudinal studies would reveal learning style changes as foodservice students progress from this classroom to the industry where self-directed learning would be an option for continuing education to fulfill professional association mandates.
4. The learning style transformation dimension (AE-RO) modal score was zero in the current research. Further research might reveal the implications of such a balanced preference for the active and reflective elements of this dimension.

5. Factor analyses might also reveal significant relationships between the transformation AE, RO and the prehension AC, CE scores. Kolb's formulas may need to be changed if different significant relationships between these four experiential elements of the learning process are discovered.

6. Marshall and Merritt's Learning Style Questionnaire needs further investigation to verify instrument validity and reliability. Additional instrument designs would also be appropriate in the continuing investigation of learning style.

Summary

The purpose of the study was to develop a Quantity Food Preparation Study (QFPS) guide combining the elements of quantity food preparation and the principles of food sciences and a cognitive achievement pre- and posttest for foodservice supervisors in accordance with a table of specifications based on the cognitive level of related topics in existing HRIM texts. In addition, learning styles of these adult self-directed learners were measured using Marshall and Merritt's (1985) Learning Style Questionnaire to investigate any significant relationships that might exist with between cognitive change and selected demographic data: age,
gender, highest level of education attained, and months of related foodservice work experience.

The current study revealed the most predominant learning style as diverger in the combined groups' pre- and posttests. Pretest and posttest LSQprehension (taking-in) dimension scores are slightly positively correlated with the cognitive change scores, but neither is significant at a p<.05 level. Similar to the prehension (taking-in) scores, the pretest transformation (processing) scores are slightly positively correlated (.106) with cognitive change scores, but not at a significant p<.05 level. As a result of these findings, it is presumed the LSQ transformation (processing) dimension (AE-RO) scores are not significantly (p<.05) more predictive of cognitive change than the prehension (taking-in) dimension (AE-RO) scores.

Pretest combined groups' highest level of education attained did have a significant effect at the p<.05 level on subject learning style. Pretest learning style was predictable based on respondent's age. Pretest gender demonstrated a significant p<.05 relationship with learning style. However, the community college combined samples were primarily female with similar learning styles, creating gender bias. Learning style was not predictable based on months of related foodservice experiences.

Age, gender, highest level of education attained, and months of related foodservice experience did not demonstrate significant relationships with cognitive change scores.

The 66-item achievement test demonstrates a Kuder-Richardson reliability estimate of .77. The refined 55-item and 30-item cognitive
tests' KR-20 scores are .75 and .57, respectively. For the research, the minimum acceptably KR-20 score was .70.

As a result of the positive cognitive change, respondent evaluations, and resulting Kuder-Richardson-20 reliability estimates, the QFPS guide and cognitive achievement device are an acceptable educational method for the target population, self-directed adult learners working as foodservice supervisors in intermediate and extended-care nursing facilities.
REFERENCES


Kirby, P. (1979). *Cognitive style, learning style and transfer skill acquisition*. Columbus, OH: Ohio State University, National Center Research in Vocational Education.


APPENDIX A.

QUANTITY FOOD PREPARATION STUDY GUIDE
Hotel, Restaurant, and Institution Management
Quantity Food Preparation Study Guide
Spring, 1991
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</table>
VEGETABLES

UNDERSTANDING VEGETABLES

Vegetables in a quantity foodservice operation add color, shape, texture and nutrition to meals. Modern methods of processing, transporting and storing vegetables make them available in fresh, frozen, canned, or dried forms all year.

Vegetables, especially fresh ones, are among the best sources of vitamins and minerals. Yellow and green vegetables are good sources of vitamin A; while green peppers, tomatoes, broccoli and brussels sprouts are good sources of vitamin C. Usually vegetables are low in calories, except for starchy vegetables like corn, peas and potatoes. Starch is a storage form of carbohydrate and the main source of calories in vegetables. Protein and fat contents of vegetables generally are very low. Legumes, however, have a much higher content of protein than other vegetables.

Structure of Vegetables

Structure. Vegetables, as a class, have a lot of water and cellulose, the firm structure. The structure of vegetables consists of a dermal outer skin and a vascular system to transport water and nutrients. The edible parts of vegetables consist of cellulose and pectic substances. The water content within the plant cells determines the crispness of the tissue. As vegetables lose water, they begin to wilt. Cooking can partially break down cellulose to be more palatable and digestible. It also can change or improve the flavor and the texture of vegetables. Very coarse stems that contain firmer cellulose must be softened by a longer cooking time. Since cellulose is not digestible and cannot be absorbed, fresh vegetables are very important for the bulk and fiber they add to the digestive tract.

Pigments. The color of vegetables is due to the various pigments they contain. Four important pigments are the green pigment, chlorophyll; yellow to orange-red pigment, carotinoid; red pigment, anthocyanin; and white pigment, anthoxanthin. Usually acid, alkaline or overheating during cooking causes vegetable to change colors.

Acid and alkaline affect vegetables when they are present in cooking water. The pH of the cooking water may vary from one source of water to another. Water may have low pH which indicates acid or high pH which indicates alkaline. Alkaline is another name of base. Other ingredients in the recipe may also affect the pH of cooking condition. Examples of ingredients that make a low pH or acid condition are: vinegar, tomato juice, lemon juice, wine and cream of tartar. Baking soda is an example of high pH, alkaline.

The distinctive flavors of some vegetables are due to the enzyme activity. For example, sulfur adds to the flavor of cabbage, cauliflower, broccoli, mustard greens and turnip greens. Another enzyme in onions contains a tear-producing factor.
### Classifications

Classification of vegetables is important because cooking methods and storage conditions are largely determined by it. Vegetables are classified in several ways: edible part of plant, color, flavor and moisture content. The following chart shows these classifications and gives examples of vegetables in each.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Edible part of plant</td>
<td></td>
</tr>
<tr>
<td>Root</td>
<td>Beets, carrots, radishes, parsnips, sweet potatoes.</td>
</tr>
<tr>
<td>Tuber</td>
<td>White potatoes.</td>
</tr>
<tr>
<td>Bulb</td>
<td>Onions, garlic, leeks, shallots.</td>
</tr>
<tr>
<td>Stem</td>
<td>Celery, asparagus.</td>
</tr>
<tr>
<td>Leaf</td>
<td>Spinach, lettuces, parsley, cabbages, brussels sprouts.</td>
</tr>
<tr>
<td>Flower</td>
<td>Cauliflower, broccoli.</td>
</tr>
<tr>
<td>Seed</td>
<td>Green beans, peas, corn.</td>
</tr>
<tr>
<td>Fruit</td>
<td>Peppers, summer squashes, cucumbers, tomatoes, eggplant, okra, winter squashes.</td>
</tr>
<tr>
<td>2. Color</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Onions, potatoes, cauliflower.</td>
</tr>
<tr>
<td>Green</td>
<td>Lettuce, spinach, green pepper, broccoli.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Carrots, corn, rutabagas.</td>
</tr>
<tr>
<td>Red</td>
<td>Beets, tomatoes, red cabbage, red onions.</td>
</tr>
<tr>
<td>3. Flavor</td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>Broccoli, cabbages, onions, cauliflower, turnips, parsnips, brussels sprouts.</td>
</tr>
<tr>
<td>Mild</td>
<td>Asparagus, beans, beets, carrots,</td>
</tr>
</tbody>
</table>
corn, lettuces, mushrooms, potatoes

4. Moisture content

<table>
<thead>
<tr>
<th>High</th>
<th>Lettuces, radishes, tomatoes, onions, asparagus, cabbages, carrots, pepper.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Okra, parsnips, potatoes, acorn squash</td>
</tr>
<tr>
<td>Dry</td>
<td>Dried beans, lentils, dried onions, dried parsley.</td>
</tr>
</tbody>
</table>

**SELECTION**

Whatever the classification of vegetables, an acceptable product can be expected only when quality raw, frozen or canned products are used. Vegetables should not be too old when purchased or processed. Starting with a good quality vegetable is the best way to ensure proper volume, high quantity and the best quality end products. Therefore, the quality of foods that is needed by the foodservice operation and their use on the menu must be decided before purchasing.

**Fresh Vegetables**

When buying fresh vegetables, check for:

- **Peak of ripeness:** Vegetables will not ripen in storage. If they are not ripe when they were purchased, they will have poor texture and flavor.

- **Color and texture:** Color is the key to nutrition especially for yellow and green vegetables. Vegetables should have a bright, characteristic color and a crisp texture.

- **Shape:** Misshapen vegetables are usually poor in texture and flavor.

- **Size:** Extra large vegetables may be overripe, coarse and have poor flavor. Extremely small ones tend to be immature and have poor flavor, too. Vegetables should feel heavy in relation to their sizes.

In addition to these points, specific vegetables have characteristics that indicate good quality. Some suggested guides for fresh vegetables are presented in Table 1.
## Purchasing Guide for Fresh Vegetables

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<th>Vegetables</th>
<th>What to Look For</th>
<th>What to Avoid</th>
</tr>
</thead>
<tbody>
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<td>Asparagus</td>
<td>Compact, flexible tips;</td>
<td>Over grown size; open and spread out tips;</td>
</tr>
<tr>
<td></td>
<td>smooth, round spears; rich green color.</td>
<td>excessive amount of sand; no flexibility.</td>
</tr>
<tr>
<td>Beans, green</td>
<td>Fresh, bright color; young, tender crisp.</td>
<td></td>
</tr>
<tr>
<td>Beets</td>
<td>Rich, deep red color; firm, round, root;</td>
<td>Wilted; soft; elongated shape; top root missing.</td>
</tr>
<tr>
<td></td>
<td>fresh green top.</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>Firm, compact cluster of small buds;</td>
<td>Spread cluster, open or enlarged bud; yellowish-green color; slippery, water soaked spot; soft.</td>
</tr>
<tr>
<td></td>
<td>dark-green or sage-green color;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fresh stem.</td>
<td></td>
</tr>
<tr>
<td>Brussels sprouts</td>
<td>Fresh, bright-green color, firm, tight-fitting outer leaves.</td>
<td>Yellowish green color; worm injury sign.</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Hard, firm head.</td>
<td>Overripe; worm-eaten wrappers.</td>
</tr>
<tr>
<td>Carrots</td>
<td>Well formed; smooth skin; firm; bright color.</td>
<td>Large sunburn spot; flabby; wilted; overripe.</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>White color; compact, solid, clean bud;</td>
<td>Spread or wilted bud; discolored spot; smudgy or speckled appearance.</td>
</tr>
<tr>
<td></td>
<td>good green-colored jacket leaves.</td>
<td></td>
</tr>
<tr>
<td>Celery</td>
<td>Solid, rigid texture; glossy light-green color.</td>
<td>Insect injury; brown or gray inside; soft; overdeveloped.</td>
</tr>
<tr>
<td>Corn</td>
<td>Fresh, juicy; plump; good green color;</td>
<td>Worm injury; overripe; wilted or dried.</td>
</tr>
<tr>
<td></td>
<td>bright-yellow color; small size kernels.</td>
<td></td>
</tr>
<tr>
<td>Cucumber</td>
<td>Good green color; well shaped; firm;</td>
<td>Extra large size; dull-yellowish color; soft, wilted end.</td>
</tr>
<tr>
<td></td>
<td>small lumps on the skin.</td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td>Freshly harvested characteristics</td>
<td>Overgrown or decay characteristics</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Eggplant</td>
<td>Firm, heavy, smooth shape; dark-purple color with shiny peel.</td>
<td>Over grown size; soft shape; irregular dark brown or white spots on the surface.</td>
</tr>
<tr>
<td>Greens</td>
<td>Fresh, young, tender texture; good green color.</td>
<td>Coarse, fibrous stem; yellowish-green color; evidence of insects on the leaves; wilted leaves.</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Crisp, good bright green color, medium size.</td>
<td>Overripe, decay, irregular shape or hard bump on top, small for weight.</td>
</tr>
<tr>
<td>Okra</td>
<td>Flexible, tender pods under 4 1/2 inches long; dull-green color.</td>
<td>Tough or fibrous pods; pale- and faded-green color; soft or split skin.</td>
</tr>
<tr>
<td>Onions</td>
<td>Firm, dry with small neck; covered with papery scales; free from sun burn or blemish.</td>
<td>Wet or with soft neck; fresh sprout; thick center in the neck.</td>
</tr>
<tr>
<td>Parsnips</td>
<td>Small or medium; firm; well formed; smooth; free from blemish.</td>
<td>Large; coarse; yellow decayed.</td>
</tr>
<tr>
<td>Pepper</td>
<td>Dark green or red color with glossy surface; weight with firm wall.</td>
<td>Thin walls; soft watery spot on the surface.</td>
</tr>
<tr>
<td>Sweet green or red, Bell pepper</td>
<td>Well-shaped; firm; no blemish or damage.</td>
<td>Sprouted; shriveled; green color; bruised; soft.</td>
</tr>
<tr>
<td>Potatoes</td>
<td>Fresh, crisp, green tops; yellow color; wilted; two or three inches of tops from the root end.</td>
<td>Bruised tops; discolored tops.</td>
</tr>
<tr>
<td>Shallot and Leeks</td>
<td>Fresh, crisp, green tops; yellow color; wilted; two or three inches of tops from the root end.</td>
<td>Bruised tops; discolored tops.</td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>No blemish; firm; no warm hole.</td>
<td>Worm hole; cuts.</td>
</tr>
</tbody>
</table>
Processed Vegetables

Canned vegetables. Advantages of using canned vegetables are moderate cost, year-round availability, consistent quality, reduced energy use and good variety. Canned vegetables are produced according to the United States government standards and may have a grade on the label. Grading services are provided by the U.S. Department of Agriculture (USDA). The grade may be listed as a letter or descriptive word. The grade purchased usually depends on the intended use, with the lower grade being used in mixed-food combinations such as soups. Standards for canned vegetables are:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Quality of vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Grade A or Fancy</td>
<td>Best flavored, most tender and juicy, uniform in size, shape, color, tenderness; represents choice of crop.</td>
</tr>
<tr>
<td>U.S. Grade B or Choice Extra standard</td>
<td>Flavor fine, tender and juicy, may be slightly more mature, more firm in texture and sometimes less uniform than fancy grade.</td>
</tr>
<tr>
<td>U.S. Grade C or Standard</td>
<td>Flavor less delicate; more firm in texture, often less uniform in size, shape, color; more mature.</td>
</tr>
<tr>
<td>Standard</td>
<td>Lower than the minimum grade for standard.</td>
</tr>
</tbody>
</table>

Avoid using canned vegetables with any signs of spoilage. Cans that bulge at the sides or ends may show spoilage and should not be used. Liquid spurting out from the can when it is opened, or mushy contents also are signs of spoilage. A sour smell of the contents probably means it is spoiled. In these cases, never taste the food, because they may contain a food poison, botulism, which can be fatal in very small amount. Remember, a canned vegetable that is spoiled may look and smell alright but still be unsafe. Discard all canned products with any of these signs.

Frozen Vegetables. Frozen vegetables are packed according to the U.S. Grade such as U.S. Grade A or Fancy, U.S. Grade B or Extra Standard and U.S. Grade C or Standard. The grade is not commonly listed on the label. Frozen vegetables provide freshness and vivid colors while saving labor time and waste compared to fresh. They are closest in nutrients, color and flavor to fresh and are available whole or in cut pieces.

Some frozen vegetables are packed in special sauces such as cheese or butter sauce. Frozen vegetables for quantity production usually come in 2 1/2 pound boxes or in plastic bags lined cases of 20 to 30 pounds. When buying frozen vegetables, they must be frozen thoroughly and packages that have holes, tears, open seams, have been thawed or have other damages should be avoided. An
opening in the package could mean the food has been contaminated.

**Dried Vegetables.** Dried vegetables include legumes: lentils, peas, beans and soybeans; herbs and spices; or vegetables used for seasonings. Other dried vegetables are chives, mushrooms, onions, parsley flakes and potato flakes or granules. Look for the following characteristics when buying dried vegetables:

- **Uniform, bright color:** Loss of color means staleness and longer cooking time.
- **Uniform size:** In legumes, mixed size will cook unevenly. Smaller pieces cook faster than larger ones.
- **No visible defects:** Foreign materials such as sticks, stones and dirt, cracked coating and small insects holes are sign of a low-quality product.
- **Container:** Tightly sealed.

**STORAGE**

Vegetables should be stored in optimal conditions to retain their nutrients, flavor and texture. Suggested storage temperatures and conditions for different types of vegetables are:

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Maximum Temperature (F)</th>
<th>Storage conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen vegetables</td>
<td>0 to -20</td>
<td>Original container or in moisture- and vapor-proof wrapping; heavy duty foil or heavy duty plastic container with tight fitting lid.</td>
</tr>
<tr>
<td>Leafy vegetables</td>
<td>45</td>
<td>7 days, unwashed.</td>
</tr>
<tr>
<td>Potatoes, onions, root vegetables (room temperature)</td>
<td>70</td>
<td>7 to 30 days; keep in ventilated bags or containers.</td>
</tr>
</tbody>
</table>

Fresh vegetables should be stored in plastic bags or a tightly covered container approved by the National Sanitation Foundation (NSF) to prevent loss of water resulting in dehydration. Refrigeration also will prevent the change of sugar to starch in vegetables such as corn and green peas.

Dried vegetables will keep their quality for months if stored properly. Storage places for them should be dry and cool. Once a
package is opened, any remaining portion should be stored in a plastic container with a tight-fitting lid. This will protect the food from insects, humidity and any other contamination.

PREPARATION

Some foodservice operations use fresh vegetables in a convenience form like peeled potatoes and carrots, washed greens and other vegetables, or cut vegetables, ready for cooking. With these vegetables, it is not necessary to spend costly labor time in preparing them or to purchase expensive equipment for preparation. The fresh convenience vegetables are relatively high in cost, may have poor flavor, and may have preservatives added. For this reason many foodservice operations prefer to maintain quality standards by purchasing fresh vegetables in their natural state.

Fresh Vegetables

Most fresh vegetables perish easily and should be refrigerated as soon as they are purchased or received. Large quantity operations may use an ingredient room or vegetable preparation area for vegetables used in standardized recipes. However, many nursing facilities do not have a separate ingredient room or vegetable preparation area. Usually fresh vegetables in their natural state are directly delivered to the kitchen area. Proper sanitation methods are necessary when handling vegetables. It is very important to realize that clean vegetables have a much longer shelf life than dirty, soiled and partially spoiled ones. The following are common and basic preparation tips.

Washing. Raw vegetables should be washed thoroughly before use. Soaking entire vegetables in water during this cleaning also helps dried or wilted vegetables absorb water. It also might be necessary to add a small amount of salt, one tablespoon per gallon of water, to help loosen dirt and grime on leafy and flower vegetables. This also helps remove small insects from inner leaves. However, this method should not be used for preparing food for low sodium diets.

All leafy vegetables should be washed under cold running water and drained thoroughly at least two hours before use. Some leafy vegetables such as spinach, leaf or endive lettuce, need a more thorough cleaning. The quickest and most efficient way to clean the veins and greens is to fill the sink with water and then slosh the leaves up and down several times in the water to remove the dirt. Drain the water from the sink, being sure to rinse the dirty sediment down the drain. Then refill the sink with fresh, cool water. Repeat sloshing action and draining until the water remains clean. After washing, they should be stored in plastic bags or airtight containers and refrigerated to retain freshness and crispness.

Oversoaking will cause nutrients and minerals to be lost in vegetables. Overhandling of some vegetables like lettuce will
increase the rate of spoilage. Therefore, minimum handling is recommended.

(graphics: washing vegetables)

Vegetables usually require special handling. After washing, vegetables are carefully inspected to remove all blemishes for quality control. At this point, any necessary trimming, paring and cutting also should be done.

Trimming is done to remove woody stalks, heavy, tough leaves or other features that are not eaten. For example, green beans should be trimmed at both ends to remove the tough cellulose area such as the stems and blossom; cabbage wedges should be cut so that the remaining core will hold the wedge together; and beets should not have their roots cut off before cooking so they will keep their color. Bruised and spoiled sections of all vegetables should be trimmed immediately. It takes very little time for one spoiled vegetable to increase the spoilage of the remaining case or lug.

Paring is done to remove skins of some vegetables such as potatoes and carrots. Use of a knee-action peeler will minimize the trimming loss. When a commercial potato peeler is used, the amount of peeling needs to be watched carefully. Excessive peeling by such machine will increase the loss of minerals and vitamins through deep paring while at the same time increasing food cost. Many minerals and vitamins in vegetables are found in or near the outer skin, so deep paring should be avoided. Variation of food yield is influenced not only by the vegetables but also by the tool and method used in trimming. The following table gives approximate yield in preparation of selected vegetables.

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Yield percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus, turnips</td>
<td>93</td>
</tr>
<tr>
<td>Broccoli, trimmed</td>
<td>78</td>
</tr>
<tr>
<td>Cabbage, green</td>
<td>79</td>
</tr>
<tr>
<td>Carrots, topped</td>
<td>82</td>
</tr>
<tr>
<td>Onions, mature, white</td>
<td>91</td>
</tr>
<tr>
<td>Potatoes</td>
<td>84</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>69</td>
</tr>
</tbody>
</table>

(foot note 1)
To get the as purchased weight (AP) of raw vegetables, divide the edible portion (EP) weight in recipe by the food yield percent. For example, if there is 8 pounds of topped carrots in the recipe, that means 8 pounds of peeled, trimmed carrots are needed for cooking. To prepare 8 pounds of peeled, trimmed carrots, the purchase weight of topped carrots must be known. To get the As Purchase weight of carrots, the 8 pounds are divided by 0.82 (82% of food yield). Therefore, to serve 8 pounds, \[ \frac{E}{P} / \text{yield} = \text{AP} \], \[ \frac{8}{0.82} = 9.756 \text{ lb} = 9 \text{ lb 12 oz} \] of raw carrots are needed. When the amount of AP is known, but not the EP, the following formula is used: \[ \text{AP} \times \text{yield\%} = \text{EP} \]

To avoid bruising, it is important to use sharp stainless-steel knives when cutting vegetables. In addition, stainless steel will not interact with the acids in the vegetables causing the knife to discolor.

Cooking Fresh Vegetable

Boiling. Boiling and steaming are the most commonly used methods in quantity vegetable cookery. Boiling may be done in a steam-jacketed kettle or an open kettle on the range. Large or small amount of vegetables can be cooked evenly in a steam-jacketed kettle with a wire insert basket. Boiling methods should be selected to retain their bright color and shape. Rapid boiling, using a high temperature, reduces the nutritive level of the vegetables. After cooking vegetables, they should be drained quickly to avoid overcooking.

Steaming. Most quantity foodservice operations use commercial compartment steamers. Usually vegetables can cook more quickly and evenly by steaming rather than boiling. When using a steamer, vegetables are placed in single layers to cook rapidly and to prevent crushing. Vegetables should be steamed until tender-crisp. Small, high pressure steamers are used for individual servings sometimes called for in modified diets in nursing homes and hospitals.

Newer compartment steamers give the operator a choice between pressureless, with pressure, vented or unvented steam cooking. A compartment steamer can keep nutrients better than any other cooking method because a shorten cooking time and a small amount of water is used.

The compartment steamers use solid and perforated pans. Perforated pans are used for vegetables like snow peas that are steamed without direct contact with water. Care should be taken not to fill the pan unevenly. Since the product should not be cooked until needed for service, it is best to divide the total vegetable production into smaller batches. This should ensure nutrients, texture, flavor and color are retained. If the product is overcooked or held more than a few minutes; flavor, color, texture and nutritional value level will decrease. Vegetables that can be cooked by vented, pressureless steam include: Peas, carrots, snow peas, brussels sprouts, spinach, green beans, cauliflower,
lima beans. Refer to Table 3 for boiling and steaming times for selected fresh vegetables.

**Baking.** Baking is to cook by dry heat in the oven and commonly is used for cooking potatoes, squash, tomatoes and eggplants. It retains more vitamins and minerals than most other cooking methods. Many other vegetables except for green vegetables can be baked in a covered pan. Vegetable casseroles also are prepared by baking. Temperature for baking vegetables usually range from 300 to 425 F.

**Stir-Frying.** Stir-frying is an Oriental cooking method that can be done in a skillet, wok, fry pan or steam-jacketed kettle in quantity foodservice operations. Vegetables must be sliced into thin, uniform pieces and cooked until the outside is just done. In spite of their thin slices, vegetables are still crisp and juicy after cooking. A relatively short cooking time also reduces the loss of soluble nutrients such as vitamin C. Other advantages of stir-frying are retention of the fresh flavors and vivid colors of vegetables.

**Microwave Oven Cookery.** The microwave oven cookery is an ideal method to cook small amounts of vegetables. Because the microwave oven cooks quickly and little water is used, vegetables retain most of their color, flavor, nutrients and texture. Microwave cooking will be discussed thoroughly in the Microwave Cooking chapter.

**Cooking Frozen Vegetables**
Most frozen vegetables have been partially cooked or blanched, so the final cooking time is shorter than for fresh products. If vegetables are frozen in a solid block form like spinach, they should be partially thawed in the refrigerator or broken into pieces before cooking. This will help them cook more evenly.

Steaming is the recommended cooking method to use for frozen vegetables in quantity foodservice preparation. A full size pan (12 x 20 x 2 1/2") will hold three 2 to 4 pounds packages of vegetables. Standardized recipes will give directions on how to cook frozen vegetables.

**Cooking Canned Vegetables**
Canned vegetables are fully cooked when canned and need only heating for service (140-160 F). Overheating results in further loss of nutrients, a soft texture, an unattractive appearance and poor flavored product. The dark green color of canned vegetables is due to the overcooking at high temperature during canning process.

Only enough liquid to cover the bottom of the pan when heating is needed. The liquid from canned vegetables contain water-soluble nutrients and should be used in cooking. The remaining liquid may be used in preparing soups, stocks and sauces. Because this liquid may be high in salt, additional salt may not be necessary when it is used in other products. Vegetables should be drained and seasonings added, if needed, before serving.
Cooking Dried Vegetables

Dried legumes such as navy, lima, pinto and kidney beans must be soaked before cooking to shorten the cooking time and increase the yield. The length of the soaking period depends on the temperature of the water. After soaking dried vegetables, the water often is used in cooking. Dehydrated onion is one of the most common types of dried vegetables used in quantity foodservice operations.

Usually 1 pound of dehydrated onions can be substitute for 8 pounds of fresh onions. To rehydrate the onions, cover them with cool or lukewarm water 1 and 1/2 times the volume of onions and let them stand about 20 to 30 minutes until the water is absorbed. For example, if a recipe requires 1 pound fresh onions, substitute 2 ounces dry onions and cover with 1/2 cup room temperature water.

CONTROLLING QUALITY CHANGES DURING COOKING

High quality preparation of vegetables can be challenging considering the variations of acceptable standards that exist. It is important to choose a preparation method that can maximize the desirable characteristics of vegetables. However, cooks in quantity foodservice operations should undercook vegetables rather than overcook them. This will ensure maximum retention of vitamins while assuring desirable texture. Successful mastery of vegetable cookery is a necessity, if meals high in nutrition with a variety of textures, flavors and colors are to be offered.

An appealing vegetable may be ruined by an incorrect cooking method. However, during the cooking process, the color, texture and flavor may be altered and some of the nutrients may be lost. The quality of cooked vegetables is determined by the amount of changes of texture, color, flavor and nutrient. Overhandling or stirring during cooking also will result in misshapen or broken vegetables.

Effects of Cooking on Texture

The cooking process mainly causes a breakdown of protein, thickening of starch and softening of cellulose in the vegetable structure. These physical changes result in a change in texture with the final effect being determined by the cooking period. The cooking time is determined by the type and amount of vegetables, amount of fiber, the presence of acids, the size of pieces, and the desired degree of doneness. The amount of fiber varies with different types of vegetables and in different stages of maturity. In some vegetables, such as asparagus and broccoli, the amount of fiber even varies between the stem and the bud. Buds of broccoli or asparagus contain less fiber than stems do, so they actually need less cooking time than the stems.

The acidity or alkalinity of the cooking water influences the texture change of vegetables. The texture of vegetables quickly becomes mushy in alkaline water. A small amount of baking soda causes the water to become alkaline and destroys the water-soluble
vitas. Therefore, baking soda is not recommended in vegetable cookery. However, the softening of dried beans can be speeded by adding a maximum of 1/8 teaspoon of baking soda per cup of beans.

On the other hand, acidity of the cooking water causes the opposite result on the texture of cooked vegetables. An acid, such as tomato juice in vegetable soup, slows the breakdown of firm structures during the cooking period. Small pieces of vegetables in vegetable soup can retain their shape even after an hour of cooking.

The degree of doneness also varies with different types of vegetables. Winter squash is considered done when it is quite soft, but most vegetables are cooked until they are tender-crisp. Vegetables at this stage of tenderness are not only more palatable but they retain maximum color, flavor and nutrients. The range of cooking time usually is given in the recipe.

Effects of Cooking on Color

Color is one of major factors considered by clients when consuming vegetables, so cooking methods should be selected to retain their colors by controlling the cooking time, liquid and methods. Usually optimal cooking methods are different with the color pigment that dominates in the different vegetables. If the color is stable during cooking, vegetables can be cooked in a covered pan.

Green. The pigment in green vegetables is chlorophyll. Proper cooking should improve the green color, but overcooking causes green vegetables to turn a dull-olive green. If green vegetables are covered during cooking, they usually turn a dull-olive green because the natural acid of the vegetable cannot evaporate.

Fresh and frozen green vegetables should be cooked rapidly in a small amount of boiling water to retain their green color. Although adding baking soda may produce a bright green color, it will destroy most of the water-soluble vitamins. It also breaks the cell wall and produces a mushy texture.

Steaming is the recommended method of cooking green vegetables in quantity foodservice operations. However, timing must be controlled carefully to achieve optimal color and flavor. Overcooking or holding too long before serving will cause a change from bright green to a dull-green unappealing color.

Many quantity foodservice operations may choose to use compartment steamers in vegetable cookery. The vented, pressureless method is best for preparing green vegetables. Vented, pressureless steamers are preferred for fresh and frozen vegetables because they allow the steaming of vegetables to be done uncovered.

Yellow. The pigment in yellow vegetables is carotinoid, a source of vitamin A. This pigment is very stable in water and heat but unstable in fat. Because yellow or orange carotinoid-containing vegetables are not affected by acidity or alkalinity of the cooking solution, these vegetables can be cooked with or without a lid.
For quantity food production, they can be cooked in a pressure or pressureless compartment steamers. Steam-jacketed kettles also are used.

White. The pigment in white vegetables is anthoxanthin. They stay white in acid but turn yellow in alkaline solutions. White vegetables can retain their color by the addition of a little bit of acid during cooking. They should be cooked in a covered pan to keep their color. Overcooking or holding too long in steamer or tray line may turn the white color to a dull yellow or gray. Steaming for a short period helps maintain color and flavor of white vegetables.

Red. The pigment in red vegetables is anthocyanin. It is stable in acid but changes to blue or purple in an alkaline solution. Therefore, the cooking container with a lid or compartment steaming under pressure is selected to retain the volatile acidic compounds.

In sweet-sour red cabbage, the addition of vinegar enhances the red color. Only a small amount of vinegar should be added right away and the rest after the vegetable is tender. If the full amount of vinegar is added at first, it toughens the cabbage and extends the cooking time.

Hard water can change red vegetables to an unattractive blue or bluish green. Because anthocyanin pigments are placed at the end of the roots and are water soluble, beets should be cooked unpeeled, untrimmed and in an uncovered pan. If roots or more than one inch of the stem is removed, the red color will be lost. For this reason, most quantity foodservice operations use canned beets that have similar quality to fresh ones. The colors change under varying conditions as shown in Table 2.

<table>
<thead>
<tr>
<th>Pigments</th>
<th>color</th>
<th>effect of acid</th>
<th>effect of alkali</th>
<th>water soluble</th>
<th>effect of overheating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyll</td>
<td>green</td>
<td>*olive green</td>
<td>bright green</td>
<td>water</td>
<td>*olive green</td>
</tr>
<tr>
<td>Carotinoid</td>
<td>orange</td>
<td>orange</td>
<td>orange</td>
<td></td>
<td>*yellow</td>
</tr>
<tr>
<td>Anthocyanin</td>
<td>red</td>
<td>red</td>
<td>*blue, green</td>
<td>water</td>
<td></td>
</tr>
<tr>
<td>Anthoxanthin</td>
<td>white</td>
<td>*yellowish</td>
<td>water</td>
<td>*grey yellow</td>
<td></td>
</tr>
</tbody>
</table>

*: undesirable color for vegetable quality
Effects of Cooking on Flavor

Although color plays an important role in acceptance of vegetables, flavor and aroma are key aspects in making vegetables appealing. Aroma of cooked or fresh vegetables adds to the expected flavor of food. Usually most flavor-producing substances are lost or dissolved in the water during the cooking. A longer cooking period will also cause the loss of flavor.

Strong-flavored vegetables such as onions and cabbage have a good color and mild flavor if cooked correctly. The onions family will become milder after cooking. The desirable aroma can be achieved by cooking onions for a moderate length of time.

The cabbage family develops intense flavors with longer cooking time. The longer the cooking time, the greater the production of undesirable flavor. A short cooking time without a lid will increase the palatability of the cabbage family. Cabbage should not be held in the steamer or tray line longer than 20 minutes.

Proper cooking methods will bring out or improve the flavor of mild-flavored vegetables. Even slight overcooking of mild-flavored vegetables does some damage to the flavor.

Other factors believed to influence the effect of cooking on flavors are the hardness of the water and the presence of salt in the cooking medium. The use of hard water in cooking increases the cooking time by hardening the cell structure of mild-flavored vegetables. The addition of salt is important in developing and maintaining good flavor even though it may have an effect on certain nutrients. Both a minimum amount of water and short cooking time helps to maintain flavor and taste of mild-flavored vegetables.

For optimum flavor of cooked vegetables, the foodservice personnel must know (1) whether to use a lid or not, (2) how much water is needed and (3) how long the cooking period should be.

Effects of Cooking on Nutrients

Nutrients in vegetables, especially minerals and vitamins, can be lost easily during cooking. Many vitamins and minerals are water-soluble, some including vitamin C are destroyed in alkaline solution and some are destroyed by either high heat or overcooking. Actually, the methods used to retain good flavor, texture and appearance also tend to be the same way that conserve nutrients.

Many times, a compromise of the cooking methods must occur. Increased amount of water in the cooking process might provide more mildly flavored vegetables, but it increases the risk of loss of water-soluble vitamins. To conserve the nutrients found in vegetables, they should be cooked in their skins or cooked only minimally to the desired degree of doneness. If an antioxidant is used on vegetables, one that will not destroy ascorbic acid, vitamin C, should be chosen. When commercial antioxidant is used, package directions should be followed.

In addition, excessive heating should be avoided to prevent additional losses of vitamins B and C. A balance between the amount of water used and the temperature selected must be
considered to prevent the loss of these important water-soluble vitamins.

GENERAL RULES OF VEGETABLE COOKING

The effect of cooking on various characteristics of vegetables include several general rules:

- Handle vegetables carefully to avoid bruising.
- Cut vegetables in uniform size for even cooking.
- Bring the small amount of water to boil first, when blanching vegetables.
- Cook strong-flavored and green vegetables uncovered.
- Do not use baking soda when cooking vegetables.
- Cook vegetables as close to serving time as possible.
- Cook vegetables in as little amount of water as possible to minimize the nutrients loss.
- Do not overcook vegetables. Cooking time should be short as possible and only cook until they are tender-crisp for best color, flavor, texture and nutritional value.
- Hold cooked vegetables a minimum time, not longer than 20 minutes, before serving.

POTATOES

In large quantity food preparations, potatoes are cooked in a variety of ways. They have excellent keeping qualities if they are stored at room temperature, 60 F. U.S. potatoes may be classified into four groups according to the appearance: Round white, Russet, Round red and Long white. Usually storage ability, solid content, texture and other characteristics of potatoes influence on use and preference. Round white and Round red groups are the waxy type; Russet and Long white groups are the non-waxy type.

The potatoes are divided into two types based on texture: waxy and non-waxy or mealy types. Waxy potatoes are high in sugar and low in starch. These potatoes will hold their shape after cooking and are optimal for stews, soups, pan-fried potatoes or potato salad. Non-waxy or mealy potatoes are high in starch and low in sugar. They are best for French-fries, mashed, baked potatoes and for potato-thickened soup.
Preparation

Potatoes should be selected according to a purchasing guide, (see Table 1) and cleaned thoroughly with water and a brush to remove soil and microorganisms. Discoloration or browning of potatoes may appear while handling or paring them. It is caused by the dehydration of sulfur and an enzyme reaction. After peeling and trimming, potatoes can be covered with clean, cold water to prevent them from turning brown. Commercial antioxidant powder except sulfite type also can be used to prevent browning. Soaking in water will reduce the vitamin C content of potatoes. Surface discoloration usually disappears when the potato is cooked.

Storage

Storage temperatures can change the sugar/starch ratio over a period of time. If the storage temperature is lower than 45 F, the amount of sugar increases and starch decreases. The optimal quality of cooked potatoes will be decreased. An optimal storage place for potatoes is dry and well ventilated at room temperature, about 60 F. To prevent potatoes from turning green, they should be stored in a dark place. Under this condition, they could keep their quality for 1 to 2 weeks. If they are stored in the refrigerator, the humidity could cause mold and spoilage.

The green parts of potatoes contain a bitter tasting, chemical that could be poisonous in sufficient quantity. It is developed when potatoes are exposed to light during storage or handling. Areas of the potato that are sprouting also contain this chemical. If green parts and sprouts develop during storage, they must be cut off before cooking.

Potato Cookery

Baked Potatoes. The baked potato is a genuine American food. It should be fluffy, white and mealy, almost dry in texture.

In large quantity foodservice operations, baked potatoes usually are not wrapped in foil. Foil tends to slow down the cooking process and produces a steamed product. It also adds labor and supply cost.

The optimal baking temperature for potatoes is around 400 F. The holding period should be limited to keep them at their best quality. Long holding periods of baked potatoes will result in a moist and soggy texture, yellowish-gray color, and sour flavor.

Some operations use the microwave oven to solve holding problems. Potatoes are oven-baked until they are three-fourths done and then refrigerated. The final cooking is completed as needed in the microwave oven. However, only 2 to 4 potatoes can be heated at a time.

Mashed Potatoes. Mealy types of potatoes are used for mashed potatoes. Some facilities use dried mashed potatoes to save time and labor costs. To prepare dried mashed potatoes, the instructions on the recipe should be followed. Adding seasonings like salt and white pepper can improve the flavor. The potatoes
should be moist, smooth, and thick enough to hold their shape.

Dried potatoes may be purchased in granules and in flakes. They also are available with or without dried milk solids and seasonings.

**French Fries.** French fries can be prepared in different cuts of potato. Most quantity foodservice operations use frozen products. They are partially cooked and are prepared by deep-fat frying while still frozen. A good French fry is golden brown, cooked through, non-greasy, crisp on the outside, mealy-tender on the inside and hot when served. If it holds poorly, French fries become moist and soggy while the outside is shriveled and dull.

**Duchesse Potatoes.** Duchesse potatoes is a type of mashed potatoes piped through a pastry bag. The mixture is prepared from mashed potatoes with egg yolks added. It can be prepared into different shapes and stored in the cooler for a few days or freezer for weeks before finishing the cooking. A duchesse mixture is also available in an instant form.

Deep-fat fried duchesses potatoes are golden brown and crisp in the outside with a soft yellow-white center. A good breaded duchese potato has a light brown glossy crust top and soft-texture inside. Mashed potatoes, whether plain or duchese, should be smooth, free from lumps, fluffy and mealy. They should have a creamy white color with no hint of gray.

**SUMMARY**

Vegetables add color, shape, texture and nutrients to meals. They are available in fresh, canned, frozen and dried forms. Fresh vegetables are among the best sources of many vitamins and minerals. Vegetables may be classified by the parts of plant, color, flavor or moisture content.

High quality vegetables must be purchased to have high quality products. Several guidelines should be followed when buying preparing and storing vegetables.

Cooking may increase the color and texture, and change flavor and nutritional value. It is important to choose preparation and cooking methods that can maximize the desirable characteristics of vegetables.
UNDERSTANDING FRUITS

Fruits are popular at all meals as well as for snacks. Fruits can be served raw, whole or sliced; or in salads as a dessert or snack. They add contrast in texture, flavor and color. Fruits are an important source of vitamins and minerals. Yellow fruits like peaches, cantaloupe and apricots are excellent sources of vitamin A due to their high level of carotene. Citrus fruits are the main sources of vitamin C in the diet. Usually fruits provide minor amount of calcium. Bananas provide potassium, and dried fruits like raisins are a source of iron. Some raw fruits also are an excellent source of fiber when the peel is eaten.

Structure of Fruits

Structure. Most fruits have a high water content that provides a firm, juicy texture. Carbohydrates also are a main component in fruits. The type of carbohydrate in fruits varies with the maturity of fruit, but the total amount of carbohydrate remains about constant. Starch in immature fruits changes into sugar as they ripen. This can be detected in the sweet flavor of ripened fruits.

Fruits, like vegetables, consist of four parts. Those four parts are: an outer covering, a vascular system, edible parts and supporting parts. Cellulose is found in supporting tissue and edible parts.

Pectic substances, the complex carbohydrates in fruit, help to give fruit its texture. The texture of overripe fruits is mushy due to changes in pectic substances. Enzymes in fruits are responsible for the ripening process including development of sugar and aroma. Enzyme reactions also cause the browning on the cut or peeled surface of fruits.

Pigments. The attractive colors of fruit are due to the pigments they contain. Pigments also are responsible for some color changes as fruit ripen and during cooking.

<table>
<thead>
<tr>
<th>Pigments</th>
<th>Fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyll</td>
<td>Avocados, greengage plums, gooseberries.</td>
</tr>
<tr>
<td>(green)</td>
<td></td>
</tr>
<tr>
<td>Carotinoid</td>
<td>Apricots, muskmelon, oranges, peaches,</td>
</tr>
<tr>
<td>(orange)</td>
<td>pineapples, red grapefruits, watermelon.</td>
</tr>
</tbody>
</table>
Anthocyanin
(red)
Strawberries, blueberries, sweet
cherries, concord grapes.

Anthoxanthin
(white)
White membrane of orange.

These pigments are also found in vegetables and their specific characteristics and interactions with acid and alkaline are discussed in the Vegetable chapter.

Generally, color changes during cooking are not a problem with fruit. When fruits containing anthocyanin such as concord grapes, cherries and black raspberries are combined with an acidic juice like lemon juice, the color of mixture will be acceptable. If a large amount of orange juice is added to red or purple fruit juice, an unappealing brownish color is produced. However, these fruit juices may turn blue if the water is hard or basic. Problems may develop when these fruits are added to quick breads. The alkaline leavening agents reacts with the pigment resulting in a blue or green color.

The pigments in strawberries and cranberries are quite stable and they are used as ingredients when making red colored fruit juice mixtures. Both anthocyanin and anthoxanthin change in the presence of metal ions such as aluminum, iron or tin. Therefore, fruit knives and pans made from aluminum or iron should be avoided.

Classification

Fruits are classified by their shape, structure, type of seed or where they are grown. The classification system helps identify characteristics common to fruits within a class. They are classified according to the following groups:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berries</td>
<td>Strawberries, cranberries, grapes, raspberries, blueberries, currants.</td>
</tr>
<tr>
<td>Citrus fruits</td>
<td>Oranges, limes, lemons, grapefruits, tangerines.</td>
</tr>
<tr>
<td>Drupes (stonefruits)</td>
<td>Cherries, plums, peaches, nectarines, apricots, prunes.</td>
</tr>
<tr>
<td>Melons</td>
<td>Cantaloupes, watermelon, honeydew, casaba.</td>
</tr>
<tr>
<td>Tropical fruits</td>
<td>Avocado, banana, dates, kiwi, pineapples.</td>
</tr>
<tr>
<td>Pomes</td>
<td>Apples, pears.</td>
</tr>
</tbody>
</table>
Fruits are available in fresh, canned, frozen and dried forms. Each of these has advantages. When selecting fruits their use, storage, and nutritional value should be considered.

**Fresh Fruits**

Fresh fruits are graded by the U. S. Department of Agriculture (USDA) and are designated by number or name. The two most common grades used in quantity foodservices are U.S. Fancy and U.S. No 1.

- **U.S. Fancy**: The highest quality available
- **U.S. No.1**: Most commonly available produce

The quality of fresh fruits depends on their maturity and ripeness. Maturity means fruits have reached their full size, and ripeness refers to how ready they are to eat. Fresh fruits are purchased by the weight or count rather than size. However, the size is reflected in the count. The larger the size, the fewer in a case, therefore the lower the count. Medium size tends to be more desirable than the extra large or very small size. Many fresh fruits spoil quickly and must be used shortly after purchase. A purchasing guide for fresh fruits is listed in Table 1.

**Table 1 Purchasing Guide for Fresh Fruits**

<table>
<thead>
<tr>
<th>Food items</th>
<th>What to look for</th>
<th>What to avoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>Firm, crisp, good color for the variety of apple.</td>
<td>Overripe, soft or mealy, bruises.</td>
</tr>
<tr>
<td>Apricot</td>
<td>Uniform, golden color, plump, juicy, barely soft.</td>
<td>Soft or mushy, hard, yellow or green color.</td>
</tr>
<tr>
<td>Avocados</td>
<td>Firm if to be used later, slightly soft for immediate use.</td>
<td>Dark patches, cracked surfaces.</td>
</tr>
<tr>
<td>Bananas</td>
<td>Firm, bright color, free from bruises.</td>
<td>Bruises, discolored skins.</td>
</tr>
<tr>
<td>Blueberries</td>
<td>Dark blue with silver bloom, firm, plump, uniform size.</td>
<td>Soft, spoiled berries; stems &amp; leaves.</td>
</tr>
<tr>
<td>Cantaloupes</td>
<td>Smooth area where stem grew, bold netting, yellowish cast to skin.</td>
<td>Soft rind, bruised, mold.</td>
</tr>
<tr>
<td>Fruit</td>
<td>Description</td>
<td>Condition</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Cherries</td>
<td>Dark color in sweet cherries, bright red in pie cherries, glossy, plump.</td>
<td>Shrivelng, soft, leaking fruit, dull appearance, mold.</td>
</tr>
<tr>
<td>Cranberries</td>
<td>Plump &amp; firm, lustrous red color.</td>
<td>Soft &amp; spongy, leaking.</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>Firm, well-shaped, heavy for size, thin skin (juiciness).</td>
<td>Soft &amp; discolored area; mold.</td>
</tr>
<tr>
<td>Honeydew</td>
<td>Faint odor, yellow to creamy rind, slight softening at blossom end.</td>
<td>Greenish-white rind, hard and smooth skin.</td>
</tr>
<tr>
<td>Lemons</td>
<td>Rich yellow color, firm, heavy.</td>
<td>Hard or shriveling, soft spots, mold, dark yellow.</td>
</tr>
<tr>
<td>Limes</td>
<td>Glossy skin, heavy.</td>
<td>Dry skin, decay.</td>
</tr>
<tr>
<td>Oranges</td>
<td>Firm &amp; heavy; bright, fresh skin either orange or green tint.</td>
<td>Light weight, dull skin, mold.</td>
</tr>
<tr>
<td>Peaches</td>
<td>Slightly soft, yellow color between the red areas.</td>
<td>Very firm, hard; green ground color; very soft; decay.</td>
</tr>
<tr>
<td>Pears</td>
<td>Firm, but beginning to soften; good color for variety(Bartlet, yellow; Anjou or Comice, light green to yellow green; Bosc, greenish yellow with skin russeting; Winter Nellis, medium to light green).</td>
<td>Weakening around the stem, spots, shriveled.</td>
</tr>
<tr>
<td>Pineapples</td>
<td>Good odor, green to yellow color, spike leaves easily removed, heavy for size.</td>
<td>Bruises, poor odor; sunken or slightly pointed pips.</td>
</tr>
<tr>
<td>Plums</td>
<td>Good color for variety, fairly firm.</td>
<td>Hard or shriveled, poor color; leaking.</td>
</tr>
<tr>
<td>Strawberries</td>
<td>Good red color, clean, lustrous, cap stem attached.</td>
<td>Mold, leaking, large seeds.</td>
</tr>
</tbody>
</table>
Processed Fruits

In quantity foodservice operations, canned and frozen fruits often are served to avoid labor and high food costs associated with cleaning, handling, preparing and spoilage of fresh fruit. For example, the individual sectioning of citrus fruits could be too expensive for some facilities. Therefore, a number 10 can or gallon jar of citrus sections could be used. Canned or frozen products will be close to the flavor and quality of fresh fruit.

Care needs to be taken not to buy a larger quantity than can be used when an item is sale-priced. Before deciding on the amount to purchase, consideration must be given to the loss of the product through spoilage, freezer burn or dehydration.

Frozen Fruits. Like fresh fruits, frozen fruits are more nutritious than canned fruits. They may be processed with or without sugar. Grade A or Fancy products are used for freezing fruits. Usually frozen fruit has the same bright color and flavor of fresh fruit. The texture tends to be softer, because the ice crystals break the fruit cell walls during the freezing process.

For some recipes, frozen fruit should be thawed in the refrigerator in the unopened package then used immediately. If only the pieces of frozen fruit are to be used in the recipe, the thawed juice needs to be drained before the fruit is used. Otherwise, there will be too much liquid in the recipe.

When frozen berries and melons are served, they should be portioned, while frozen solid ones served when they are partially thawed. Frozen blueberries are used frozen in baked quick bread.

Canned Fruits. Canned fruit is often used in salad or dessert by itself or as an ingredient. The finest grade, Grade A, canned fruits should be used when they are served alone. U.S. Grade B can be used in making fruit mixtures like fruit pies where perfect and large pieces are not needed. Canned fruits come packed in various liquid and solid forms. If fruits are packed in solid form without added juice, they are called pie pack. Fruit comes with heavy and light syrup and juice pack. Refer to Table 2 for syrup sweetness. Each form is best suited for different recipes.

The following table shows suggested standards for canned fruits.
Table 2 Suggested Standards for canned fruits

<table>
<thead>
<tr>
<th>Grade</th>
<th>Quality of fruit</th>
<th>Syrup</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Grade Fancy or US Grade A</td>
<td>excellent quality, firm, good color, ripe, free from blemish, uniform in size and very symmetrical.</td>
<td>Heavy, about 55% or 40-70%, depending on acidity of fruit.</td>
</tr>
<tr>
<td>US Grade Choice</td>
<td>Fine quality, ripe, firm, free from some blemishes, good color, uniform in size and symmetrical.</td>
<td>About 40%, contains 10-15% less sugar than in Fancy grade.</td>
</tr>
<tr>
<td>US Grade B or Extra standard</td>
<td>Good quality, reasonably free from blemishes, reasonably good color, reasonably uniform in size, color and degree of ripeness and reasonably symmetrical.</td>
<td>About 25%, contains 10-15% less sugar than in Choice Grade.</td>
</tr>
<tr>
<td>US Grade C or Standard</td>
<td>Lower than the minimum grade for Standard.</td>
<td>Often water packed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If packed in syrup, it is not over 10%.</td>
</tr>
</tbody>
</table>

**Dried Fruits.** Dried fruits can be nutritious snacks and also are used for cooking and baking. The most common dried fruits are raisins, prunes, dates, and apricots. Sometimes the drying process makes the products tough. When buying dried fruit, look for good color and soft texture.

**Fruit Juices.** Only 100 percent fruit juices can be labeled fruit juice. If they are mixed with other liquids, such as water, they are labeled fruit drink. Fruit juices are available in frozen, canned, or dehydrated crystals.

One of the most popular fruit juices is orange juice and all market forms of orange juice contain about the same amount of vitamin C. Once canned juice is opened, the remaining portion should be covered or transferred to nonmetal containers and stored in the refrigerator. It is covered to prevent the air from destroying the vitamin C content.

Grape, apple, prune, pineapple, and cranberry juices and apricot nectar contain little or no vitamin C. For this reason, unless they are fortified they cannot be substituted for citrus juice as a source of the vitamin C.
Fresh Fruits

Fruits often are produced far from the markets where they will be purchased by consumers, so they usually are picked when they are still unripened. The damage that may occur during shipping also is reduced when fruit is unripened. Bananas and avocados are harvested when they are still firm, and green. They will continue to ripen during shipping and storing. These fruits should be stored at room temperature until they are ripe. Other fruits should be refrigerated to maintain flavor and firmness. Apples are a fruit that can be stored for a long time. Except for citrus and apples, most fruits should be used within a few days.

The keeping quality will depend on how fresh they were when they were purchased, how they were handled and the storage conditions. The following chart gives guidelines for storing fresh fruits.

<table>
<thead>
<tr>
<th>Fruits</th>
<th>Storage conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underripe fruits</td>
<td>Allow to stand at room temperature to ripen. If desired, put fruits in brown paper bag for fast ripening.</td>
</tr>
<tr>
<td>Bananas</td>
<td>Ripen at room temperature. Can refrigerate after ripening.</td>
</tr>
<tr>
<td>Citrus fruits</td>
<td>Can store at room temperature. Refrigerate for longer storage.</td>
</tr>
<tr>
<td>Melon, pineapple</td>
<td>Refrigerate. Wrap in food film to keep aroma from flavoring other foods.</td>
</tr>
<tr>
<td>Berries, cherries, grapes</td>
<td>Sort to remove damaged and decayed ones. Refrigerate in a plastic bag or shallow container covered. Use as soon as possible. Wash just before serving.</td>
</tr>
<tr>
<td>Cut fruits</td>
<td>Refrigerate in a container, covered. To avoid browning, sprinkle with citrus juice before storing.</td>
</tr>
<tr>
<td>All other ripe fruits</td>
<td>Wash before storing. Dry well. Refrigerate loosely wrapped.</td>
</tr>
</tbody>
</table>
Processed Fruits

Canned Fruits. Although processed fruits are more stable than fresh, canned fruit should be stored in a cool, dry area that is no warmer than 70 F. Often, the color, flavor and texture of canned fruit is changed, if it is stored in a very warm place or held longer than a year. Because it is not recommended to store either canned or frozen fruit for longer than one year, care should be taken to date and rotate stock when it arrives.

Opened canned fruit should not be stored in its original container. Any unused fruit should be transferred to an National Sanitation Foundation (NFS) approved container and refrigerated, 36 to 40 F.

Dried Fruits. Dried fruits are a stable form of fruit if held in a cool, dry environment. Although they can be kept for six months or longer, refrigeration may be necessary during hot, humid summer months. Due to this limited shelf life, it is necessary that management and storeroom personnel do not over order or have too much on hand.

If dried fruits such as apples, apricots, peaches and pears are stored properly, they can retain their bright colors. The concentration of sugars in dried fruits is high, so humid air should be avoided in the storage area. Otherwise, sugar will be crystallized on the surface, and turn a dull, unappetizing appearance.

PREPARATION

In order to maximize the nutrients found in fruits, quantity foodservice operations should choose preparation methods that will retain texture, color, flavor and nutrients. To retain their best quality, preparation should be scheduled as near the time of service as possible. Overhandling also causes bruises and may cause the fruit to spoil. Therefore, minimum handling is recommended.

Fresh Fruits

Washing. All fruits should be washed to remove surface soil, sprays and preservatives before serving or cooking. Usually apricots, cherries, grapes, pears and plums are washed in a colander under cold running water. Some fruits such as apples, pears and plums may be washed and dried before being refrigerated. Their smooth skins can protect their flesh from bruising or spoilage by washing.

Berries deteriorate rapidly, so washing should be done right before service. They need to be handled gently during preparation. Stems of strawberries should be removed after washing. If stems are removed before washing, the rate of vitamin C loss and bruising
will be increased. After washing, they should be drained thoroughly and refrigerated.

Citrus fruits can be served in three ways: prepared in sections, cut in half horizontally or perpendicularly. A sharp, stainless knife should be used in peeling or sectioning. To peel and serve citrus fruits in section:
1. Cut off a thick slice at the top and bottom and place the fruit on a cutting board.
2. Cut skin from the top to bottom deep enough to remove all white membrane.
3. Cut a section free of its membrane on one side.
4. Turn the knife and force the blade along the membrane of the next section so that the section falls out.
5. Continue sectioning.

When a citrus fruit is cut in half, the sections should be loosened with a knife. To cut a citrus fruit perpendicularly, peel then slice perpendicularly to center core.

When serving fruits, care should be taken to preserve the nutritive values and physical appearances. Pieces of fresh fruits should be large enough to be identified. They are more attractive and retain nutrient value better than a finely chopped product. When fruits are strained or mashed, the loss of vitamin C will be increased.

Processed Fruits
Cleaning is the first step in dried fruit preparation. Dirt should be removed by washing. After washing dried fruits, they are soaked in water to absorb some of the moisture lost during drying. Soaking too long in cold water will give a poor, watery flavor rather than improved quality. To soften dried fruit, it may be boiled for a short time or soaked in hot water a short time and then simmered. The amount of soaking time depends on the size of the pieces of fruit and the amount of cut surface exposed.

Due to the high sugar content of dried fruits, additional sugar is not necessary. If sugar is needed, only a small amount should be added at the end of the cooking period. If added early in the cooking period, sugar will prevent the fruit from softening.

To prepare dried fruits properly, the instructions on the package should be followed. If dried fruit is properly cooked, it will be tender, plump, a good flavor and the flesh will separate easily from the pit.

CONTROLLING QUALITY CHANGE

Many fruits like bananas, apples, peaches and pears darken rapidly when cut as a result of the oxidizing action of the enzymes when they come in contact with the air. This is called browning. Since this change in color is the result of contact with air, cut surface of the fruit must be protected from the air. Using fruit juice or a small amount of sugar can help prevent browning of
fruits. The sugar draws water from the fruit to the surface. A sugar solution forms and that blocks the air. The vitamin C in fruit juice interacts with the oxygen to protect the natural color of the exposed fruit surfaces. The juice also coats the fruit and keeps the air out.

Antioxidant powders are sold to prevent the oxidizing action. Sulfite types of products should not be used because they can cause severe allergic reactions. Ascorbic acid products are acceptable for nursing facilities. Package directions should be followed carefully. Overuse will cause the fruit to be too soft, underuse will not prevent browning.

If fresh fruits are not consumed immediately, they can be cooked or frozen. Freezing stops enzyme activity, while cooking destroys enzymes all together. Bananas can be peeled and frozen for future use in baking.

COOKING METHODS

Many fruits can be steamed, simmered or poached. Fruits should be cooked for a short time at a low temperature so they retain their flavor and color. Usually firm or slightly underripe fruits are cooked by steaming, simmering, baking, or broiling. Whenever a fruit is poached, covered with liquid and heated just below the boiling point, the fruit is softened and enzymatic browning stops. Flavors can be preserved by limiting the amount of water used, by controlling heat, and by covering fruit throughout the cooking process.

Just enough sugar needs to be added to the fruit to prevent it from absorbing water. Without this sugar, buildup of water in the cells would cause them to break resulting in a product that is very soft or mushy. In the preparation of sauces and pureed fruits, this is desired. For sauces, sugar is added at the end of cooking to sweeten the product yet still allow the fruit cells to break producing the desired pureed texture.

Glazing is a cooking method in which water and sugar are combined to form a sugar syrup. If fruits are cooked in syrup, they will retain their shape.

Simmering. Dried fruits are often simmered to rehydrate and tenderize them. Dried fruits need to be soaked before simmering. Because some of the sugar and water soluble nutrients are dissolved in the water during soaking, the water can be used in cooking. Dried fruits usually are simmered until they can be cut easily.

Baking. Fruits like apples and pears can be baked without the removal of their skins. However, to avoid breaking of the skin from built up steam pressure inside the fruit, it is necessary to partially peel or make a thin cut into the peel around the center of the fruit allowing for the expansion and release of moisture. Perhaps the most popular baked fruits are apples. Usually
they are baked with the skin on and the cores removed. The core cavity is often filled with sugar, cinnamon and butter or margarine. Apples vary in cooking quality from one variety to another. The best uses for each variety are listed in Table 3. The following table shows the description and use of different apples:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Description</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden delicious apple</td>
<td>Whitish-golden, tender skin, delicious flavor.</td>
<td>Raw, cooking, baking.</td>
</tr>
<tr>
<td>Jonathan apple</td>
<td>Rich red with tiny white spots, tart flavor.</td>
<td>Raw, cooking, baking.</td>
</tr>
<tr>
<td>Rome beauty apple</td>
<td>Bright red, juicy, mild acidic flavor.</td>
<td>Cooking, baking.</td>
</tr>
<tr>
<td>Red delicious apple</td>
<td>Elongated shape, 5 knoblike points on bottom, deep red, sweet.</td>
<td>Raw.</td>
</tr>
</tbody>
</table>

Fruits also are used in other baked products. Berries, dates, prunes and figs add flavor to muffins. Typically, apples, cherries, peaches and blueberries are made into pies, crisps and cobblers with a sweetened and thickened filling. Most quantity foodservice operations use canned or frozen fruit for pies rather than using fresh fruit. Fruits come packed in various liquid and solid forms. If fruits are packed in solid form without added juice, they are called pie pack. Fruit comes with heavy and light syrup and juice pack. Refer to Table 2 for syrup sweeteners. Each form is best suited for different recipes.

Production time would be reduced, and the employee skill level needed would be much lower and less costly assuming more is paid for pie-making skills. It also could be less costly simply because less labor is required.

**Broiling.** Grapefruit, bananas, peaches and pineapple easily lend themselves to broiling. However, it is important the broiling be only for a brief period to avoid dehydration and over browning of the fruit. Broiled fruits are an excellent low-sugar-low-calorie alternative to pastry desserts.
Microwave Oven Cookery. Small amounts of fruit can be cooked in the microwave oven. Cooking time should be carefully controlled to get an optimal product with good texture. Cover the fruit during cooking for a more even heat distribution. Follow the specific microwave cooking procedures in the recipe. More information on microwave cooking can be found in the Microwave cooking chapter of this study course.

SUMMARY

Fruits are an important source of vitamins and minerals. They may be classified by their shape, structure, type of seed or where they are grown. Fruits are available in frozen, canned and dried forms. Many fresh fruits spoil quickly and must be used shortly after purchase.

Fruit should be stored properly to retain their color, flavor, texture and nutrients. Once canned fruits or canned juices are opened, any leftovers should be covered and refrigerated to retain the vitamin C level.

The preparation methods for fruits should be selected to retain their texture, color and nutrients. Usually overhandling causes bruises and spoilage. Color changes during cooking are not a problem in fruit cookery. Processed fruits can save cooking time and labor.
Salads add variety to any meal by the colors and textures of the individual ingredients. As a separate course or accompaniment to the entree, salads can contain ingredients from all of the basic four food groups. Salads are a good source of vitamins A and C and minerals.

Role of Salad in the Menu

Americans usually prefer the salad at the beginning of the meal, as an accompaniment to the entree, or as the entree. Salads will vary in size and contents according to their role in the meal and are classified according to their course in the menu. A small, light salad served at the beginning of a meal is an appetizer. An entree salad contains a hearty, protein food and is popular at lunch. An accompaniment salad is a light and refreshing side dish served with or before the entree. Usually this is larger than an appetizer salad, but is not as large or hearty as an entree salad.

Standards for Salad

There are standards for planning all types of salads. These standards are guides for the appearance, color, flavor, texture, temperature and how well the salad goes with the rest of the meal. A salad should be colorful and fresh looking. The ingredients should be arranged simply over the right size plate. Each ingredient should be identifiable. The texture and flavor of the salad should combine well with and enhance the rest of the meal. The zesty and pleasant flavor may come from the ingredients or the salad dressing. A salad should have ingredients that are crunchy or crispy. A well combined, variety of textures will create an appetizing salad.

Salad preparation and style of service can take a lot of labor. As a result, foodservice managers should plan salad menus to balance with the workload requirements of the rest of the menu.

Parts of Salad

There are four parts to a salad. These include:

Base (Liner). A leaf of lettuce, endive or cabbage on which the other ingredients are placed, provides a contrasting color or texture, helps hold salad in center of plate or bowl.
(Ex) Leaf, romaine, head, and boston lettuce; red or green cabbage (See Figure 1).

(Figure 1) Liner

Body. Main part of the salad, includes the ingredients that are the salad.
(Ex) Vegetables, fruits, poultry, fish, meat, cheese, ham.
Salad dressing. Usually a combination of oil and vinegar or mayonnaise with a variety of seasonings, provides flavor that goes well with the body of salad, can be spooned over the salad, served separately, or mixed with the salad body before serving. (Ex) French dressing, Italian dressing, mayonnaise, low calorie dressings.

Garnish. Provides color and texture contrast, should be simple and not overpower the salad. (Ex) Sliced tomato, parsley, carrot curls, olive, croutons.

TYPES OF SALADS

The basic types of salads are fruit and vegetable salads, protein salads, gelatin salads and cooked salads.

Fruit Salads

Fruit salads may be served as the entree at a luncheon, as an accompaniment to the main course or as a dessert. Fruits for salads may be fresh, canned or dried. Usually frozen fruits are used only in gelatin salads, because they become mushy when defrosted.

Fresh Fruits. Ripe fresh fruits can make colorful, attractive and popular salads. Large fruits may be served in slices, cubes, or attractive pieces. Melons are usually cut in wedges, cubes or balls. Cutting fruit should improve its appearance and natural shape. Fresh fruit that is cut into very small or odd-shaped pieces may lose its appeal. Pits should be removed from fruit before it is used for salad, especially in nursing facilities.

Canned Fruits. Canned fruits are frequently used in gelatin salads, because they require no special preparation other than draining and chilling. Peaches, pineapple, pears and mandarin oranges are popular in salad. The best quality canned fruits should be used.

Dried Fruits. Dried fruits also are used in some salads. Stewed dried fruit can be whipped with gelatin and cream to form a sweet fruit whip. Dried prunes, peaches, pineapples and apricots also can be used as garnishes.

The use of fresh and processed fruits is discussed thoroughly in the Fruit chapter. Refer to that chapter for additional information.
Vegetable Salads

Any vegetables; raw, cooked, frozen or canned; can be used in making salads. Raw vegetables provide vivid color, texture and flavor for salads. The many styles of cutting vegetables improve the appearance of vegetable salads. Julienne, sliced, diced and grated vegetables add visual interest. The wide range of color; the yellow of corn; the creamy white of cauliflower; the deep red of tomato and the variety of different green vegetables; creates an appealing salad.

Vegetable salads are good sources of nutrients and fiber and are quite low in calories. Mixed green salads provide a useful amount of fiber and vitamins.

How ingredients are combined is important in preparing vegetable salad. For example, a green bean salad needs the crunchy texture from diced celery; white cole slaw will become a more colorful dish by adding grated carrots, diced green pepper or pineapple tidbits.

Molded Salads

Gelatin salads are another popular salad. They are fairly easy to prepare and add a variety of color and texture to the menu. Although the gelatin contains animal protein, it is in such small amounts that it cannot be considered as a source of protein. Gelatin salads are usually evaluated nutritionally for the sugar content of the gelatin, and the content of ingredients molded into the salad. All types of gelatin can be used for salads: unflavored, sweetened flavored, and sugar free flavored.

Protein Salads

When meat, fish or poultry is used in the body of salad, it becomes a hearty entree. These protein foods can be used alone or in combination with vegetables or fruits. They are usually served on a green liner. If protein salads are served as an entree, they need to include adequate protein and enough other ingredients to be the main course.

Of the meats, ham is one of the most popular for salads because of its smokey flavor and texture. Chicken and turkey are popular for salads due to their delicate flavor and color. Seafood salads are an expensive source of protein. Shrimp, salmon and crab are popular for seafood salads, while tuna is a less expensive, popular salad ingredient. Other foods used in protein salads are cheese, eggs and beans. Aged cheese or cottage cheese add flavor and texture.

The yellow color of hard cooked egg yolk is very attractive in salads. For example, chopped eggs add color and flavor to potato salad; sliced eggs can brighten tuna salad; and stuffed eggs can be a main body of salad.
SALAD PREPARATION

The main rule for salad preparation is to keep the salad ingredients cold. All ingredients, including salad dressings, should be chilled before the salad is made.

Because many salad vegetables are not cooked, sanitary conditions are very important. Employees should use disposable plastic gloves or utensils when handling any vegetable after it has been cleaned initially. After the vegetables have been cleaned they should be allowed to drain. Vegetable cleaning methods are explained thoroughly in the Vegetable chapter.

Greens
Head and leaf lettuce should be washed completely and placed on a rack for draining. Excess water can be removed easily with the use of a vegetable spinner. The lettuce is put into the container. The spinning motion causes the centrifugal force to remove droplets of water, similar to the spin cycle of a washing machine. Over spinning remove too much water and will dehydrate the lettuce and cause it to wilt. The vegetable spinners come in two sizes; smaller manual types will do one head, while larger mechanical size will hold one or more cases.

Greens should not be stored in containers that are too small and crush them. A tightly sealed container or plastic bag creates a vaccum that allows the greens to absorb part of its normal water that is lost when dehydrated. If the lettuce takes up the water it has lost, the process called rehydration, it becomes more crisp and firm. Complete exposure to the open air during storage will cause the vegetables to dry out and wilt.

To have the best appearance and longest shelf life, salad greens should be torn by hand. However, because this may not be practical in a quantity foodservice operation, many employees use sharp stainless-steel knives or a high-speed chopper to cut salad greens. It is important to remember that the more surface area that has been cut and the greater the exposure to air, the faster the product will wilt and turn brown from loss of water.

Molded Salads
Most quantity recipes specify that boiling water is added to the gelatin in a steam-jacketed kettle. If unflavored gelatin is used, the gelatin should first be rehydrated by soaking it in cold water then heating in boiling water. After the gelatin has been dissolved by adding a small amount of boiling water and stirring gently, the remainder of the cold or even frozen liquid can be added. Ice speeds up the cooling of the gelatin and helps to set up the gelatin structure. However, gelatin cooled by this method, adds extra water into the gel causing the firm gel to melt more quickly. Adding cold water or ice usually is done by slow stirring to ensure the gelatin is free of any thickened lumps.

Most vegetables and fruits can be added to the gelatin, once it is the thickness of unbeaten egg whites. This helps to evenly
distribute the fruits or vegetables, and it also prevents the ingredients from floating to the top of the pan.

Addition of a large amount of vegetables, fruits or other foods weakens the gel. This happens because there is not enough gelatin to suspend the food in the gelatin, and the produce adds moisture to the gelatin mixture. A small amount of acid speeds up the gelling. However, the addition of a very acid liquid interferes with the gelatin absorbing water, so more gelatin is needed. The addition of sugar causes the gelatin to be softer.

Uncooked, frozen, or fresh pineapple will prevent gelling as the result of bromelin, an enzyme. Papaya and kiwi will have an effect similar to pineapple. For this reason, these fresh products should not be used in making molded salads.

The addition of extra amounts of fruit juice will weaken the gelatin structure. Therefore, fruit juices must be considered as part of the total liquid called for in the recipe.

To keep the fruit distributed as uniformly as possible for serving, the gelatin is molded in layers. First the fruit is set in position in a thin lay of gelatin. After chilling, another layer is added to immerse the fruit in the gelatin. Fruits such as bananas require this additional layer of gelatin to keep them from turning brown. An important factor to remember with gelatin preparation is that the gelatin crystals must be completely dissolved in the solution. If not, a rubbery layer of gelatin will form at the bottom of the pan. If the gelatin granules are not dissolved completely, the final product will have undissolved gelatin, the consistency of tapioca.

If an error is made in dissolving the gelatin granules or in the addition of fruits, vegetables, or liquid; the gelatin can be slowly warmed and returned to a liquid state. After correcting the problem, the gelatin can be refrigerated and returned to the gelled state.

Protein Salads

Because protein foods can be contaminated easily, proper care is needed in preparation. The cutting board should be sanitized before and after use. The ingredients should be chilled before and after preparation. They should be kept cold until serving time.

Most cheeses require refrigeration and are combined with vegetables or fruits. Cheese can be diced or cubed for salads. Eggs also are very perishable and must be kept under refrigeration before and after cooking. Usually large size eggs are used for sliced or stuffed eggs. On the other hand, medium size eggs can be used for chopping. Only top quality fresh eggs are suitable for salad making. To prepare hard boiled eggs: Eggs are placed in boiling water for 18 to 20 minutes and cooled immediately in ice cold water. Over cooking and failure to cool immediately will cause a greenish ring around the yolk, and the white will become tough. Further information on egg cooking is explained in the Egg chapter of the study course.
Tools used in Salads Preparation

Proper tools can save time and energy in making salad. A sharp stainless-steel knife or stainless french knife, and cutting board are used to chop or slice salad ingredients such as fruits, vegetables and meats. An egg slicer is another useful tool in salad preparation. Measuring equipment including scoops and ladles are convenient in portion control of salad dressings. The mixing bowl and serving plates should be chilled.

SERVING SALADS

Salads are appealing when they are served with some attention to detail. For instance, a cold salad should be chilled before serving, all the ingredients should be arranged attractively on the plate, and the proper amount of dressing should be added right before serving.

Dippers and ladles are helpful for in portion control of salads. To obtain uniformity, portion control, and cost control, it is necessary to standardize the amounts of ingredients. Guidelines to follow in portion control are to determine the:

- Number of portions to be made from large fruits or vegetables, as number of wedges from a tomato.

- Number of pieces per serving for items such as slices of hard cooked eggs, tomato slices, carrot sticks or green pepper rings.

- Size of dipper or ladle to measure salad mixtures such as potato salad, tuna fish salad, cottage cheese or potato salad.

- Number of portions to be cut per pan of molded salad.

- Standards used for salads in the preparation area showing. Showing a picture of the way the salad should look on the plate helps ensure all salads are alike and the portions are controlled (See Figure 2).

(Figure 2) Salad recipe with picture

In quantity foodservice operations, salad dressings are available in portion control packets or can be served by using proper portion control utensils.

Gelatin salad should be unmolded carefully before serving. Often a food release product is lightly sprayed in the individual molds to help unmold the salad. Most gelatins can be removed from the mold by dipping the bottom half of the mold into warm water. The mold should not remain in the warm water longer than it takes to loosen the gelatin. Gentle shaking of the mold and turning its upside down will help free the gelatin. A plastic gloved hand is
used to catch the gelatin as it comes out of the mold. A leaf lettuce base can prevent the gelatin from sliding off the plate while also hiding any melted product. After the gelatin has been removed from the mold, it is returned to refrigeration to stop further softening, this allows the gelatin salad to become firm again.

GARNISHES

Garnishes also can be a part of salad. Well planned salads usually require little, if any, garnishing. The color of the ingredients generally provides sufficient contrast. If garnishes are used, they should be selected to provide contrasts in color and texture and complement the other foods served. Suggested garnishes for salads are in Figure 3:

Figure 3 Garnish Ideas for Salad

<table>
<thead>
<tr>
<th>Vegetable Garnishes:</th>
<th>Shredded carrots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sliced or fluted cucumber</td>
<td></td>
</tr>
<tr>
<td>Cherry tomatoes or tomato wedge</td>
<td></td>
</tr>
<tr>
<td>Green or red pepper, or red onion rings</td>
<td></td>
</tr>
<tr>
<td>Diced green pepper</td>
<td></td>
</tr>
<tr>
<td>Ripe, green or stuffed olive</td>
<td></td>
</tr>
<tr>
<td>Radish rose or slices</td>
<td></td>
</tr>
<tr>
<td>Marinated onion slices or tomato wedges</td>
<td></td>
</tr>
<tr>
<td>Tiny new onions or pickles</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruit Garnishes:</th>
<th>Fresh or frozen blueberries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiwi or star fruit slices</td>
<td></td>
</tr>
<tr>
<td>Dark sweet cherries</td>
<td></td>
</tr>
<tr>
<td>Whole or stuffed prunes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Garnishes:</th>
<th>Shredded or grated cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sliced or chopped hard cooked eggs</td>
<td></td>
</tr>
<tr>
<td>Bacon chips</td>
<td></td>
</tr>
<tr>
<td>Toasted or plain croutons</td>
<td></td>
</tr>
<tr>
<td>Toasted chopped nuts</td>
<td></td>
</tr>
<tr>
<td>Sunflower seeds</td>
<td></td>
</tr>
<tr>
<td>Whole or stuffed dates</td>
<td></td>
</tr>
</tbody>
</table>

SALAD DRESSINGS

Salad dressing may be served with all types of salads to add flavor and taste. Although there are no specific guidelines in which dressing to use for a certain type of salad, the dressing
should complement and blend with the other flavors in the salad. Dressings should be thin enough to mix with the salad ingredients easily, yet not too runny to drain rapidly to the bottom of the salad. Salad dressings should not be used in an excessive amount, but should lightly coat salad ingredients rather than smother them.

The flavor of salad dressings varies with the ingredients. Oil is the main ingredient in most salad dressings. The oils used in making salad dressings are peanut, cotton seed, corn, soybean and olive oil. Because most of the calories of salads are in the salad dressing, the calories can be controlled easily by portioning salad dressings. Low calorie dressings also are used to limit calories.

The flavor of salad dressing can be spoiled and become strong when it is stored in warm place. All salad dressings should be stored in the refrigerator, once the container has been opened. Even cooked dressings will spoil easily because they contain eggs.

**Types of Salad Dressings**

Salad dressing often consists of an oil, an acidic liquid and seasonings. They are an emulsion, a suspension of droplets of oil in a liquid, that can be done by a food processor, blender or a mixer on high speed. They can be temporary emulsions that have to be shaken before use, semi-permanent that remain in emulsion for a few days, or permanent emulsions. An emulsifying agent; such as dry seasonings, egg yolk or gelatin works as a binder to hold droplets of oil in suspension.

**Temporary Emulsion**

French, Italian and vinegar and oil dressings are examples of temporary emulsions. This type of salad dressing is prepared by shaking the oil and acid with dry ingredients each time it is used. Oil is broken into small droplets by shaking, but the droplets are not small enough to stay in the acid. The ingredients separate quickly and form an oil layer when allowed to stand. Dry seasoning ingredients in French dressing work as an emulsifying agent to keep oil droplets.

**Semipermanent Emulsion**

A semipermanent emulsion is unstable and remains in emulsion for a few days. A thick liquid ingredient such as honey, a cooked sugar syrup, or a starch-thickened sauce is the emulsifying agent. Emulsifying agents are used to increase thickness and stability. Sweet dressings, for fruit salads, and herb dressings are included in this group. When these dressings separate, they can be recombined again by stirring, whipping or shaking.

**Permanent Emulsion**

Mayonnaise is an example of a permanent oil-in-water emulsion. Mayonnaise can be easily prepared by mixing together the seasonings, egg yolk and vinegar. Egg yolk is used as an effective emulsifying agent by forming a thin coat around the oil droplets.
Oil is added drop by drop while mixing to start forming the emulsion. Ingredient proportions for mayonnaise are one pasteurized egg yolk, 1/8 cup of vinegar or lemon juice, and one cup of oil. If too much oil is added at any time, the emulsion will break apart and start to curdle. Permanent emulsions can be broken by adding too much oil, adding the oil too fast, freezing or heating.

Preparing mayonnaise is a good way to use commodity oil, if it is available in large operations. Because the eggs in mayonnaise recipe are not cooked, only pasteurized eggs should be used. Commercial mayonnaise will be thicker, more stable, and have a longer shelf life than the product prepared in the facility. Purchased mayonnaise includes the use of emulsifying agents and also may be homogenized. Homogenization means that there is a fine division of fat particles so that they remain in suspension and are not separated. For example, in homogenized milk, the cream does not rise to the top.

**Cooked Salad Dressing**

Cooked salad dressing consists of a cooked white sauce and egg base, vinegar and butter. It is fluffy and creamy with a tart flavor. Sweet cooked dressings are used for fruit toppings.

**Selecting Salad Dressings**

Selection of dressing for salad is important to have the best flavor and to go well with main ingredients. General suggestions in selecting the dressing are:

- Salads with a strong flavored body need a mild flavored dressing. (Ex) Tuna fish salad with mayonnaise.

- Salads with a mild flavored body need a highly seasoned dressing. (Ex) Lettuce salad needs a strong, sharp flavor.

- Sweet salads need a sweet dressing. (Ex) Fruit salad is good with a sweet, honey and lime juice.

- The color and appearance of the dressing should make the salad more attractive. (Ex) Mixed green salad is good with red french dressing.
SUMMARY

Salads add variety, texture, color and refreshing flavor to meals. High quality ingredients, and proper methods for preparing, storing and serving need to be considered. The four basic parts of salad are the base or liner, the body, the dressing and the garnish. Salad ingredients may include almost any raw, cooked, canned, or frozen vegetables and fruits as well as protein foods.

Salad dressing is an oil-in-water emulsion. The dressing should complement and blend with the other flavors in the salad. It should lightly coat salad ingredients.
MEATS, POULTRY, FISH, AND ENTREES

Meats, poultry and fish are major sources of protein. Meat also contains large amount of iron and several B vitamins. Poultry is a good source of the B vitamin, niacin, while fish is an important source of vitamin D. Some beans, primarily legumes; corn, rice, cheese, milk, and eggs also provide protein and are the major sources of it in vegetarian diets.

The main entree for each meal is usually a meat product, the remainder of the meal is planned to compliment the meat dish. Meat is usually the most costly item served for each meal. It is very important that an acceptable and popular meat entree is offered. Standardized recipes should be used to ensure portion control is maintained and cooking losses are as low as possible.

Meats are composed of muscle, connective tissue, fat, and bone. The muscle portion of most meats is composed of 75% water and 20% protein. The remaining 5% is a combination of carbohydrate, fat, vitamins, and minerals. The ability of meat to hold water and contain fat affects its juiciness. The water content of meat varies according to the type of muscle and time of the year the meat is purchased.

Collagen, an important protein found in meat, forms the basic structure of connective tissue. Collagen, often referred to as the white connective tissue, is the structure that is broken down by the application of heat, especially moist heat. The more breakdown, the more tender the final product.

Elastin, another connective protein, is found in concentrated deposits appearing as a yellow, rubbery mass. It often is referred to as gristle and is changed very little by the cooking method.

Tenderness of the cooked meat has a direct relationship to the amount of connective tissue the cut of meat contains. For example, the loin strip near the back bone in beef cattle is used as a supportive muscle and has little body movement resulting in muscle cells that contain very little connective tissue. However, muscles in the front part of the leg and shoulder have more connective tissue and are less tender.

Fat, found between and within the muscles of all meat, contributes to the meat’s juiciness and flavor. The fat content within the lean tissue is critical in the grading of meat. Marbling, the fat dispersed throughout the meat muscle, is desirable in beef; but is not desirable in cuts of pork. Not only is it difficult to remove, but it also gives the cooked pork a greasy taste.

It is important to select a cooking method that will maximize the tenderness of the meat while retaining nutrients. Cooking temperature and time have an effect on the amount of shrinkage and loss of vitamins and minerals in cooked meat. Protein, when subjected to 185 F or above, coagulates and continues to shrink until the meat has finished cooking. If the temperature is increased, the protein will continue to contract until all the moisture is squeezed out, leaving a very dry, tough product. This excessive reduction of liquid from the muscle cells also causes essential fats, minerals, and vitamins to be lost.
The weight loss that occurs during cooking affects the yield percentage of the meat. Figure 1 lists how a yield percentage is calculated for an 8 lb 8 oz beef roast.

**Figure 1. Calculation of yield**

<table>
<thead>
<tr>
<th>Breakdown</th>
<th>Weight</th>
<th>% of Total Purchase Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Weight</td>
<td>8 8</td>
<td>100.0%</td>
</tr>
<tr>
<td>Loss in Trimming</td>
<td>2 0</td>
<td>23.5%</td>
</tr>
<tr>
<td>Trimmed Weight</td>
<td>6 8</td>
<td>76.5%</td>
</tr>
<tr>
<td>Cooked Weight</td>
<td>5 8</td>
<td>64.7%</td>
</tr>
<tr>
<td>Loss in Cooking</td>
<td>1 0</td>
<td>11.8%</td>
</tr>
<tr>
<td>Loss after Cooking</td>
<td>1 8</td>
<td>17.6%</td>
</tr>
<tr>
<td>(bone and fat)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usable Weight</td>
<td>4 0</td>
<td>47.1% Yield %</td>
</tr>
</tbody>
</table>

The yield percentage of 47.1% helps to determine the amount of meat needed. This yield percentage takes into consideration both the losses that occur before cooking and after cooking. This yield percentage will also assist in determining the amount of meat to purchase using the following formula:

\[
\text{Amount to Order} = \frac{\text{Number of Portions} \times \text{Portion Size}}{\text{Yield Percentage} / 100}
\]

Although cooking causes shrinkage and weight loss in meat, it produces many desirable changes. Some of these changes are listed below:

Meat is cooked to:

- Change the appearance for eye appeal
- Kill any surface microorganisms
- Soften the tissue
- Develop flavor
Inspecting

Inspection of meat must be done by United States Department of Agriculture (USDA) inspectors. The round inspection stamp bears the number of the inspector and states: U.S. Inspected and Passed. This shows the meat carcass was safe for consumption at the time of the inspection. Meats produced and sold within the same state do not require this federal inspection. However, quantity foodservices must buy only meat inspected and passed to ensure wholesomeness for human consumption.

Grading

Grading is required whether the meat is shipped between states or sold within the state in which it is produced and processed. Conformation; the shape, form and outline of the animal; quality and cutability are the three major factors considered in judging and grading of meat.

Figure 2. Factors Affecting Meat Grades

Conformation: Shape and form of the whole animal

Quality: Characteristics related to the palatability of the lean portion of the meat. It is affected by color, texture, and firmness of the lean. It is also related to the maturity of the carcass and the marbling of the fat within the lean.

Cutability: The amount of usable meat contained in the carcass.

Figure 3. USDA Grades for Beef, Veal, Pork, and Lamb

<table>
<thead>
<tr>
<th></th>
<th>Beef</th>
<th>Veal</th>
<th>Pork</th>
<th>Lamb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>Prime</td>
<td>U.S. #1</td>
<td>Prime</td>
<td></td>
</tr>
<tr>
<td>Choice</td>
<td>Choice</td>
<td>U.S. #2</td>
<td>Choice</td>
<td></td>
</tr>
<tr>
<td>Select</td>
<td>Good</td>
<td>U.S. #3</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Standard</td>
<td>U.S. #4</td>
<td>Utility</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>Utility</td>
<td>Utility</td>
<td>Utility</td>
<td></td>
</tr>
<tr>
<td>Utility</td>
<td>Utility</td>
<td>Utility</td>
<td>Utility</td>
<td></td>
</tr>
<tr>
<td>Canners &amp; Cutters</td>
<td>Utility</td>
<td>Utility</td>
<td>Utility</td>
<td></td>
</tr>
</tbody>
</table>

U.S. Choice is the grade of beef most often purchased by quantity foodservices. It also is the grade of meat that is most abundantly produced in the United States. For
many quantity foodservices it is selected because it has a lower fat content than Prime. As a result, it can be used on many low fat, low cholesterol diets.

Pork grades are based more on yield than on quality due to minimal differences between the grades for flavor. Fresh pork that is watery or soft is unacceptable. During recent years the demand for leaner cuts of pork has resulted in breeders and producers marketing carcasses that contain less fat. Pork no longer can be considered to be higher in fat content than beef.

Grades used for veal are very similar to those of beef. The higher grades of veal have higher levels of fat and thicker flesh than lower grades. Bones are small in relationship to the weight and size of the carcass. However, due to the high cost of veal products, few foodservices can afford to offer these meats on a regular basis.

When lamb is offered on the menu, Choice or Good grades are usually selected. Mutton is rarely used due to its strong flavor and odor.

**Purchasing**

**Meats.** All meat products should be purchased by specifications. The National Association of Meat Purveyor publishes the Meat Buyer's GUIDE 1 which is commonly used by meat suppliers and food buyers to help standardize these specifications. The Institutional Meat Purchase Specifications (IMPS) numbers were developed for use in institutions are listed in the Meat Buyer’s Guide. These specification can aid quantity foodservice managers in ordering the exact meat specified in the recipe.

Meat specifications should include the following:

- Name of the cut
- USDA grade
- Chilled or frozen
- Packaging, number of units per container
- Requirement for boning, rolling and tying, if applicable
- Meat Buyer’s Guide specification number

These specifications will help ensure that the exact meat product is ordered to meet production needs. Specifications should be used no matter what the size of the purchase unit.

**Poultry Products.** Chicken must be inspected by the USDA when it is shipped across state lines. State inspections are required for poultry sold within states. However, quantity foodservices should require chicken and poultry products to be inspected by USDA to ensure strict sanitary standards are being met during processing. If inspected by USDA, the federal inspection circle mark must appear on the package label.
Recent outbreaks in Salmonella contamination have reemphasized the need for plant inspections. If contaminated by these germs and improperly handled and prepared, massive outbreaks in food-borne illness can occur.

Poultry may be graded as U.S. Grade A, U.S. Grade B, and U.S. Grade C. U.S. Grade A is most commonly used in quantity foodservice operations. The lower two grades do not have a high quality of meat conformation, well-developed layer of fat, or skin that is free of cuts and defects. Lower grades might be appropriate for use in casseroles where the whole chicken section is not being served. Diced chicken or turkey can be purchased frozen for use in salads and casseroles.

Poultry specifications should include the following:

1. Kind of bird. This refers to the species, such as turkey, chicken, duck, etc.
2. Class. This refers to age and sex.
   A. Broilers: Young birds 1 1/4 to 2 1/2 pounds, very tender and short on flesh.
   B. Fryers: Young birds 2 1/2 to 3 1/2 pounds, used for frying, roasting, and broiling.
   C. Roasters: Quick-grown birds 3 1/2 to 5 pounds, Capons, unsexed males that grow rapidly would fall under this class.
   D. Roosters or Hens: Older birds that weigh 3 1/2 pounds or more.

Fish and Seafood. Fish processors are inspected on a voluntary basis by the National Marine and Fisheries Service of the U.S. Department of Commerce. If inspected, fish products will display a shield stating the grade. Fish is graded as Grade A, Grade B, or Grade C. Grades A and B are the most commonly used grades. However, Grade B has more variation in size with more blemishes than Grade A.

Fresh fish should have shiny and unfaded skin, clear eyes, and red gills. The odor should be fresh and not a strong smell. Frozen fish should be packaged in airtight containers and frozen solidly. Fish is often sold frozen in solid blocks which require thawing and portioning. If specified, it will arrive frozen in individual breaded, battered, or unbreaded fillets. These preportioned fillets make it easy for quantity foodservices to standardize portion sizes.

Some fish products like frozen unbreaded shrimp or scallops may be packaged in a frozen block of ice. Unless specified as individually quick frozen (IQF) the yield of edible product from the solidly frozen block may be less than 25% of the total frozen received weight. Therefore, it is necessary the foodservice department
purchaser pay attention to the pack when placing the initial order. This is especially critical when making price comparisons between the frozen block and IQF fish products.

Fish is sold in two groups: finfish and shellfish. Finfish are subdivided into two types: lean and fat. Cod, halibut, haddock, flounder, and perch are examples of lean fish that contain less than 5% fat. Tuna, salmon, and mackerel are examples of fat fish that contain more than 5% fat. Shellfish, the second major classification of fish, are either crustaceans or mollusks.

<table>
<thead>
<tr>
<th>Major Fish Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean</td>
</tr>
<tr>
<td>Cod</td>
</tr>
<tr>
<td>Halibut</td>
</tr>
<tr>
<td>Flounder</td>
</tr>
</tbody>
</table>

All Fish are highly perishable and deteriorate rapidly. The fresher the fish, the better the final cooked product.

Storage

Beef and Pork. Raw meats should not be stored for periods longer than three to four days. When refrigerated, meat should be stored loosely wrapped. This will prevent growth of bacteria that grows in the absence of air. Meat should be refrigerated at 30-to-36 F with a high relative humidity of 80-to-90%.

Meat should be stored away from other foods like vegetables and fruits to prevent cross contamination. In addition, hams and cured meats should be wrapped or covered to prevent their odors from contaminating other foods in the refrigerator.

The more surface area of meat that is exposed to air, the faster the meat deteriorates. Sliced, ground, and cubed meats should be used within 24 hours. Frozen meat should be tightly wrapped to prevent exposure from air which in turn will cause freezer burn and off flavors from other foods in the freezer. Beef can be stored frozen, below 0 F for up to 12 months if correctly wrapped. Because the fat of pork products becomes rancid more rapidly than beef, veal, or lamb; frozen pork should not be stored longer than six months. Frozen meat that has been thawed should be used at once and never refrozen.

Veal and Lamb. Unlike frozen beef that can be stored frozen for 12 months, frozen veal and lamb are limited to 6 to 9 month storage. If stored longer, the meats may become rancid and develop off flavors.

Poultry. Inspected poultry products from approved sources should be purchased to ensure the meat is free from microorganisms like Salmonella. Because of this threat, poultry should be stored under refrigeration as soon as it is received. Most
poultry products are purchased frozen. Ideally, they should be thawed just prior to preparation.

When thawing or storing poultry in the refrigerator, it should be placed in a location where its juices cannot contaminate other foods. Raw poultry products should never be placed in areas of the refrigerator where leftovers are stored.

Thawing large poultry products like turkey at room temperature is very dangerous. The outside of the poultry will be at room temperature while the inside will still be frozen. This allows microorganisms to multiply on the outside before the inside is thawed.

Fish. Fish products must be refrigerated as soon as they are received. Fresh fish should be prepared the same day it is received and discarded after 72 hours. Frozen fish products are best if used within three months. However, frozen fish can be stored for up to six months.

Preparation and Cooking Methods

When deciding whether to use moist or dry heat cooking methods, the tenderness of the meat must be considered. If purchasing less tender cuts, enzymes like papain, found in papaya; or bromelin, produced from fresh pineapple, can be used to help tenderize the meat. Mechanical tenderization including grinding, cutting, cubing, scoring, and pounding also can be used to breakdown the connective tissue in less tender cuts. When preparing meats with large amounts of connective tissue, it is best to use moist cooking methods like braising or stewing.

Tender cuts of meat like beef tenderloin can be prepared by using roasting, broiling, pan broiling, pan frying, and deep-fat frying cooking methods. However, even these tender cuts of meat can become tough if they are cooked too long. The more the protein muscle is heated and denatured, the more the protein draws up and becomes tighter. This tightly drawn up protein is tough and difficult to eat.

Factors affecting length of cooking time:

- Cooking temperature
- Oven load
- Degree of doneness
- Tenderness of the meat
- Temperature of the meat prior to cooking
- Size of the meat

Checking for Doneness. A meat thermometer should be used to check meat for doneness. The muscle is pierced at its thickest point without letting the thermometer touch the bone. Meat should not be tested for doneness by piercing with a fork or cutting with a knife. This releases the juices from the meat and causes the meat to be dry.
The final temperature for beef is dependent on personal preference. Well done beef should have a center temperature of 160 F; medium beef, 150 F; and rare beef, 145 F. When roasting meats of various sizes, the internal temperature of the smallest item should be checked first to prevent it from overcooking. The internal temperature of meats like roasts will continue to rise even after being removed from the oven. Lamb also can have varying degrees of doneness similar to beef. Many people prefer lamb cooked medium and not well done.

Figure 4. Stages of Doneness

<table>
<thead>
<tr>
<th>Internal Doneness</th>
<th>Temperature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well done</td>
<td>160 F</td>
<td>Flesh is completely cooked with little or no juice; exterior is hard and has a shrunken look; surface is dry and dark brown.</td>
</tr>
<tr>
<td>Medium</td>
<td>150 F</td>
<td>Interior of flesh is rose and juices are pink, but less juices than rare. Exterior is well-browned with the flesh that resists pressure, less plump than rare.</td>
</tr>
<tr>
<td>Rare</td>
<td>145 F</td>
<td>Flesh is very red. Outside is brown and plump, and juices are red but not bloody.</td>
</tr>
</tbody>
</table>

Trichinae, a parasite occasionally found in raw and uncooked pork is not the threat that is once was. The Foodservice Department of the National Pork Producers Council recommends a final cooking temperature of 145-to-160 F for all pork. The USDA’s Food Safety and Inspection Service suggests the end point for cooking pork be 160 F.

Meat Cooking Methods.

The most common methods for cooking meats are:

- Baking or roasting
- Broiling
- Pan or oven frying
- Deep fat frying
- Barbecuing

**Roasting.** Roasting is a common method of dry heat cookery. Meats can be roasted in conventional, convection-air and deck ovens. In each type of oven the meat is placed on a rack with the fat side up to allow the meat to self baste. No moisture is
added to the pan. Heat from the top of the conventional oven or the hot moving air of the convection oven produces surface browning. There is no need to sear the roasts before placing them in their roasting pans. Rather than preventing the loss of juices, searing increases total cooking losses.

The most commonly selected roasting temperatures are 300-to-325 F. This temperature range produces the most tender product with the least amount of shrinkage. The standardized recipe should be checked for exact temperature settings.

**Broiling.** Broiling is another form of dry-heat cooking. The meat is placed directly under or over radiant heat from gas flames, charcoal briquettes, or electric heating elements. This method of cooking is very rapid. The meat should never be broiled longer than the desired doneness. To keep it from becoming dry and tough, these cuts should be turned only once during broiling. Seasoning with salt should be done after the cooking is completed. The salt draws moisture out of the meat and delays browning. Frozen meats can be broiled, but they should be placed further away from the heat to prevent the outside from burning before the inside is done. Meat thicker than 1 1/2 inches should be thawed prior to broiling.

**Frying.** In frying, heat is conducted from the surface of the braising pan, grill, or skillet to the surface of the meat. The cooking surface should be oiled before lean cuts of meat are placed on it. Medium cooking temperatures should be used to prevent overbrowning and crusting of meat surfaces. Many recipes like Swiss steak combine browning with moist heat. Meat also can be oven fried. In oven frying the meat is placed on a greased sheet pan. The top surface is brushed with fat, and it is cooked at a high temperature.

**Deep Fat Frying.** Meats should be coated or breaded before deep fat frying. Careful control of the temperature in deep fat frying is very critical. If the fat is too hot, the food will be overcooked on the outside before the center of the meat is done. If the fat is too cool, longer cooking time will allow increased absorption of fat, leaving a greasy end product. Common frying temperatures are usually between 350 and 375 F. When frying large quantities, the fryer must be allowed to return to the proper frying temperature before cooking the next batch. After frying, the product should be placed on a wire rack for draining.

**Moist Cooking Methods**

The moist cooking methods are:

- Braising,
- Pot roasting,
- Fricasseeing,
- Swissing and
- Stewing

**Braising.** Braising primarily is used for less tender cuts of meat. The terms fricasseeing, pot roasting, and swissing often are used instead of braising. The meat is dredged in a small amount of flour to increase browning when fried in a small
amount of fat. After browning, these meats are cooked slowly in a small amount of liquid. Steam-jacketed kettles and tilting braisers often are used in quantity foodservices for this cooking method.

**Stewing.** Stewing is used to cook the toughest cuts of meat. It is very similar to braising except the meat is completely covered in liquid. To make the product more tender, the meat is simmered; not boiled, after the liquid has been added to the recipe to make the product more tender. However, when vegetables are added; the stewing time is lengthened. Vegetables can be cooked separately and added as a garnish for the meat.

Figure 4. The stewing cooking method:

2. Brown meat at 350 F.
3. Add seasoning: salt, pepper, and spices.
4. Cover and simmer at 300 F until tender.
5. Check tenderness with a fork.

Although using pressure steamers or tightly wrapped foil can be used on less tender cuts; shrinkage and drip loss actually may be greater than other moist cooking methods. The flavor and color of steamed meat is not highly desirable.

Causes for shrinkage in meat:

- Character of the meat cut
- Method of cooking
- Cooking temperature
- Length of cooking period
- Degree of doneness

**Poultry Cooking Methods**

**Roasting.** The same cooking methods used for meats are also used for poultry. One of the most common methods for preparation of poultry is roasting. Turkey is often prepared by roasting whole or cutting into sections to allow for different cooking times of white and dark meat.

Most quantity foodservices use either deboned turkey breasts or turkey rolls that contain white meat or a combination of white and dark. Usually, these turkey breasts and rolls have been precooked and only require reheating in the compartment steamer. Occasionally, they are roasted in a conventional oven when pressurized steamers are not available. If cooked in the oven, a small amount of heated water should be added to the pan to help prevent the breasts or rolls from drying out.
Although turkey rolls are used by many quantity foodservices, they may not be appropriate for low sodium diets. If questions arise concerning nutritional content of the product; by law, manufacturers must provide nutritional information. In addition to higher sodium content, turkey rolls and breasts are very expensive.

Turkey rolls are very convenient. It is very easy to slice a roll for use as a hot entree or for use cold on a turkey sandwich. However, some clients will object to processed turkey rolls.

Foil used to cover the turkey breasts prevents over browning and drying. The foil can later be removed to allow for browning during the last 30 minutes of cooking. Turkeys are usually done when the inside temperature is 180 F. When checking for doneness, the thermometer must be inserted into the thigh muscle at its thickest part where it is joined to the body cavity.

There is risk of microorganism contamination on the inside of the turkey if roasted overnight at very low temperatures below 200 F. If not served immediately, all cooked turkeys should be refrigerated. They should not be allowed to remain at room temperature for more than one hour. However, if being carved for immediate service, turkeys should stand for 15 minutes after being removed from the oven to allow the meat juices to be reabsorbed.

Quantity foodservice managers should never allow whole turkeys to be stuffed. Without the stuffing, poultry will cook and cool faster. Extended cooking and cooling times allow microorganisms to multiply and contaminate the final product. Dressing can be baked separately in shallow pans that allow the dressing to be cooled rapidly.

**Frying.** Frying is a popular method to prepare young and tender chicken. Frying can be done in the oven on greased sheet pans or in the deep fat fryer. The oven-fried method is most practical for preparing large quantities. Usually oven-fried chicken is dipped in a milk and margarine mixture before being lightly coated with bread crumbs, cracker crumbs, and spices. This coating and dip will vary according to the recipe being used.

**Broasting and Slow Roasting.** Broasting has become a popular method for cooking poultry, especially chicken. The broaster applies steam under pressure while the chicken is being deep fat fried. The end product is a very tender and juicy meat. Other equipment like the slow roast and hold units can be used for poultry by following the manufacturer’s cooking instructions.

**Deep Fat Frying.** Deep-fat frying often is used for processed chicken patties, chicken tenders, and a variety of convenience chicken products. These products are fast and easy to prepare. The temperature of the fat for frying these products should be between 350 and 365 F. High temperatures will cause the product to become too brown. Low temperatures will promote grease absorption.

**Broiling.** Broiling commonly is chosen for the more tender cuts of poultry like young chicken quarters or chicken breasts. This method is growing in popularity with more public awareness of low calorie, low fat cooking methods.
Moist Cooking Methods. Stewing, braising, steaming, and simmering can be used for the older, less tender poultry products. Whichever method is used, the poultry should be cooked until the meat is tender and can easily be removed from the bone with a fork.

Stewing. Stewing is an effective method for making creamed chicken, chicken soup, chicken casseroles, and chicken gravy. However, with the availability of commercially prepared frozen and canned chicken and turkey, quantity foodservice managers may choose to use the convenience products to save time and to ensure standardization of the product.

Fish

Because fish becomes rancid very rapidly, it should be kept refrigerated until it is prepared. Frozen breaded fish should not be allowed to thaw. Instead, it should be placed directly in the oven or the deep-fat fryer depending on the cooking method chosen. Lean fish are best poached or steamed. Fat fish are best broiled, pan-fried, or baked. Shellfish should be cooked at low temperatures, below 300 F for a short period of time to avoid toughening the protein. Oven baking, oven frying, and deep-fat frying are common methods that require the least amount of time and labor. Pan frying and broiling are more labor intensive.

<table>
<thead>
<tr>
<th>Considerations in selecting cooking methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenderness of fish</td>
</tr>
<tr>
<td>Fatness or leanness of fish</td>
</tr>
<tr>
<td>Fat fish should be cooked at low temperatures</td>
</tr>
<tr>
<td>Lean fish should be broiled or fried</td>
</tr>
</tbody>
</table>

When baking in the oven, it is best to place unbreaded fish fillets on a well oiled sheet pan coated with oil. In oven frying, breaded fish fillets are placed on a well oiled sheet pan with a thin layer of melted shortening poured over the top. Fish products are done when the flesh is white, and it flakes when tested with a fork.

Leftovers

Quantity foodservices should be managed so the amount of leftovers is minimized. However, even with accurate menu forecasting counts, all operations have some leftovers. Because the quality of prepared foods deteriorates very rapidly, leftovers either need to be stored under refrigeration for later use or disposed of properly.

Protein-containing foods should be refrigerated or frozen to inhibit growth of microorganisms. Leftovers should be inventoried by the foodservice manager or production supervisor to ensure they are rotated and used within 48 hours.

Leftovers should be labeled, dated, and stored away from all raw and uncooked foods. If frozen, use a heavy foil, freezer wrap, or approved plastic and metal containers. Leftovers should never be stored in used containers such as gallon jars in which salad dressings are received. Containers covered with aluminum foil or plastic film should not be stacked on top of each other.
Refrigerators and freezers should be organized so leftovers can easily be retrieved. One example is placing all leftover beef products on one rack in the freezer and all leftover pork products on a separate rack. A diagram of the leftover storage area should be placed on the freezer door to help keep order.

Leftovers should be reheated to 165-to-170 F before they are served again. Once leftovers are reheated, they should never be refrozen. Instead, they should be disposed of properly. Leftover casseroles, gravies, dressings, and any deep-dish foods should be placed in shallow containers to allow for rapid cooling. Foods in deep containers cool slowly and allow microorganisms to grow rapidly in the warm center part of the product.

Leftover meat dishes containing tomato products should not be stored in aluminum foil. The acid from the tomatoes dissolves the foil.

SANDWICHES

Sandwiches are a very popular entree with most clients. They allow a large variety of breads, spreads, and fillings to be offered.

Close-grained bread should be used for sandwiches because it is less likely to become soggy from moist fillings. Coarse breads should be avoided because of its tendency to become stale faster. Sandwich fillings should provide color, flavor, texture, and be nutritious. Fillings can be spreads, meats, cheeses, poultry, and sausage.

When using any of the new turkey hams or sausages for sandwiches, the fat content must be checked. Many of these products are actually higher in fat content than similar beef and pork products.

Often, sandwich fillings use salad dressings to hold the ingredients together. Two good examples of this are tuna and ham salad.

Sandwiches made from egg products and salad dressing with a mayonnaise base provide a medium for microorganism growth. These sandwiches should be refrigerated if not served immediately. If not served within 24 hours, these leftover sandwiches should be disposed of properly.

If sandwiches are allowed to stand for several hours, they should be covered to prevent the bread from drying out and the absorption of off flavors. They also are much easier to handle if they are wrapped.

Sandwich Production

Sandwich production flow charts should be drawn for efficient use of labor and food. Good planning and work station organization should facilitate speed of production. With the guide of a well-planned flow chart, less skilled personnel can be used in the assembly freeing more qualified cooking personnel for other production tasks. Many foodservice managers use a deli-style assembly to allow for a wide variety of sandwich combinations using many of the available sliced meats and cheeses.
The sandwich work center should be comfortable for the worker. A 34 inch working height is recommended for short workers. The height should be 36-to-42 inches for tall workers. Plates, necessary tools, and utensils should be within easy reach of the worker.

Portion control of sandwich filling is very important. Recipes should be closely followed and appropriate scoop sizes should be used to ensure uniform amounts of filling. For example, if a No. 20 scoop is used (1 1/2 ounces) for a sandwich spread, 100 sandwiches can be made from 5 quarts of filling.

Grilled and fried patty sandwiches can be prepared separately from the bread or the bun. The final assembly can be completed on the serving line. Grilled sandwiches like grilled cheese or ruben sandwiches should be cooked as close as possible to serving time to ensure maximum freshness and quality. Grilled sandwiches also are prepared by many quantity foodservices by placing the sandwiches on sheet pans and placing them in the oven. This is an effective method for producing a large quantity of sandwiches with limited labor.

SUMMARY

A cooking method that will maximize the tenderness of meats, poultry and fish while retaining nutrients should be chosen. Cooking temperature and time have an effect on the amount of shrinkage and loss of nutrients. High temperature cooking increases shrinkage and reduces the tenderness of meat. Slow, low temperature cooking helps to ensure higher quality and yield with more uniform doneness.

To ensure wholesomeness of meats, poultry and fish, foodservices should buy only meats that have been inspected. Proper storage conditions will help retain high quality products.

Meat grades are determined by conformation, quality and cutability. Specifications for meats, poultry and fish need to be used to make sure that exact products are ordered to meet the foodservice’s needs.

If leftover protein foods are going to be used at a later time, they need to be stored under refrigeration to inhibit growth of microorganisms. A procedure for storing and using leftovers should be used.

Sandwiches provide another popular entree choice for clients. Many products are available to be used as filling ingredients. Portion control of filling ensures uniform amounts are served for the clients.

Footnotes
BAKERY PRODUCTS, DOUGH, PASTRY, AND BATTERS

High quality bakery products are a popular part of each meal. These products provide important nutrients, calories, and some of the fiber necessary for a well-balanced diet.

Yeast breads, pastries, quick breads, cakes, cookies, and batters have similar ingredients. However, the preparation methods are different for each type of baked item.

YEAST BREADS

Yeast breads are baked dough usually made from flour, water, sugar, and yeast. An understanding of yeast fermentation and gluten development are necessary before beginning to make these products in quantity.

To produce a high quality yeast dough, the amount, type and quality of ingredients must be carefully controlled. For example, if using hotel and restaurant flour; the baker must be aware that a wide range of gluten content is allowed. Whenever possible, flour of similar content should be used. Consistent quality can be purchased by specifying the percentage of flour protein the flour on purchase specifications.

Bread flour has more gluten than all purpose flour. All purpose flour is milled to be slightly weaker than bread flour. The amount of gluten is described as weak or strong. The greater the amount of gluten the stronger the flour. Figure 1 lists some of the types of flour that can be purchased and when they should be used. Using the best flour for the product will result in the best quality with controlled costs.

Figure 1. Uses for the types of flour

<table>
<thead>
<tr>
<th>Types of Flour</th>
<th>Indicated Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight flour</td>
<td>White bread and</td>
</tr>
<tr>
<td></td>
<td>Whole wheat blends</td>
</tr>
<tr>
<td>Bread or Patent flour</td>
<td>White bread and whole wheat blends</td>
</tr>
<tr>
<td>Clear flour</td>
<td>Rye bread</td>
</tr>
<tr>
<td>Cake flour</td>
<td>Cakes and delicate baked goods</td>
</tr>
<tr>
<td>Pastry flour</td>
<td>Pie doughs, cookies, biscuits, and muffins</td>
</tr>
<tr>
<td>Whole wheat flour</td>
<td>Whole wheat bread</td>
</tr>
<tr>
<td>Bran flour</td>
<td>High fiber bread</td>
</tr>
<tr>
<td>Self rising flour</td>
<td>Breads and some pastries</td>
</tr>
</tbody>
</table>
Whole wheat flour produces breads that are higher in fiber content. It is made by grinding the entire wheat grain including the bran and germ. Because the wheat germ is included, this flour becomes rancid very easily and has a shorter shelf life than bread or all purpose flour. However, refrigeration will extend the life of the flour.

Whole wheat flour is also called graham flour. It can be used in yeast breads because it contains gluten. Bread made solely from 100% whole wheat flour will be much heavier than white bread. The heavy, dense structure forms because the sharp edges of the bran cut the gluten strands. This causes a lower volume.

The fat from the wheat germ contributes to the shortening action of the flour because the oil in wheat germ also acts as a tenderizing agent. Other fats, oils, and sugars also help tenderize the product.

To prevent a small loaf that is too tender, most whole commercial wheat breads also contain white bread flour. If whole wheat flour is not available, miller’s bran can be added to white flour to produce whole grain bread. With this substitution, adjustments in the quantity of water used may be necessary.

Although it does not contain gluten, rye also is a popular flour used in yeast breads. Breads made 100% from rye flour will be very heavy and dense. Hard wheat, bread, or all purpose flour must be added to the dough if a lighter loaf is wanted. Recommended ratios are 25% to 40% hard wheat flour to 60% to 75% rye flour. Some examples of these proportions are given in Figure 2. Rye flour is used to make rye and pumpernickel bread and similar speciality products.

Figure 2. Rye flour:Hard wheat flour proportions for a 5-lb recipe of yeast breads.

<table>
<thead>
<tr>
<th></th>
<th>Rye Flour Amount</th>
<th>Whole Wheat Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recipe A</td>
<td>3 lb.</td>
<td>1 lb.</td>
</tr>
<tr>
<td>Recipe B</td>
<td>2.4 lb.</td>
<td>1.6 lb.</td>
</tr>
</tbody>
</table>

Mixing the Dough

Four points are important in making yeast bread.

- All ingredients should be blended evenly.
- The dough should be smooth in appearance.
- The gluten needs to be developed for structure.
- The yeast needs to be evenly distributed throughout the dough.

There are three different methods of preparing yeast dough. The first, called the straight dough method, is the most simple. The yeast is softened in a little water before it is added to the other ingredients. Then the ingredients are placed in a mixing bowl and mixed in one step. A dough hook attachment should be used for mixing. This method produces a high quality plain white bread. However, other methods are used to produce high quality sweet or whole grain products.
Desirable yeast breads should have good volume with a golden domed crust that is not split or broken. The texture and crumb should not be too dense, too coarse, or too open. In addition, the inside crumb should not be crumbly, streaked or gray. It should have an even cream color.

The modified straight dough method is used primarily for rich sweet doughs. Like the straight dough method, the yeast is presoftern. The fat, dry milk solids, salt, and sugar are mixed together with a whip until they are evenly combined. The eggs are added slowly to the mixture to ensure even distribution. The liquid is added all at once and then the flour and yeast are added. The dough is mixed with the dough hook until it is smooth and cleans the sides of the bowl.

To increase the yeast dough volume, milk should be scalded. To use this method, the dry milk is reconstituted then scalded, heated to 185 F. Fresh milk can be substituted for the reconstituted dry. The milk is added to the dough with the other liquids.

Scalding the milk kills any microorganisms that might prevent the yeast from growing. It also releases some of the milk sugar, lactose, making it easier for the yeast to use as food. The milk proteins begin to coagulate during scalding allowing them to better help build structure in the bread.

In quantity food production, the baker should evaluate if the extra volume possible when milk is scalded is more important than using the more efficient dough mixing methods.

The sponge method mixes the dough in two stages to give the yeast extra time to leaven the bread. This method is best for breads with lower gluten such as rye and whole grain. First, the liquid, yeast, and part of the flour are mixed to form a soft dough. This dough is allowed to proof to double in bulk before being punched down. The remaining flour and ingredients then are added and the dough is kneaded using a dough hook until it has a smooth texture.

Proofing

The proofing that occurs in yeast doughs is the result of yeast, the leavening agent. Yeast is available as a cake or active dry granules. Yeast ferments the sugar in the recipe to form carbon dioxide, alcohol, and water. The sucrase enzyme produced by the yeast breaks down the sugar into fructose and glucose, which are simple sugars. When the recipe does not have sugar, the yeast will use the small amount of sugars contained in the flour and milk as a source of food.

The alcohol produced by fermentation evaporates during baking. The carbon dioxide remains in the product until it is baked forming the necessary pockets of air that leaven and proof the bread. As more and more carbon dioxide is formed, the pockets grow larger. As the carbon dioxide heats in the oven it expands. This exerts pressure that in turn causes the dough to expand.

Most quantity foodservice operations use a proofing cabinet to create the heat and moisture needed to develop the yeast. Without the proper amount of proofing, it is difficult to produce a flavorful bread of good texture and volume. The desired temperature for proofing is between 85 and 95 F. Caution should be taken to ensure this proofing temperature never exceeds 110 F; otherwise, the yeast will be killed and the bread will not rise to full volume.
Although oven temperatures also kill yeast, yeast produces additional carbon dioxide until the internal temperature reaches 110 F. Ovens should be preheated before products are placed in them. This ensures the yeast is killed before the outer crust is baked. When this does not happen the bread tries to rise and the crust splits. The increase in volume that occurs in the oven is called oven spring.

Baking

Baking equipment and utensils should be selected for their usefulness. Follow the recipe directions for the correct pan to use.

Pans should not be overlapped or placed directly over each other to allow for even distribution of the heat from one oven rack to another. Preheating controls the amount of oven spring and gives an even, controlled baking condition.

When loading the oven, leave the oven door open the minimum time possible. The oven temperature cools every time pans are added. If too many pans are put in at one time, the temperature may cool off too much. This will cause the bread to overproof and be coarse in texture and split because proofing will continue until the bread temperature reaches 110 F.

Due to the delicate structure of baked products, the oven should not be opened to check for doneness until close to the end of expected baking time. Before this, the tender and weak state of the bread could cause the product to fall. Yeast breads are usually done when they are golden brown, produce a hollow sound when tapped, and the bread springs back into place when the product is pushed with a finger.

QUICK BREADS

Quick breads are much easier and less labor intensive to produce than yeast breads. The limitless varieties are dependent on the ingredients selected. Type of flour and other ingredients like nuts, bran, spices and fruits can be added to a basic recipe to add variety and increase fiber in the menu. Many quantity foodservices use quick bread mixes to reduce production time, save on expensive labor, and ensure standardized quality in the final product.

The primary leavening agents in these quick breads are baking soda and baking powder. Steam produced by the liquid in the recipe also contributes to the product volume. Foods containing acids and baking soda, sodium bicarbonate, form carbon dioxide and water. Baking powder, made from sodium bicarbonate and starch; produces carbon dioxide when moisture is added.

However, baking powder can be single acting or double acting. Double acting baking powder is preferred for quantity food production to provide safeguards that ensure proper leavening. Single acting baking powder might be specified in older or ethnic recipes. Single acting baking powders react when the mixture is cold, while double acting agents react when the mixture is cold and also again when the mixture is heated during baking.
The mixtures used to make quick breads are usually soft doughs or batters. The soft doughs are used for rolled and drop biscuits, and batters are used for the remaining breads such as muffins and pancakes.

Like yeast doughs, a main structural ingredient in quick breads is the flour. The starch and protein add structure to breads. Because only slight development of gluten is desired in quick bread products, the dough or batter is handled as little as possible during mixing. The amount of fat and sugar in the recipe also help to prevent overdevelopment of the gluten and contribute to tenderness and flavor. If gluten is overdeveloped as the result of improper handling, the final product will be tough, and foods like muffins will have large, oval-shaped holes called tunnels.

Eggs are another important ingredient in quick breads. They contribute to structure, but once beaten they also help incorporate air in the mixture. They help the product to retain the steam produced by baking.

Mixing Methods

There are three basic methods for mixing quick breads; the biscuit method, the muffin method, and the creaming or cake method. The mixing method is important in determining the expected quality, tenderness, volume, and texture of the final product. Each method contributes different characteristics to quick breads.

In the biscuit method, also known as the pastry method, the dry ingredients are thoroughly combined first. Next, the fat is cut into the dry ingredients with a flat beater attachment until the fat is broken down into pea sized clumps evenly distributed throughout the product. Finally, the liquid is added slowly.

Caution should be taken when mixing biscuit ingredients. Overmixing will give a fine texture much like cake, and under mixing will result in a product with a course texture.

After mixing, some kneading of biscuit products on a lightly floured surface will develop layers of fat in the dough and some gluten. Because gluten is easily developed, it is best to knead softly with the fingertips to work flour on the table into the dough. This light kneading will result in a light, flaky product.

In the muffin method, the dry ingredients are mixed together first to ensure an even distribution. The beaten eggs, milk, and oil are mixed together then added all at once. Minimal mixing is necessary to prevent overdevelopment of the gluten that will result in the loss of volume and the formation of tunnels in the final product.

Overmixing also can occur in the dipping or portioning of the batter. A scoop that holds exactly one portion should be used. This will prevent the need for extra dipping resulting in over mixing of the batter. Quantity foodservices should not prepare batches larger than 100 portions at a time to prevent the portioning from over mixing the batter. It is best when several small batches rather than one large batch is made. The necessary mixing is kept to a minimum. The dry and liquid ingredients can be premeasured then combined in small batches before portioning into the baking pan.

The cake or creaming method calls for combining and creaming of the sugar and fat. Creaming incorporates air into the product. The beaten eggs are added next to incorporate additional air. Finally, the liquid and the mixed, sifted ingredients are added alternately. This method, is referred to as the quick mix method. It is used in many quantity foodservice operations to save production time.
Muffin tins and baking pans should be greased with food release and sometimes they are lightly dusted with flour as stated in the recipe. Paper muffin liners also are available. The paper liner makes the pans easier to wash, but it adds to the cost and are not well accepted by clients. To unwrap food is difficult for some clients and unappetizing to others. Sheet pans used for products like corn bread can be greased lightly or lined with bun pan paper liners.

Baking quick breads follows many of the same rules of yeast breads. Begin with a preheated convection or conventional oven. A convection oven will take much less time. In a conventional oven, the oven should not be overloaded, and one pan should not be placed directly above another for even distribution of the heat.

Opening the oven door to check for doneness should not happen until close to the end of the expected baking time due to the delicate structure of the quick breads. Before this, the delicate balance of the leavening and the structure of the product could result in the product falling.

Quick breads are tested by piercing with a toothpick or a metal cake tester. If no batter clings to the tester, the product is done.

**PANCAKE AND WAFFLE BATTERS**

Pancake and waffle batter can be mixed longer than cake or muffin ingredients without fear of over development of the gluten because the batter has more oil and liquid. Baking powder is used as the leavening agent.

The use of an institutional pancake dispenser or proper sized dipper will help standardize portions in quantity foodservice operations. The grill should be heated to 350 F. If the temperature is too hot, the final product may be dark on the outside, but still raw in the inside. A cold grill will cause the product to be pale and have a poor, dense structure. The pancake is ready to turn when bubbles form on the surface. The best products result when turned only once.

**Mixes**

Many quantity foodservices choose to use a variety of cake, muffin, biscuit, and other institutional mixes. Because many of these mixes have dried egg and fat solids. Only liquid will need to be added before portioning. Most mixes have higher levels of sugar that add tenderness to the final product and prevent gluten overdevelopment. However, this usually results in a finer cake-like texture than recipes made from raw ingredients. Stabilizers in modern mixes extend the self life of the final product longer than if prepared using "from scratch" recipes.
Most quantity foodservices use large institutional size mixers, pastry knife attachments, and pie dough rollers to prepare pie dough for use in crusts, shells, and tarts. Smaller operations could prepare them in large batches and freeze until needed. Otherwise, the home method for dough preparation could be followed.

The dough mixing operation should be watched closely to ensure that the fat is not over blended into the dry ingredients. Overmixing will result in a crust that has a mealy texture. Instead, the fat should be blended very little, leaving it in pea-size pieces that will make a crust with a flaky texture.

Good techniques, accurate standardized recipes, and high quality ingredients are necessary to produce an acceptable pie dough in quantity foodservices. The tenderness and flakiness is an important characteristic of a desirable pie crust. The fat chosen should be a commercial grade with good shortening power.

When preparing quantity recipes of pie dough, add the water very slowly. Too little water will result in a dry, unflaky crust. Too much water will assist in hydrating the gluten in the flour resulting in a tough crust.

Many foodservices purchase frozen pie dough shells or ready-to-use pie crusts. These frozen shells and crusts can be kept for long periods of time and can be used when either equipment, or trained staff is unavailable.

An important factor in production of pies is the prevention of soggy pie crusts. This can be avoided in fruit pies by thinly coating the lower crust with melted fat or flour to create a barrier to the liquid. Some recipes will call for a higher oven temperature the first 10 to 15 minutes to bake the lower crust so it will resist soaking. This may not be possible in quantity food production if staggered baking times are used. In quantity production a partially thickened filling may be used to solve this problem. The most frequent solutions are using a standardized recipe that carefully controls the amount of juice in the filling and baking the pie as soon as it is filled.

**Puff Pastry**

Puff pastry can be purchased frozen in ready-to-use portions or sheets. These can be used to make tarts, small pies and stuffed turnovers or Wellentons. Once thawed, the dough can be handled, rolled, and stretched to make many shapes. In quantity foodservice operations puff pastries also can be used as a main entree with meat fillings.
SUMMARY

Bakery products include a broad array of foods. Yeast and quick breads are important accompaniments to other foods. Doughs, cakes and pastries are used in many desserts and offer variety to the final course of the meal. Pancakes, waffles, and corn breads are typical foods made from batters.

Bakery products contribute many of the B vitamins, fiber and calories necessary for good nutrition. Quantity production methods balance efficiency with high quality. Knowledge of how ingredients act when combined helps ensure correct techniques are used. Flour is responsible for most of the structure and texture in breads. The quantity of liquid and fat and the amount of mixing determines the quality of the end products.

CAKES AND COOKIES

One of the most popular items on any menu is the dessert. With the sweetness and richness of desserts also come the calories associated with fat and sugars. Today, clients still desire desserts with their meals, but they also want nutritional quality considered in menu planning. Some modifications in traditional cakes and cookies can control fat, sugar, and calories while still allowing variety and flavor.

Cakes

Cakes are usually classified into the two categories of foam cakes and shortened cakes. These two classifications also can be subdivided as follows:

**Foam Cakes**
- Angelfood Cake
- Sponge Cake
- Chiffon Cake

**Shortened Cakes**
- Layer Cake
- Pound Cake

**Ingredients.** Basic ingredients for cakes include flour, sugar, eggs, water, a leavening agent like baking powder or baking soda. Because water and fat do not mix naturally, an emulsion needs to be formed during mixing.

Beaten eggs and cake flour are the major structure forming ingredients in the recipe. It is a mistake to add too much sugar to a recipe. The result is a cake that is too tender to stand up. The extra sugar uses up the water that would usually form the structure to hold the cake up. The result is a small or collapsed cake.

Fats and oils tenderize bakery products by preventing the development of the gluten and add flavor. Emulsifiers in some shortenings permit cakes to be made with higher levels of water and sugar. These fats, called high ration shortenings allow the cake to be more moist and tender than would be possible with shortenings that are not emulsified. This name refers to the large amount of sugar and liquid allowed in relation to the amount of fat. Regular shortening, butter, and margarine are not equal substitutes for this high ratio, emulsified shortening.
Eggs have many functions in bakery products. Beaten eggs are used to incorporate air and volume into a mixture. They also help products retain steam released by heat. Eggs add structure, flavor, and color to the product. However, a large amount of eggs in a cake recipe can produce toughness.

In egg-white foam cake recipes cream of tartar usually is used to stabilize egg whites and keep them from breaking or losing their volume after whipping. Cream of tartar is used in angel food cakes as a stabilizer for the egg white foam by increasing the acidity of the egg-white mixture. The cream of tartar also helps to create smaller air cells in the mixture producing a finer texture. Recipes that call for egg yolks use them as an emulsifier. Because the egg yolk is a combination of fat and water, it easily blends with both in a cake batter. The yolk provides a way for the usually unblendable oil and water to mix together in a smooth a batter.

To produce a cake with a tender crumb, cake flour is used. However, some recipes will allow all purpose flour to be added to the mixture, but the cake will be more compact and less tender than cakes made with cake flour.

Cake flour is milled to have a smoother texture than all purpose flour. It is treated to destroy some of the gluten and bleach out the creamy color. Because the gluten is missing, it cannot form to toughen the cake. Cakes made with cake flour can be handled more during mixing and panning than those made with all purpose flour without a decrease in quality.

Types of Cakes and Mixing Methods

Foam cakes get their name from egg foams that form the structure of the batter. These foam cakes must be mixed very carefully. Careful blending of the foam with the other ingredients will reduce the risk of loss of volume. When correctly prepared and baked they spring back to their original shape when touched. Cooling the cakes upside down helps maintain full volume and shape because while hot the cake structure may not be able to support the weight of the top crust. The cakes have a medium-fine grain and slightly rubbery texture.

Angelfood cake is an example of a foam cake. This cake is based on a whipped egg white foam and contains no fat. Many quantity foodservices use these cakes for people who are on low fat, low cholesterol, or diabetic diets. Because of the very large quantity of egg whites needed, a mix or frozen whites are often used in quantity production. When frozen whites are substituted for fresh, a larger amount of egg white is needed to reach the same volume. The lower volume results from small amounts of water and egg yolk that is always present in purchased frozen egg whites. The adjustment is usually adding two ounces of egg white for each pound required in the recipe.
AngelFood Cake Preparation Method:

- Sift flour with half the sugar to help the flour mix more uniformly with the foam.
- Beat the egg whites until the soft peak stage.
- Add cream of tartar after eggs are a very soft foam
- Add the remaining sugar gradually.
- Fold in the flour and sugar mixture with a minimum amount of mixing.
- Place the mixture in an ungreased pan and bake.

Sponge Cakes

Sponge cakes are very similar to angel food cakes except they start with an egg foam that also contains the egg yolk. The volume of sponge cakes is increased if the eggs are at room temperature before beating. Beating the egg yolk foam after the addition of the sugar is an important step for a high quality product. Additional beating of this egg yolk foam helps the even distribution of the yolk in the egg white foam later in production.

After the egg yolk mixture is beaten to the soft peak stage after 15-to-20 minutes, the cake flour is folded very gently into the egg white foam with a wire whip and placed in a pan for baking. Like angel food cakes, it is best to cool these cakes in an inverted position to help retain maximum volume in the final product. For quantity foodservices that do not have the space to invert these cakes while they are being cooled, the cakes can be cooled on wire racks in a cart. They must be handled gently when they are still warm.

Chiffon Cakes

Chiffon cakes are much more delicate than either angel food or sponge cake. The important difference is the beating of the egg whites. Instead of forming soft peaks, the egg whites should form stiff peaks without being too dry. This additional beating of the egg whites is necessary because of the thin fluid consistency of the egg yolk mixture. The additional strength and structure of the egg white foam holds this yolk mixture without letting it settle to the bottom of the pan.

Shortened Cakes

Shortened cakes refer primarily to the high fat content in the recipe. These cakes have a finer crumb, more flavor, and finer grain or texture than foam cakes. Several preparation methods can be used for shortened cakes. The product quality varies according to the method used even with identical ingredients.

The conventional method of preparing shortened cakes involves three steps. First, the sugar and fat are creamed. Next, the beaten eggs are added. Finally, the flour and the liquid are alternately mixed into the recipe one third of each at a time.
The modified conventional method of preparing shortened cakes differs from the conventional method by how the eggs are incorporated. The egg yolks are added to the creamed mixture. The egg whites are beaten separately to a foam and folded gently into the batter to incorporate more air. These whites help to make a lighter final product.

The sides of the pans of shortened cakes do not need to be greased or coated with flour. Many foodservices lightly grease the bottom of the pans, use a pan release spray or use paper pan liners to help remove the cake from the pan. Oven temperature needs to be sufficiently hot, at least 350°F, to help produce carbon dioxide from the baking powder or baking soda. Unlike foam cakes, shortened cakes are not inverted during cooling. If inverted these cakes might fall out of the greased and lined pan.

**Alternative Cake Mixing Methods**

The muffin method can be used for making cakes. Like muffins, all the dry ingredients are blended together and the fat in the form of a melted liquid or oil is added to the other liquid ingredients. This two stage method saves production time when compared to the other multistep methods. However, in using this method, tenderness and quality in the final product are sacrificed.

The single stage method is the same as the cake mix method. The dry ingredients are combined with shortening and all the water or milk. In the final stage the eggs and any remaining liquid are added to the batter and blended for a specified time. Cakes using this method are coarser.

**SUMMARY**

Cakes should be light, sweet and tender. Foam cakes should have a uniform cell structure and a texture that is slightly rubbery. Shortened cakes are more tender due to the larger amount of fat and sugar. The following list summarizes typical quality problems and causes.
Potential Problems in Cake Production:

<table>
<thead>
<tr>
<th>Potential Problem</th>
<th>Probable Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tough Crumb</td>
<td>Too much egg or flour, Too little fat, sugar, liquid</td>
</tr>
<tr>
<td>Sticky Crust</td>
<td>Too much sugar</td>
</tr>
<tr>
<td>Humped Cake</td>
<td>Too hot an oven, pan too deep, Too much flour, Too little milk, sugar, or fat, or overmanipulation. Pan too full</td>
</tr>
<tr>
<td>Dark crust</td>
<td>Too hot an oven, use of molasses or honey, or cake too near the top of the oven</td>
</tr>
<tr>
<td>Tunnels</td>
<td>Overmixing the cake or too much leavening agent</td>
</tr>
<tr>
<td>Cake that falls</td>
<td>Too much fat, sugar, or baking powder; oven too cool, or cake is removed too soon from the oven</td>
</tr>
<tr>
<td>Reduced volume</td>
<td>Too much liquid or fat, oven is too cool, or leavening agent is inadequate. Cake moved before completely cooked</td>
</tr>
</tbody>
</table>

COOKIES

Cookies are a dessert which are classified in one of three categories: bar, drop, or rolled. The method for mixing is very similar to that used in shortened cakes. The fat and sugar are first creamed together, the beaten eggs are added, and finally the dry and liquid ingredients are added alternately in thirds.

Rolled cookies need a stiff dough to be properly handled and cut before being placed on the cookie sheet. Much of this stiffness comes from refrigeration of the dough and not from the addition of extra flour. Too much flour produces a tough end product. Quantity foodservices might choose this type add a theme cut-out cookie into the menu. Some organizations use purchased frozen cookie doughs. After labor and ingredient costs are considered, this purchased product is convenient, standardized in quality, and similar in cost to cookies prepared from scratch.

Drop cookies have a dough that is fairly stiff so they will maintain their shape on the baking surface. It is easy to make uniform drop cookies by using a dipper. Depending on the baking time and the ratio of fat and sugar to flour, the cookies will either be crisp or soft. Many large quantity foodservices use commercial cookie presses to portion this dough. Favorite drop cookies include chocolate chip and peanut butter.
Bar cookie dough is usually stiffer than dough used for drop cookies. This consistency causes the dough to produce a firm dense bar. A softer dough produces a cake-like dessert. The favorite bar cookie is brownies.

**SUMMARY**

Baking products require more understanding than any other type of cooking of how ingredients act when combined. Knowing the function of flour, sugar, fat and eggs allows the baker to understand why different methods are used with various types of baked goods.

Flour is the structural ingredient in all bakery items. It contributes gluten to yeast breads allowing the yeast to create a good volume. In other products, like quick breads, cakes, pastries, and cookies gluten development is avoided. The amount of fat and sugar indicates how tender the food will be. The eggs and flour provide structure and the needed toughness. The following list provides a summary of problems that happen to bakery foods and where the problem developed.

<table>
<thead>
<tr>
<th>Potential Problem:</th>
<th>Possible Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape</strong></td>
<td></td>
</tr>
<tr>
<td>Reduced volume</td>
<td>Too much salt</td>
</tr>
<tr>
<td></td>
<td>Too little yeast</td>
</tr>
<tr>
<td></td>
<td>Not enough liquid</td>
</tr>
<tr>
<td></td>
<td>Flour with low gluten content</td>
</tr>
<tr>
<td></td>
<td>Under/Overmixing</td>
</tr>
<tr>
<td></td>
<td>Oven too hot</td>
</tr>
<tr>
<td>Too much volume</td>
<td>Too little salt</td>
</tr>
<tr>
<td></td>
<td>Too much yeast</td>
</tr>
<tr>
<td></td>
<td>Too much time elapsed before dough is panned and baked</td>
</tr>
<tr>
<td></td>
<td>Overproofed</td>
</tr>
<tr>
<td>Poor shape</td>
<td>Too much liquid</td>
</tr>
<tr>
<td></td>
<td>Flour with little gluten</td>
</tr>
<tr>
<td></td>
<td>Improper molding</td>
</tr>
<tr>
<td></td>
<td>Improper fermentation or proofing</td>
</tr>
<tr>
<td></td>
<td>Too much steam in oven</td>
</tr>
<tr>
<td>Split or burst crust</td>
<td>Overmixing</td>
</tr>
<tr>
<td></td>
<td>Underfermented dough</td>
</tr>
<tr>
<td></td>
<td>Improper molding and shaping, seam not on the bottom</td>
</tr>
<tr>
<td></td>
<td>Uneven heat in oven</td>
</tr>
<tr>
<td></td>
<td>Oven too hot</td>
</tr>
<tr>
<td></td>
<td>Insufficient steam</td>
</tr>
</tbody>
</table>
### Texture and Crumb

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too dense or close grained</td>
<td>Too much or little salt</td>
</tr>
<tr>
<td></td>
<td>Too little liquid</td>
</tr>
<tr>
<td></td>
<td>Too little yeast</td>
</tr>
<tr>
<td></td>
<td>Underfermented</td>
</tr>
<tr>
<td></td>
<td>Underproofed</td>
</tr>
<tr>
<td>Too coarse or open grain</td>
<td>Too much yeast (open grain)</td>
</tr>
<tr>
<td></td>
<td>Too much liquid (Coarse grain)</td>
</tr>
<tr>
<td></td>
<td>Overmixing</td>
</tr>
<tr>
<td></td>
<td>Overfermentation</td>
</tr>
<tr>
<td></td>
<td>Overproofed</td>
</tr>
<tr>
<td></td>
<td>Pan too large</td>
</tr>
<tr>
<td>Streaked crumb</td>
<td>Improper mixing procedure</td>
</tr>
<tr>
<td></td>
<td>Poor shaping</td>
</tr>
<tr>
<td></td>
<td>Too much flour used for dusting</td>
</tr>
<tr>
<td>Poor texture or crumbly</td>
<td>Flour too weak</td>
</tr>
<tr>
<td></td>
<td>Too little salt</td>
</tr>
<tr>
<td></td>
<td>Fermentation time too long or too short</td>
</tr>
<tr>
<td></td>
<td>Overproofed</td>
</tr>
<tr>
<td></td>
<td>Baking temperature too low</td>
</tr>
<tr>
<td>Gray crumb</td>
<td>Fermentation time or temperature too high</td>
</tr>
<tr>
<td></td>
<td>Poor flour quality</td>
</tr>
<tr>
<td><strong>Crust</strong></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Too dark</td>
<td>Too much sugar or milk</td>
</tr>
<tr>
<td></td>
<td>Underfermented dough</td>
</tr>
<tr>
<td></td>
<td>Overproofed</td>
</tr>
<tr>
<td></td>
<td>Oven temperature too high</td>
</tr>
<tr>
<td></td>
<td>Baking time too long</td>
</tr>
<tr>
<td></td>
<td>Too much steam in oven</td>
</tr>
<tr>
<td>Too thick</td>
<td>Too little sugar or fat</td>
</tr>
<tr>
<td></td>
<td>Oven not preheated</td>
</tr>
<tr>
<td></td>
<td>Improper fermentation</td>
</tr>
<tr>
<td></td>
<td>Baked too long and/or at wrong temperature</td>
</tr>
<tr>
<td></td>
<td>Too little steam</td>
</tr>
<tr>
<td>Blisters on crust</td>
<td>Too much liquid</td>
</tr>
<tr>
<td></td>
<td>Improper fermentation</td>
</tr>
<tr>
<td></td>
<td>Improper shaping of loaf</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Flavor</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat taste</td>
<td>Too little salt</td>
</tr>
<tr>
<td>Poor flavor</td>
<td>Inferior, spoiled, or rancid ingredients</td>
</tr>
<tr>
<td></td>
<td>Poor bakeshop sanitation</td>
</tr>
<tr>
<td></td>
<td>Under or overfermented</td>
</tr>
<tr>
<td></td>
<td>Unclean baking pans</td>
</tr>
</tbody>
</table>
All quantity foodservice operations offer a number of beverages to their clients. Beverages vary in popularity from one region of the country to another, but the same variety is usually offered. For example, sweetened ice tea usually is served in the South, and unsweetened tea is offered in the North. The most popular beverages served are coffee, hot and ice tea, milk, carbonated sodas, hot chocolate, and fruit juices.

Coffee
Regular and decaffeinated coffee are available. They are usually a roasted blend of several different coffee beans selected to create the desired color, aroma, and flavor. Although the coffee beans are usually shipped while still raw, they become their dark-brown color after roasting. The brown color is the result of the browning of the sugar in the beans and breaking down of the starch called dextrinizing. The pleasing aroma and flavor are enhanced by grinding the roasted coffee bean to expose the maximum amount of surface area for brewing. The type of grinding must match the requirements the coffee equipment being used.

The coffee percolator uses a coarse grind with a limited amount of exposed surface. A foodservice operation would use a fine grind for quantity foodservice coffee machines. Because this grind increases the exposure to the grounds, it is used in drip and pour-over coffee machines. This method dispenses the hot water so it drips through the ground into the pot. The hot water is only exposed once to the coffee grounds in these machines. These units usually require 4-6 minutes for brewing a 1-2 quart pot of coffee.

One pound of coffee grounds usually will make two gallons of coffee using the pour-over method. The correct water temperature for brewing coffee is between 195 and 200 F. Once brewed, coffee should be held between 185 and 190 F. Hotter temperatures cause the coffee to scorch and the natural oils to separate and float to the top. To ensure that taste, aroma and flavor are maintained; brewed coffee should not be held longer than one hour.

Quantity foodservices often use automatic commercial coffee machines that require only placing a premeasured packet of coffee grounds in a disposable filter and turning on the machine. The less an individual needs to do in measuring the coffee and timing the process, the better the chances for a standardized cup of coffee. Premeasured coffee packets and water and automatic timers reduce the risk for error.

One of the most critical elements in brewing coffee or any beverage is that the operator must start with clean machine and containers. Coffee machines are very susceptible to buildups of acids and oils that turn rancid. Therefore, it is very important to maintain a regular cleaning schedule to prevent these rancid and bitter flavors from ruining the freshly brewed beverage.

Coffee pots and machines are cleaned by using a commercial coffee cleaning packet provided by the coffee or machine manufacturer or by using soapy water to dissolve the oils that cling to pots and machines. Cleaners should be stored in a separate area away from all foods and beverages. It also is important to rinse all the equipment very thoroughly to eliminate the possibility of soapy residue. Glass coffee pots easily can be cleaned by swirling crushed ice and a mild soap solution in each pot and rinsing with clear water.
Manufacturer's instructions should be followed for removal of lime deposits in coffee machines. Water lines should be filtered to help reduce the buildup of lime, calcium, and other minerals.

Coffee machines should not be connected to hot water unless the machine has a built in filter for hot water. Many hot water systems are softened using salt that will cause off flavors in coffee.

Coffee also is available in a number of soluble forms. Flakes, crystals, frozen liquids, and powders are alternatives to conventional ground coffee. Many quantity foodservice operations use specially designed coffee machines to reconstitute these forms of instant coffee. Usually, these machines are smaller and more compact than the larger coffee urns required for service with regular coffee grounds.

Even when these machines are less expensive than urns using ground coffee, the cost per cup may be more expensive. Therefore, it is wise to compare each system for coffee quality, labor, product, and equipment costs. Many of these machines require less cleaning and maintenance and produce a more standardized cup of coffee. However, due to the loss of many of the flavoring substances during the processing of these coffee concentrates, many people do not like the taste of the coffee they produce.

Decaffeinated coffee is another form of coffee all foodservices should offer. Some clients may need a low-caffeine or no-caffeine beverage. Today many people select decaffeinated coffee to eliminate the stimulating effect of caffeine.

Decaffeinated coffee, like regular coffee, is available in ground, flaked, powdered, and liquid forms. Most foodservices choose to carry only one type of decaffeinated coffee for economy of space and inventory cost. Many methods of removing the caffeine from the coffee bean are used. Because of the possible danger when the petroleum method is used, the water extraction method is preferred. Currently, water extracted decaffeinated coffee is more expensive than that produced by the older petroleum method.

In order to brew a good cup of regular or decaffeinated coffee, the following guidelines should be followed:

1. Use clean, fresh water that is not hard and has not been softened using salt additives.
2. Use clean coffee machines, coffee pots, and china.
3. Only fresh coffee grounds of the appropriate grind for the brewing method should be used.
4. Coffee should be brewed at the proper temperature. (The desired temperature range for brewing coffee is between 185 and 200 F.)

Most quantity foodservices use premeasured packets that have been standardized for the size of the brewing machine that is being used. When these standardized packets of coffee grounds are not used, it is best to check with the coffee distributor or coffee machine manufacturer for the recommended coffee grounds to use.

One of the best ways to judge the many types of coffees that are on the market is to have a taste panel sample the various brands without knowing what brand they are tasting. Quality and taste should be considered along with product price. Color and strength desired for coffee will vary from one individual to another. Therefore, it is best to provide a written description of what is considered acceptable coffee prior to the beginning of the test.
Coffee vendors, who may want to provide coffee for the foodservice, should not be allowed to conduct the test. They should provide enough samples to compare the products. They might attempt to influence the results of a taste test in their favor.

Tea
Tea is available in many different variations. The three most common varieties of tea are: oolong, black, and green. The same tea leaf with some variation in the processing is used to make all three forms. Although many of the specialty and low caffeine teas have gained popularity in recent years, the most popular tea in America is black tea.

Teas are usually a blend of two or more types of tea leaves. However, as is the case with coffee, a good tea begins with a high quality fresh product. Unlike coffee, tea does not contain oils making it much easier to clean and maintain brewing and serving equipment.

To have clean, clear water for brewing a good cup of tea, quantity foodservices may need to use a water filter. In addition, the water should be soft, but not softened. Hard water will produce a cloudy cup of tea with a film on the surface. The film is the result of tannins in the tea reacting with hard water. A filtering system used to provide water for coffee is suitable also for brewing tea.

Most tea manufacturers recommend bringing water to a boil and immediately adding the right amount of tea or tea bags. The tea should be steeped at 180 to 211°F for 3 to 5 minutes. A longer steeping period produces a strong, unpleasant flavor.

Serving hot, near-boiling water to clients along with individual tea bags, allows them to brew tea to their preference. Usually the container of water is large enough to provide adequate water for two cups of tea. Many people use the same individual tea bag to brew a second cup.

Iced tea is another beverage offered by most quantity foodservices. It can be brewed fresh using commercial-size tea bags, or it can be made using instant tea crystals or concentrated liquids. Many operators use instant tea and commercial dispensers directly on the beverage serving line. This allows clients to mix their tea fresh with the preferred amount of ice.

Milk Beverages
The milks most commonly offered as beverages are whole, 2%, skim, and low-fat chocolate milk. Because whole milk contains approximately 3.5% butterfat, many people who are controlling their fat and cholesterol intake, usually choose either skim or one of the low-fat milks. To be labeled as skim milk the product must contain less than 1% butter fat. Low fat milk is usually at the 1 to 2% level. Low-fat chocolate usually is made with 2% butterfat. This chocolate milk usually is lower in sugar than regular chocolate milk.

If not offered in individual cartons, milk products are served in quantity foodservices in bulk dispensers using five gallon plastic bag containers. However, care should be taken when installing containers into the bulk dispensing units to prevent the bags from being broken. Dispensers also need daily cleaning to maintain proper sanitation standards. Local health department officials can be helpful in providing sanitation methods for proper milk dispensing.

Careful checking of expiration dates is an important part in serving milk products. No milk product should be served beyond the expiration date even though the product may seem to have an acceptable taste and appearance. It is a good idea to make the rotation of the milk
products a responsibility of the milk vendor to ensure this does not become a major problem.

**Hot Chocolate.** Hot chocolate usually is served in quantity foodservices from liquid concentrate or powdered forms. Dispensers are designed for both products, but more commonly the powdered hot chocolate mixes are packaged in individual servings. Bulk dispensers are often used to decrease chances for theft.

The preparation of hot chocolate is designed to prevent hot chocolate mix from settling to the bottom of the finished drink. Starches in the mix are pregelatinized, expanded by the addition of moisture, to aid in preventing this settling. It is not desirable to hold the hot chocolate too long before it is consumed. This prevents scum from forming on the surface, the result of milk proteins separating.

**Carbonated Beverages**

Regular and low calorie carbonated beverages are a daily part of many people’s diet. When offered, these beverages often are served from remote syrup and carbonated gas dispensers in the cafeteria or dining room. To offer a wide variety, most quantity foodservices select dispensers that will provide four to five different carbonated beverages. Usually one of these five beverages is a low-calorie diet drink.

The Brix, the syrup/water concentration ratio in the drink, should be checked on a weekly basis to ensure the proper syrup concentration is maintained. This will assist the foodservice manager to control product costs and also ensure the quality of these beverages.

A major problem with bulk dispensers is that beverages are usually served unsealed. These cups and serving vessels will not retain the carbonated gas in the beverage for extended periods of time. Therefore, quantity foodservices that serve other locations usually choose to provide these beverages in sealed cans.

Cans also are used for tray service. The 8 or 10 ounce plastic bottles or aluminum cans are available from some manufacturers. This smaller size is often preferred in nursing facilities.

**CONVENIENCE FOODS**

Convenience foods were a novelty 30 years ago. With the advent of the microwave oven, the more packaging choices and the marketing of fast foods, society has accepted convenience foods as a way of life. However, quantity foodservices must consider the time, costs, and public acceptance in using such products.

Convenience foods are available in many forms. Any food item that has been partially processed before it is delivered to the foodservice is a convenience food. These foods are purchased either as total convenience ready for service or as partially prepared ingredients for use in other recipes. Frozen desserts, bakery rolls and dough, canned puddings and pie fillings, pregelatinized flour, frozen eggs, pies, pastries, and entrees, are only a few examples of the many convenience foods that are available.

Many of these foods are partially or even completely prepared and ready for service. Foods like unbreaded fish fillets are convenient parts of the finished fish entree. The manufacturer has partially prepared the standardized fish fillet by cutting the fillets at the processing plant.
Partially processed fruits and vegetables purchased from a produce company also would qualify as a convenience food. Products like carrot salad, potato salad, coleslaw, and macaroni salad are only a few of the convenient produce foods available. Some produce companies will make the products according to individual specifications. This can help the foodservice manager with limited staff satisfy the production demands of an extensive menu.

Puff pastry is another example of a ready-to-bake convenience food. It may be filled with a meat mixture, folded, sealed, and baked for service as a main entree or used in desserts like apple turnovers.

Frozen convenience foods have a better quality and taste if they are tempered or allowed to defrost slowly while under refrigeration of 28 to 30 F. The manufacturer instructions should be followed for thawing and final cooking.

Frozen convenience foods should be placed in the freezer immediately after being received. Due to texture changes that may occur, these foods should not be allowed to partially or completely thaw and then be refrozen. Not all convenience foods are necessarily purchased. If quantity foodservices have qualified personnel available and the necessary freezer space, foods like lasagna can be cooked and frozen for later service. Close monitoring is necessary to ensure proper sanitation, preparation, and storage temperatures and stock rotation are maintained with such cook-chill operations.

Most likely, convenience food will never replace all conventional cooking methods. However, these foods will continue to supplement the menu in providing variety and appeal. Quantity foodservices will need to continue to judge the advantages and disadvantages of using convenience foods.

Both the quality and price of these foods must be considered before they are introduced on the menu. If skills of foodservice workers are very limited, it might be necessary for the manager to place a number of convenience foods on the cycle menu. This will ensure that a variety of selections are available. Many operators offer one or two entrees prepared from scratch in combination with convenience foods. However, the quality and acceptability of these convenience foods must be watched closely. Some clients and administrators believe convenience products should not be substituted for those produced by the facility.

An analysis is necessary to compare the cost of convenience and conventional products. At the same time; a comparison of color, texture, flavor, eye appeal, ease of portioning, and mouth feel can be made. The portion size for each product must be standardized to make a fair cost comparison.

Convenience foods, already partially cooked, can rapidly spoil. They should not be left outside their storage areas for more than a short time. Reconstituting, the process of preparing it for service also should be monitored carefully to ensure optimum quality standards are maintained. As with any food item, stock should be dated when received and rotated on a first-in, first-out basis.

Frozen food should be stored at -0 F or lower; dry and canned products should be stored in a dry, cool area; and refrigerated foods should be stored below 40 F. Once a frozen convenience food has been thawed, it should be used within 72 hours. The threat of spoilage from microorganisms is increased greatly in a thawed product.

The defrosting necessary for frozen convenience food should be done under refrigeration. This minimizes the cost and time of reheating the product.
The amount of time allowed for defrosting while under refrigeration is determined by the size and density of the frozen food. For example, a spinach souffle will take considerably less time to defrost than a case of frozen, precooked turkey breasts. The spinach may take only 24 hours to defrost while the latter may take as much as 48 hours. Most convenience products provide instructions on the container to accurately determine defrosting times.

Dried, freeze-dried, and dehydrated convenience foods like onions flakes, dry soups, instant potatoes, and some stuffing mixes have a very long shelf life if kept in a clean, dry, and cool storage area. Manufacturer's instructions for rehydrating should be followed. It is important to remember that if a quantity recipe calls for a certain amount or weight of fresh product, this would be equal to the same weight of rehydrated product, not the dry weight.

Many quantity foodservices use canned convenience products to supplement their menu. These products are very stable and have a long shelf life if stored in a clean, dry, and cool storage area. Products like spaghetti sauce, ravioli, clam sauce, and chili can be heated very quickly to provide instant relief production shortages during peak work periods or staff shortages.

Many manufacturers have designed their convenience foods to be prepared in a microwave. Some specify that the product is first heated using the defrosting cycle and then cooked on the regular cooking cycle.

Convenience products designed for the bakery are especially helpful. It allows a large variety of freshly baked products to be offered on the menu. Frozen croissants, frozen doughs, and puff pastry are a few of the choices available that might otherwise not be possible to serve.

Manufacturers specializing in these products can produce a high-quality product for a reasonable cost. However, many foodservices do not have properly trained personnel for handling these delicate products, the correct equipment and ingredients, or the necessary time. The labor and ingredient costs and quality must be compared to "from scratch" products when making decisions of whether or not to use convenience foods.

**SUMMARY**

Serving beverages of best quality is possible only when dispensing machines are properly cleaned and maintained. Machines for coffee and carbonated beverages help produce and serve beverages made correctly and at the best temperature. Milk can be served from individual half-pint cartons or 5 gallon dispensing machines. Careful rotation of stock to avoid having milk on hand past its expiration date is important.

Convenience foods in a wide range of preparation stages are used in quantity foodservice. Optimum convenience products can be served when high-quality items are purchased, stored correctly and heated appropriately.
APPENDIX B.

MULTIPLE CHOICE DISTRACTOR SELECTION PERCENTAGES, DIFFICULTY AND DISCRIMINATION VALUES, AND STEM COGNITIVE LEVEL
Table B.1. Test A: Multiple choice distractor selection percentages, difficulty and discrimination values, and stem cognitive level

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APPENDIX C.

ACHIEVEMENT TESTS, TESTING CONSENT AND DIALOGUE, AND LEARNING STYLE AND DemoGRAPHIC QUESTIONNAIRES
1. Which of the following group of fruits are the best the source of vitamin A?
   A. Peaches, cantaloupe, and apricots.
   B. Apples, pears, and watermelons.
   C. Berries, bananas, and currents.
   D. Grapes, melons, and peaches.

2. Which of the following is used as a preservative for fruit to extend shelf-life and enhance visual appearance?
   A. Ethylene gas.
   B. Anti-oxidant powder.
   C. Carnauba wax coating.
   D. Aerosol polymer sealants.

3. To maintain the quality of canned fruit in a quantity foodservice operation, which of the following is NOT true?
   A. Canned fruit should be stored in a dry environment not to exceed 85 degrees F.
   B. A dry, cool, dark storage area should be provided.
   C. Cases of canned fruit should be stored and used on a first-in, first-out basis.
   D. Canned fruit should be removed from the can and placed in plastic storage containers.

4. Why do many fruits like bananas, apples, and pears turn brown after they are cut?
   A. Ascorbic acid interaction with fructase.
   B. Oxidizing action with fruit enzymes.
   C. Exposure of the fruit surfaces to metal.
   D. Anaerobic microorganisms.

5. The recommended solution used in health care foodservices to prevent the browning of fruit is:
   A. A heavy concentration of sugar.
   B. An acidic fruit juice.
   C. Commercial anti-oxidants.
   D. A strong solution of vinegar and water.

6. If a recipe calls for whole-wheat flour for a particular bakery item but none is available; you, as the foodservice manager could substitute:
   A. Carmelized starch for the sugar.
   B. Miller's bran for the white flour.
   C. Baker's gluten for the white flour.
   D. One-half cake flour in place of all purpose flour.

7. Patent flour should be used primarily for the following baked products:
   A. Cakes and delicate baked goods.
   B. High fiber breads and muffins.
   C. Rye breads and pie doughs.
   D. White bread and whole-wheat bread.
8. Which would be the best temperature range for optimum proofing?
   A. 85-95 degrees F.
   B. 72-80 degrees F.
   C. 90-115 degrees F.
   D. 75-100 degrees F.

9. As the foodservice manager, you decide that one yeast bread appears too dense and the loaf size is only one-half of what it should be. Which of the following is most likely to have happened?
   A. The oven is too cold during baking.
   B. The flour has too little gluten.
   C. There is too little sugar in the recipe.
   D. The raw dough was not properly shaped.

10. If you notice large blisters on the upper crust of a fresh batch of clover-leaf dinner rolls, which one of the following might be responsible?
    A. There were no enough liquid ingredients in the recipe.
    B. The baking time was too long.
    C. There was too little yeast in the recipe.
    D. The dough was allowed to proof too long.

11. The main function of eggs in a quick bread recipe is to:
    A. Improve the elasticity of the gluten.
    B. Reduce the amount of structure in the final product.
    C. Help hold in the steam and moisture.
    D. Provide the proper crust thickness and color.

12. The addition of lemon juice to the water for cooking cauliflower will help:
    A. Tenderize the cauliflower.
    B. Destroy the vitamin C content.
    C. Turn the cauliflower pale yellow.
    D. Help retain the white color of the cauliflower.

13. Which of the following vegetables should be covered when simmered?
    A. Broccoli.
    B. Whole-kernel corn.
    C. Peas.
    D. Brussels sprouts.

14. Vitamin C can be destroyed or lost when it is added to:
    A. A baking soda solution.
    B. A neutral cooking medium.
    C. An acid cooking medium.
    D. An acid-ash solution.

15. Which of the following should be cooked without a lid or with vented steam?
    A. Carrots.
    B. Potatoes.
    C. Broccoli.
    D. Beets.
16. If cooked in an acid solution such as diluted lemon juice, asparagus will turn:
   A. Light brown.
   B. Bright green.
   C. Olive green.
   D. Dark brown.

17. Peppers, squash, and cucumbers are examples of which type of vegetable:
   A. Tuber.
   B. Root.
   C. Flower.
   D. Fruit.

18. The following Italian dressing recipe is an example of:
   Recipe Ingredients: Dry mustard, salt, black pepper, ground oregano, garlic salt, onion salt, vinegar, and salad oil.
   A. A vinaigrette dressing.
   B. An emulsified dressing.
   C. A modified sweet and sour dressing.
   D. An egg yolk-based dressing.

19. When purchased, frozen vegetables are:
   A. Raw.
   B. 20% cooked.
   C. 50% cooked.
   D. 90% cooked.

20. The ideal holding time for most cooked vegetables is:
   A. 20 minutes.
   B. 1 hour.
   C. 2 hours.
   D. None of the above; serve at once.

21. In what order should salad greens, plates, dressing, and condiments appear on the salad bar:
   A. Salad greens, condiments, dressing, and plates.
   B. Salad plates, greens, condiments, and dressing.
   C. Salad condiments, dressing, greens, and plates.
   D. None of the above.

22. What is the basic ratio of oil to vinegar in a basic French Dressing?
   A. 2 parts oil to 1 part vinegar.
   B. 3 parts oil to 1 part vinegar.
   C. 4 parts oil to 1 part vinegar.
   D. 5 parts oil to 1 part vinegar.

23. Which of the following contains the most gluten?
   A. Whole wheat flour.
   B. Pastry flour.
   C. Bread flour.
   D. Pumpernickel flour.
24. Yeast is killed at a temperature of:
   A. 60 degrees F.
   B. 80 degrees F.
   C. 90 degrees F.
   D. 110 degrees F.

25. Salt is used in yeast doughs because it:
   A. Provides a food source for yeast.
   B. Slows yeast development.
   C. Kills the fructase enzyme.
   D. All of the above.

26. In making a cake the sugar and fat are beaten together to form small bubbles of air, the
    process is called:
   A. Foaming.
   B. Creaming.
   C. Emulsifying.
   D. Fermenting.

27. Which of the following is NOT a function of sugar in cakes?
   A. Provide the structure.
   B. Prevent the cake batter from foaming.
   C. Develop browning of the crusts.
   D. Sweeten and provide flavor.

28. Which of the following is NOT a function of fat in bakery products?
   A. Provide structure.
   B. Increase shelf life.
   C. Add moistness.
   D. Tenderize.

29. The gravy to be served for lunch developed a one-half inch layer of fat on the top when it
    was refrigerated overnight. What procedure should be used to heat the gravy?
   A. Stir in more roux and reheat in the steamer.
   B. Add instant mashed potatoes to absorb the fat.
   C. Add more liquid then reheat the gravy.
   D. Heat the gravy then stir flour into the mixture until the fat is absorbed.

30. What type of white sauce is the base for cream soups?
    A. Thin.
    B. Medium.
    C. Thick.
    D. Very thick.

31. When you are checking the cafeteria serving line, you notice that the cream of tomato soup
    is curdled. Which of the following would most likely not have been the cause?
    A. The soup was held too long at high temperatures on the serving line.
    B. The tomato juice was added too quickly to the white sauce base.
    C. The soup was made too far in advance of use and held under heat.
    D. Serving line personnel were stirring the soup while it was being served.
32. A cold uncooked soup made by pureeing raw vegetables is called:
   A. Borscht.
   B. Gazpacho.
   C. Mulligatawny.
   D. Olla podrida.

33. Which of the following types of vegetables would be the best choice for soup ingredients?
   A. Canned vegetables.
   B. Fresh raw produce.
   C. Left-over cooked vegetables.
   D. All of the above.

34. Which of the following would help eliminate the starch taste in cream of mushroom soup?
   A. Strain the soup and cool.
   B. Reduce the amount of salt in the recipe.
   C. Reduce the amount of pepper in the recipe.
   D. Additional simmering of the soup.

35. The texture of a cream soup may be adjusted by:
   A. Adding beurre manie.
   B. Adding stock or cream.
   C. Reducing by additional cooking.
   D. All of the above.

36. Minnestronne is what type of soup?
   A. Clear soup.
   B. Cream soup.
   C. Potage, naturally thickened soup.
   D. Cold soup.

37. Vichyssoise is classified as a:
   A. Clear soup.
   B. Cream soup.
   C. Potage, naturally thickened.
   D. Thin soup.

38. Coffee brewed in a three-gallon coffee urn requires a brewing time of:
   A. 8 to 10 minutes.
   B. 4 to 6 minutes.
   C. 2 to 5 minutes.
   D. 10 to 12 minutes.

39. In holding coffee for service later, should be held at:
   A. 190 to 200 degrees for less than 2 hours.
   B. 185 to 190 degrees for less than 1 hour.
   C. 185 to 190 degrees for less than 2 hours.
   D. 190 to 200 degrees for less than 1 hour.

40. The proper proportion of ground coffee to water is one pound of coffee to:
   A. One gallon of water.
   B. Four gallons of water.
   C. Two gallons of water.
   D. Three gallons of water.
41. What is the proper temperature of water for brewing coffee:
   A. 212 degrees F.
   B. 185-200 degrees F.
   C. 195-200 degrees F.
   D. 200-210 degrees F.

42. Which of the following is NOT a cause of off flavors in coffee?
   A. The coffee urns were not rinsed properly after cleaning.
   B. No weekly cleaning schedule has been established for the coffee urn.
   C. There was a build up of coffee oils and acids in the coffee urn.
   D. The coffee urn had not been seasoned after its weekly cleaning.

43. The most popular type of tea in the United States is:
   A. Ginseng.
   B. Chinese.
   C. Green.
   D. Black.

44. Oolong, green, and black teas:
   A. Originate in different parts of the world.
   B. All can be made from the same tea leaf.
   C. Are named for their region or origin.
   D. Are all produced from different tea leaves.

45. Tea should be steeped in hot water for:
   A. 1 to 2 minutes.
   B. 2 to 3 minutes.
   C. 3 to 4 minutes.
   D. 4 to 5 minutes.

46. What percentage of the muscle tissue in meat is water?
   A. 25%.
   B. 50%.
   C. 65%.
   D. 75%.

47. What does the term "green meat" mean?
   A. Meat that is aged in a cryo-vac bag.
   B. The meat is an inferior grade.
   C. Meat that is not aged sufficiently.
   D. Meat that has surface mold.

48. What is the most accurate method to check the doneness of a large roast?
   A. Follow the roasting time specified on the recipe.
   B. Use a fork to check the roast for firmness and tenderness.
   C. Use a thermometer to check the internal temperature.
   D. Cut the roast with a knife to check the color.

49. Browning meat at high temperatures prior to roasting:
   A. Seals the surface and helps retain the meat's juices.
   B. Reduces the length of roasting time.
   C. Develops flavor and color in small roasts.
   D. Reduces the amount of shrinkage and water loss.
50. What is the most frequently used grade of fresh beef used in quantity foodservice operations?
   A. USDA Choice.
   B. USDA Good.
   C. USDA Prime.
   D. USDA Extra.

51. Tenderness in meat is most affected by:
   A. The cut of meat chosen.
   B. The grade of meat chosen.
   C. The age of the animal.
   D. All of the above.

52. The marbling in meat refers to its:
   A. Elastin.
   B. Collagen.
   C. Exterior fat.
   D. Interior fat.

53. What cooking method is usually used for steaks and chops?
   A. Broiled or grilled.
   B. Broasted.
   C. Deep-fried.
   D. Braised.

54. Which of the following should be purchased to make oven fried chicken?
   A. Broiler.
   B. Hen.
   C. Capon.
   D. Roaster.

55. When touring the kitchen you observe a cook use a cutting board for lettuce salad preparation that had just been used to cut up raw chicken. What is the most serious hazard in this situation?
   A. Contamination of the lettuce with salmonella.
   B. Transfer of chicken flavors to the lettuce.
   C. Infecting the cook with salmonella.
   D. Contamination of the cutting board by the dirty lettuce.

56. Fresh fish should have which appearance?
   A. Soft, loose flesh.
   B. A fishy smell.
   C. Gray gills.
   D. Bright, bulging eyes.

57. Fish with a series of jointed shells are called:
   A. Mollusks.
   B. Crustaceans.
   C. Flatfish.
   D. Fumets.
58. The count on a box of shrimp indicates the number of shrimp in:
   A. The box.
   B. Five pounds.
   C. One pound.
   D. One ounce.

59. Which of the following fish can be classified as lean?
   A. Mackerel.
   B. Salmon.
   C. Pompano.
   D. Flounder.

60. The final internal temperature indicating poultry is approximately cooked is:
   A. 135 degrees F.
   B. 160-170 degrees F.
   C. 180-185 degrees F.
   D. 185-195 degrees F.

61. When roasting a 25-pound turkey you should:
   A. Start cooking it at 375-400 degrees F for browning and then turn the oven to 300 degrees and roast until done.
   B. Roast it at 275-300 degrees F until it is nearly done and then turn the oven to 375-400 degrees F for browning.
   C. Roast it at 325 degrees F until it is done.
   D. Roast it at 375 degrees F until it is done.

62. Fish fillets baked on a sheet pan should be:
   A. Coated with fat on the bottom side.
   B. Brushed lightly with fat on the top surface.
   C. Coated lightly with fat on both sides.
   D. Brushed with fat after baking.

63. Beef pot roast is best when cooked by which method?
   A. Roasting.
   B. Braising.
   C. Simmering.
   D. Broiling.

64. In meat cookery all but one of the following are examples of moist-heat cooking:
   A. Deep-frying.
   B. Braising.
   C. Steaming.
   D. Boiling.

65. Heat causes the protein in meat to:
   A. Gelatinize.
   B. Dissolve.
   C. Coagulate.
   D. Caramelize.
66. Which of the following is not an example of dry-heat cooking:
   A. Sauteing.
   B. Poaching.
   C. Broiling.
   D. Roasting.
1. What should you do if you received a shipment of green, unripe bananas?
   A. Place them under refrigeration in the original container until the desired color and ripeness are achieved.
   B. Keep them sealed inside the plastic bags in which they are shipped and store at room temperature.
   C. Open the plastic shipping bags and allow them to ripen at room temperature.
   D. Place them on trays in single layers and refrigerate them.

2. Upon receiving a flat of fresh strawberries to be served the next day, what procedure should you follow:
   A. Wash and sort prior to refrigeration in sealed plastic containers.
   B. Sort and refrigerate them in the container in which they were received.
   C. Sort, remove the stems, and refrigerate them in sealed plastic containers.
   D. Wash and sprinkle them with sugar prior to refrigeration.

3. Yeast breads are baked dough normally made from:
   A. Cake flour, water, simple syrup, and baking powder.
   B. Flour, water, sugar, and yeast.
   C. Flour, milk, cornstarch, and yeast.
   D. Flour, water, yeast, and baking soda.

4. The major difference between bread flour and all-purpose flour is the amount of:
   A. Endosperm content in all-purpose flour.
   B. Gluten each flour contains.
   C. Grinding and coarseness of the flour.
   D. The color of the flours.

5. All-purpose flour is formulated to be:
   A. Higher in gluten content than bread flour.
   B. Slightly weaker than bread flour.
   C. An equal substitute for all bread flour.
   D. Slightly stronger than bread flour.

6. Why does whole-wheat flour have a shorter shelf life than white all-purpose flour?
   A. The inferior grade gluten deteriorates quickly.
   B. The endosperm becomes rancid.
   C. The additional outer layer of bran becomes too coarse.
   D. The wheat germ becomes rancid.

7. The muffin method of mixing quick breads emphasizes that:
   A. Fat is cut into the dry ingredients prior to the addition of the moist ingredients.
   B. Fats and sugars are creamed prior to the addition of the dry and moist ingredients.
   C. Dry ingredients are mixed together then the eggs, milk, and oil are added all at once.
   D. Creamed fat is cut into the dry ingredients before the addition of the moist ingredients.
8. Which of the following would most likely be responsible for a cake to fall?
   A. Too many eggs in the recipe.
   B. Excessive salt in the recipe.
   C. Excessive sugar in the recipe.
   D. Extra gluten in the flour.

9. Cream of tartar is added to angel food cake to:
   A. React with the baking powder.
   B. Produce larger air cells in the egg white mixture.
   C. Stabilize the egg whites and to increase the volume.
   D. Reduce the acidity of the mixture to add stability.

10. Which one of the following statements is FALSE?
    A. Angel cakes are more delicate than chiffon cakes.
    B. Angel cakes and chiffon cakes utilize beaten egg whites.
    C. Egg whites used in chiffon cakes should be beaten to the soft-peak stage.
    D. The beaten egg whites in chiffon cakes help add volume to the egg yolk mixture.

11. Which of the following could be added to freshly cut apples to prevent oxidation?
    A. Celery juice.
    B. Apple juice.
    C. Lemon juice.
    D. Papaya juice.

12. You notice that after cooking frozen green peas in a compartment steamer, some of the peas are not completely cooked. Which one of the following could be a possible reason for this situation:
    A. The steam pressure and therefore the cooking temperature was set too high.
    B. The vegetables were mounded three inches deep in the center of the pan.
    C. The cooking pan had only one eighth inch of water added before cooking.
    D. The compartment steamer was set on the vented setting.

13. Red vegetables containing anthocyanin coloring should be simmered:
    A. Without the lid in an acidic solution.
    B. With the lid in an alkaline solution.
    C. With or without a lid in an alkaline solution.
    D. With the lid in an acidic solution.

14. Most of the calories contained in a green salad are contained in:
    A. The salad lettuce leaves.
    B. The salad liner.
    C. The salad dressing.
    D. The salad body.

15. Gelatin salads made from sweetened gelatin mixes which call for additional fruits and fruit juices like oranges and grapefruit will require:
    A. Additional cool water during initial preparation to dissolve the gelatin granules.
    B. Extra gelatin to compensate for the acidic fruit juice.
    C. Sugar to stabilize and offset the effects of the additional fruit juice.
    D. Water to dilute the concentration of the acidic fruit juices.
16. Which of the following fresh fruits should not be added fresh to a gelatin salad?
   A. Strawberries.
   B. Pineapple.
   C. Cantaloupe.
   D. Red cherries.

17. Which of these pairs of salad greens should NOT be used by themselves in a salad?
   A. Boston bib lettuce and romaine.
   B. Watercress and iceberg lettuce.
   C. Chicory and Escarole.
   D. Red leafed lettuce and kale.

18. What is the main salad green in Caesar Salad?
   A. Iceberg lettuce.
   B. Romaine.
   C. Escarole.
   D. Watercress.

19. Overcooking of vegetables causes all of the following EXCEPT:
   A. Color change.
   B. Retention of vitamin.
   C. Poor texture.
   D. Flavor change.

20. A patient complained that the whole wheat bread was flat and very dense. Upon investigation, you discover that the baker had used graham flour for 100% of the flour called for in the recipe. Which one of the following might improve the recipe?
   A. Increase the sugar content in the recipe.
   B. Reduce the fat content in the recipe.
   C. Add bread or patent flour to the recipe.
   D. Substitute baking soda for yeast in the recipe.

21. Which one of the following is NOT a preparation method of yeast doughs?
   A. The biscuit method for dough.
   B. The straight dough method.
   C. The sponge method for dough.
   D. The modified straight dough method.

22. Which one of the following is the correct definition for rolled cookies:
   A. A pastry dough that is soft and holds its shape on the baking surface.
   B. A stiff pastry dough that can be manipulated and cut before it is placed on the cookie sheet.
   C. A pastry dough slightly softer than biscuit dough.
   D. A very soft pastry dough that can be portioned by spoon.

23. Which of the following ingredients accounts for the leavening in waffle batter?
   A. Baking soda and buttermilk acids.
   B. Baking powder and liquids.
   C. Cake flour and baking soda
   D. Brewer's yeast and sugar.
24. Which flour is most appropriate for making apple turnovers?
   A. Bread.
   B. Cake.
   C. Pastry.
   D. All-purpose.

25. Quick breads were given this name because:
   A. They are quickly put together.
   B. They bake in the oven quickly.
   C. They must be mixed to form strong gluten.
   D. The leavening requires that they be baked quickly.

26. In making yeast products, proofing refers to:
   A. Kneading the dough to develop the gluten.
   B. Testing the baked product for doneness.
   C. Allowing the dough to ferment a second time.
   D. Testing the internal temperature of fermenting dough.

27. During the process of photosynthesis, plants store energy in the form of:
   A. glycogen.
   B. starch.
   C. vegetable fat.
   D. pollen and sugar.

28. Which one of the following preparation techniques is used for mixing a roux?
   A. Starch, along with all the other dry ingredients, is added to the other liquids and oils.
   B. Starch is stirred into cold water to make a thin paste, then is added to the melted fat.
   C. Starch and melted fat are stirred to make a paste which is added to the liquids.
   D. Starch and sugar are mixed prior to being added to the liquids.

29. While you are preparing a roux, you notice it has small lumps. What is probably the cause for these lumps?
   A. Vegetable oil instead of melted shortening was used.
   B. Too much fat was added to the roux.
   C. The liquid was added before the flour and fat were cooked together.
   D. Rye flour was used instead of all-purpose flour.

30. Which of the following has the most thickening power:
   A. wheat flour.
   B. cornstarch.
   C. rye flour.
   D. miller's bran.

31. During the preparation of pudding, you instruct the cook to stir the mixture occasionally to:
   A. Help mix the starch evenly throughout the mixture.
   B. Help blend the starch to the sugar in the mixture.
   C. Help mix the starch to it from binding with the fat.
   D. Help blend the starch and other carbohydrates in the mixture.
32. Starches in many pie fillings and pudding mixes do not require the addition of heat during the stirring phase of the recipe because the starches have:
   A. Additional sugar added to help them disperse the individual starch granules.
   B. Been pre-gelatinized by precooking and drying.
   C. Already been blended with the other dry ingredients to assist in their dispersion.
   D. Been pre-thickened with artificial ingredients.

33. Pudding mixtures that are acidic, like lemon pudding, require the mixture:
   A. Be cooled slowly.
   B. Starches be pre-gelatinized.
   C. Be cooled quickly.
   D. Be stirred, while cooling slowly.

34. Which of the following is not a starch that can be used to thicken puddings:
   A. Tapioca.
   B. Flour.
   C. Papaya root starch.
   D. Cornstarch.

35. What can be done to improve a brown sauce that is too thin? Additional:
   A. Flour can be added to the mixture.
   B. Dextrinized starch can be added to the mixture.
   C. Browned flour can be added while increasing the heat to the mixture.
   D. Fat drippings can be added to bond with the starch in the mixture.

36. The starch used to thicken cream pie fillings is:
   A. Bran flour.
   B. Cornstarch.
   C. All-purpose flour.
   D. Unflavored gelatin.

37. What type of white sauce should be used in a macaroni and cheese recipe:
   A. Thin.
   B. Medium.
   C. Thick.
   D. Very thick.

38. In Iowa whole milk contains what percent butterfat?
   A. 1.5% - 2.5%.
   B. 2.5% - 3.5%.
   C. 3.5% - 4.0%.
   D. 4.0% - 4.5%.

39. Public school food services specify skim milk should not contain more than:
   A. 1% butterfat.
   B. 1.5% butterfat.
   C. .5% butterfat.
   D. .75% butterfat.
40. Bricking in carbonated beverages refers to the concentration of:
   A. Carbon dioxide gas to the water in the syrup mixture.
   B. Syrup in the syrup-water mixture.
   C. Carbon dioxide in the syrup-water mixture.
   D. Water in the syrup-water mixture.

41. How often should the bricking in carbonated beverages be checked?
   A. Daily.
   B. Weekly.
   C. Monthly.
   D. Yearly.

42. When the convenience food directions specify thawing before cooking, which of the
    following defrosting procedures is best?
   A. Thawed in the microwave.
   B. Set out at room temperature.
   C. Submersed in cool water.
   D. Thawed in the refrigerator.

43. Upon making an inventory inspection of your cook's walk-in refrigerator, you notice a pan
    of cooked lasagna dated two days ago. What should you do with this convenience food?
   A. Serve the lasagna that same day.
   B. Dispose of the lasagna as soon as possible.
   C. Keep the lasagna refrigerated and serve within 2 days.
   D. Keep the lasagna refrigerated and serve within 3 days.

44. In brewing ice tea which procedure should be followed.
   A. Pour the cold water into the hot tea concentrate.
   B. Pour the hot tea concentrate into the cold water.
   C. Add ice to the hot tea concentrate.
   D. None of the above.

45. Which of the following is NOT an attribute of frozen liquid coffee concentrate?
   A. It can be stored for long periods.
   B. The quality of each cup can be easily standardized.
   C. The aroma is superior to coffee made in an urn.
   D. Less space is required for coffee brewing equipment.

46. Which is NOT one of the major problems with powdered ice tea dispensers?
   A. The powdered tea often becomes clogged in the dispenser.
   B. Humidity in the air affects the water concentration.
   C. The tea crystals do not evenly disperse in the beverage.
   D. The powder often become compacted inside the jar.

47. The most suitable fat for the deep fryer is:
   A. Hydrogenated vegetable oil.
   B. Animal fat such as lard.
   C. Olive oil.
   D. Butter or margarine.
48. All but one of the following indicate the breakdown of fat:
   A. Off flavor or odor.
   B. Smoking at cooking temperatures.
   C. Yellow foam.
   D. Clear white bubbles.

49. When you flip food quickly in a small amount of fat in a pan over high heat, this type of cooking method is called:
   A. Sauteing.
   B. Stir-frying.
   C. Pan frying.
   D. Seasoning.

50. The center of a piece of meat cooked medium is:
   A. Deep pink and somewhat warm.
   B. Hot and pink.
   C. Cool and red.
   D. Warm and pink.

51. To cook a beef brisket you would:
   A. Simmer it.
   B. Broast it.
   C. Fry it.
   D. Steam it.

52. To cook a whole tenderloin of beef you would:
   A. Simmer it.
   B. Broast it.
   C. Fry it.
   D. Steam it.

53. All but which of the following are good tests for doneness in roasting?
   A. Loose joints.
   B. Internal temperature.
   C. Clear and translucent juices.
   D. Testing the breast with a fork.

54. Style of poultry refers to:
   A. Species of bird.
   B. Method of preparation.
   C. Degree of processing.
   D. Whether fresh or frozen.

55. A federal inspection stamp on a cut of meat indicates that the meat is:
   A. Aged properly.
   B. Tender and of good quality.
   C. A good proportion of lean to fat.
   D. Wholesome and good to eat.
56. Tenderness in cooked meat is determined by:
   A. The specific cut use.
   B. The cooking method used.
   C. The maturity of the animal.
   D. All the above.

57. The most accurate way to test the doneness of a large roast is to:
   A. Test the internal temperature with a meat thermometer.
   B. Press on the roast to feel how firm it is.
   C. Observe the roasting time given in the roasting chart, based on the weight of the roast and the oven temperature.
   D. Pierce the meat with a skewer or fork and check the color of the juices.

58. In meats, larding refers to:
   A. The exterior fat covering the meat.
   B. Inserting strips of fat with a needle into meats.
   C. Basting meats with fat during cooking to prevent drying.
   D. Interior fat that occurs naturally within muscle tissue.

59. Whole beaten eggs coagulate or are cooked at about what temperature:
   A. 140 degrees F.
   B. 155 degrees F.
   C. 185 degrees F.
   D. 212 degrees F.

60. Green egg yolks in hard-cooked eggs can be prevented by:
   A. Boiling in salted water.
   B. Adding baking soda to the cooking water.
   C. Adding a little vinegar to the cooking water.
   D. Using low temperatures and short cooking time.

61. Most quantity recipes calling for fresh shell eggs are based on what size of egg?
   A. Jumbo.
   B. Extra large.
   C. Large.
   D. Medium.

62. Egg whites will whip up into a better foam if they are:
   A. Well chilled.
   B. At room temperature.
   C. Mixed with a small amount of baking soda.
   D. Mixed with a small amount of oil.

63. A custard baked in a pastry shell is called a:
   A. Quiche.
   B. Fondue.
   C. Frittata.
   D. Sirniki.
64. One way to make hard-cooked eggs is to place them into boiling water, adjusting the heat, and simmering for:
   A. 3-4 minutes.
   B. 5-7 minutes.
   C. 12-15 minutes.
   D. 15-20 minutes.

65. Yogurt is:
   A. Milk cultured with bacteria.
   B. Fermented milk.
   C. Fermented half and half cream.
   D. Sour cream.

66. Unripened cheese include:
   A. Processed cheese.
   B. Brie.
   C. Mozzarella.
   D. All the above.
1. To cook tenderloin of beef, you should use which of the following cooking methods?
   A. Simmering.
   B. Steaming.
   C. Broiling.
   D. Any of the above methods.

2. The most popular type of tea in the United States is:
   A. Herb.
   B. Decaffeinated.
   C. Green.
   D. Black.

3. The proper proportion of ground coffee to water for large pour-over coffee urns is one pound of coffee to:
   A. One gallon of water.
   B. Two gallons of water.
   C. Three gallons of water.
   D. Four gallons of water.

4. How should broccoli be cooked?
   A. Slowly, in a covered container.
   B. Slowly, at medium heat in large amounts of water.
   C. Rapidly, at high heat in a small amount of water.
   D. Rapidly, in unvented steam.

5. Red cabbage and beets should be cooked in which of the following solutions to prevent color changes?
   A. Acidic.
   B. Alkaline.
   C. Basic.
   D. Neutral.

6. A federal inspection stamp on a cut of meat indicates the meat is:
   A. Properly aged.
   B. Of choice quality.
   C. Properly larded.
   D. Wholesome, good to eat.

7. Oven fried breaded fish fillets should be placed on a sheet pan and:
   A. Coated with fat on the bottom side.
   B. Crushed lightly with fat on the top surface.
   C. Coated lightly with fat on both sides.
   D. Brushed with lemon juice.
8. The addition of vinegar to the water for cooking cauliflower will:
   A. Tenderize the cauliflower.
   B. Toughen the cauliflower.
   C. Turn the cauliflower light brown.
   D. Help retain the white color.

9. Coffee brewed in a 1-2 quart pour-over coffee maker requires a brewing time of:
   A. 2-5 minutes.
   B. 4-6 minutes.
   C. 8-10 minutes.
   D. 10-12 minutes.

10. Fish with a series of jointed shells are called:
    A. Mollusks.
    B. Crustaceans.
    C. Oculars.
    D. Encrustaceans.

11. Hot coffee can be held at:
    A. 185-190°F for less than 1 hour.
    B. 185-190°F up to 2 hours.
    C. 190-200°F for less than 1 hour.
    D. 190-200°F up to 2 hours.

12. Which of the following shortens the shelf life of whole wheat flour?
    A. Gluten.
    B. Endosperm.
    C. Bran.
    D. Wheat germ.

13. Which of the following would be best for preventing oxidation in freshly cut apples?
    A. Water.
    B. Apple juice.
    C. Lemon juice.
    D. Vinegar and water.

14. Which would be the best temperature range for optimum proofing of yeast bread?
    A. 72-80°F.
    B. 85-95°F.
    C. 75-100°F.
    D. 95-115°F.

15. A beef brisket should be cooked by which of the following methods?
    A. Simmering.
    B. Broasting.
    C. Frying.
    D. Steaming.
16. Tenderness in cooked meat is influenced by the:
   A. Amount of connective tissue.
   B. Cooking method used.
   C. Maturity of the animal.
   D. All of the above.

17. Which of the following describes the best method for mixing muffins?
   A. Fat is cut into the dry ingredients before the addition of the liquid.
   B. Oil and sugar are creamed before the addition of the dry ingredients and liquid.
   C. Dry ingredients are mixed together then the eggs, milk, and oil are all added at once.
   D. The fat and liquids are mixed together before the dry ingredients are added.

18. The following Italian dressing recipe is an example of: Recipe
   Ingredients: Salad oil, vinegar, dry mustard, salt, black pepper, ground oregano, garlic salt, and onion salt.
   A. A vinaigrette dressing.
   B. A permanent emulsion.
   C. A temporary emulsion.
   D. A non-permanent emulsion.

19. If citrus juice was used to replace half of the cold liquid in a sweetened lime gelatin and grapefruit salad, what adjustment in the basic recipe would be needed?
   A. The total cold liquid would be increased because of the additional water necessary to dilute the citrus juice.
   B. Extra gelatin would be needed to compensate for the fruit juice.
   C. Additional sugar would be necessary to offset the effects of the fruit juice.
   D. All of the above.

20. The inside of meat cooked to medium is:
   A. Deep pink and somewhat warm.
   B. Pink and hot.
   C. Light brown and hot.
   D. Pink and warm.

21. The major difference between bread flour and all-purpose flour is the amount of ________ in the flour.
   A. Starch.
   B. Gluten.
   C. Coarseness.
   D. Color.
22. What is the approximate final internal temperature that indicates poultry is cooked?
A. 150°F.
B. 165°F.
C. 180°F.
D. 195°F.

23. All-purpose flour, when compared to bread flour, is:
A. Slightly higher in gluten content than bread flour.
B. Much higher in gluten content than bread flour.
C. Equal in gluten content to bread flour.
D. Slightly lower in gluten content than bread flour.

24. Which grade of beef is most commonly used in quantity foodservices?
A. USDA Choice.
B. USDA Commercial.
C. USDA Prime.
D. USDA Utility.

25. When doing the daily inventory of the walk-in refrigerator, you notice a pan of cooked lasagna that was heated and held for 1 hour two days ago. The lasagna is a convenience food. What should you do with this food?
A. Serve the lasagna that same day.
B. Dispose of the lasagna as soon as possible.
C. Keep the lasagna refrigerated and serve within 2 days.
D. Keep the lasagna refrigerated and serve within 3 days.

26. Vitamin C in cabbage is destroyed when placed in cooking water that:
A. Has baking soda added.
B. Has acid added.
C. Is basic.
D. Is neutral.

27. Green peppers, summer squash, and cucumbers are examples of which type of vegetable?
A. Tuber.
B. Root.
C. Flower.
D. Fruit.

28. Which one of the following statements is FALSE?
A. Angelfood cakes are more delicate than chiffon cakes.
B. Angelfood cakes and chiffon cakes use beaten egg whites.
C. Egg yolks used in chiffon cakes should be beaten to the soft peak stage.
D. The beaten egg whites in chiffon cakes help add volume to the egg yolk mixture.
29. Why do many fruits like bananas, apples, and pears turn brown after they are cut?
   A. Ascorbic acid interaction with fructose.
   B. Oxidizing action with fruit enzymes.
   C. Chemical reaction with the storage container.
   D. Contamination by bacteria.

30. As the foodservice manager, you decide that the yeast bread appears too dense and the loaf size is only one-half of what it should be. Which of the following is most likely to have happened?
   A. The baking temperature was too high.
   B. The flour had too little gluten.
   C. There was too little yeast in the dough.
   D. The pans were overgreased.

31. In making a cake, the sugar and fat are beaten together to form small bubbles of air. This process is called:
   A. Foaming.
   B. Creaming.
   C. Whipping.
   D. Extruding.

32. When the convenience food directions specify thawing before cooking, which of the following defrosting procedures is best? Thaw:
   A. In the microwave.
   B. Submersed in hot water.
   C. In cool water.
   D. In the refrigerator.

33. Quick breads were given this name because they:
   A. Are easily assembled.
   B. Must be cooled rapidly after being baked.
   C. Must be mixed rapidly to form strong gluten.
   D. Are baked immediately due to the leavening.

34. Which of the following would be selected for cooking steaks and chops?
   A. Broiled or grilled.
   B. Broasted.
   C. Deep fried.
   D. Braised.

35. How often should the Brix of carbonated beverages be checked?
   A. Daily.
   B. Weekly.
   C. Monthly.
   D. Biweekly.
36. What should you do if you receive a shipment of green bananas?
   A. Place them under refrigeration in the original container until
      the desired color and ripeness are achieved.
   B. Keep them sealed inside the plastic bags in which they are
      shipped and store at room temperature.
   C. Open the plastic shipping bags and allow them to ripen at room
      temperature.
   D. Place them on trays in single layers and refrigerate them.

37. In you have patent flour on hand, in which of the following products
    should it be used?
   A. Cakes and delicate baked goods.
   B. High fiber breads and muffins.
   C. Rye breads and pie doughs.
   D. White bread and whole wheat bread.

38. The marbling in meat refers to its:
   A. Fat conformation.
   B. Interior collagen.
   C. Exterior collagen.
   D. Interior fat.

39. Which of the following is the best holding time for cooked
    vegetables?
   A. 30 minutes.
   B. 45 minutes.
   C. 1 hour.
   D. None of the above, serve at once.

40. Upon receiving a flat of fresh strawberries to be served the next
    day, what procedure should you follow?
   A. Wash and refrigerate in sealed plastic containers.
   B. Refrigerate unwashed in the shipping container.
   C. Remove stems, and refrigerate in sealed plastic containers.
   D. Wash and refrigerate in unsealed containers.

41. Which one of the following methods is NOT a recommended way to
    prepare yeast doughs? The:
   A. Biscuit method.
   B. Straight dough method.
   C. Sponge method.
   D. Modified straight dough method.

42. Which of the following vegetables are the best source of vitamin C?
   A. Broccoli and brussels sprouts.
   B. Carrots and yams.
   C. Peas and green beans.
   D. Zucchini and beets.
43. If you notice large blisters on the upper crust of a fresh loaf of yeast bread, which one of the following might be responsible?
   A. There was not enough liquid in the recipe.
   B. The baking time was too long.
   C. There was too little yeast in the recipe.
   D. The dough was allowed to proof too long.

44. What percentage of meat muscle is water?
   A. 25%.
   B. 50%.
   C. 65%.
   D. 75%.

45. Which one of the following statements about oolong, green, and black tea is TRUE? All:
   A. Originate from different parts of the world.
   B. Can be made from the same tea plant.
   C. Are named for their place of origin.
   D. Are produced from different tea plants.

46. Heat causes the protein in meat to:
   A. Gelatinize.
   B. Dissolve.
   C. Coagulate.
   D. Caramelize.

47. The most accurate way to check a large roast for doneness is to:
   A. Use a meat thermometer to check the internal temperature.
   B. Press on the roast to feel how firm it is.
   C. Compare the cooking time with a roasting chart.
   D. Pierce the meat with a fork and check the color of the juices.

48. Which of the following is NOT a function of sugar in cakes?
   A. Provide the structure.
   B. Prevent the cake batter from foaming.
   C. Develop browning of the crusts.
   D. Sweeten and provide flavor.

49. Which of the following flours would be the best choice for making apple turnover dough?
   A. Whole wheat.
   B. Patent.
   C. Pastry.
   D. All-purpose.
50. To maintain the quality of canned fruit in a quantity foodservice operation, which of the following is NOT true?
   A. Canned fruit should be stored in a dry environment not to exceed 85°F.
   B. A dry, cool, dark storage area should be provided.
   C. Cases of canned fruit should be stored and used on a first-in, first-out basis.
   D. Opened fruit should be stored in its original can.

51. Fats in bakery products provide:
   A. Structure.
   B. A source of food for leaveners.
   C. Extension of shelf life.
   D. Tenderness.

52. Which of the following is a leavener used in waffle batter?
   A. Baking soda.
   B. Baking powder.
   C. Dried milk.
   D. Brewer's yeast.

53. What color will asparagus turn if lemon juice is added to the cooking water?
   A. Mint green.
   B. Bright green.
   C. Olive green.
   D. Dark green.

54. Which of the following flours contains the most gluten?
   A. Whole wheat flour.
   B. Pastry flour.
   C. Bread flour.
   D. Pumpernickel flour.

55. Which of the following is an example of moist heat cooking?
   A. Sauteing.
   B. Broiling.
   C. Steaming.
   D. Grilling.

56. Which of the following fish are classified as lean?
   A. Mackerel.
   B. Salmon.
   C. Tuna.
   D. Flounder.
57. The Brix scale for carbonated beverage dispensing refers to the concentration of:
   A. Carbon dioxide gas in the storage tank mixture.
   B. Syrup in the syrup-water mixture.
   C. Carbon dioxide in the syrup tank.
   D. Water in the syrup-water mixture.

58. Which of the following is NOT an example of dry heat cooking?
   A. Frying.
   B. Poaching.
   C. Sauteing.
   D. Roasting.

59. For health care foodservices, what is recommended to prevent browning in cut fruit?
   A. A heavy concentration of sugar.
   B. An acidic fruit juice.
   C. Commercial anti-oxidants.
   D. Sweetened water.

60. Hot water used in pour-over coffee makers should be:
   A. 175-185°F.
   B. 195-200°F.
   C. 200-210°F.
   D. 212°F.

61. Cream of tartar is added to angelfood cake to:
   A. React with baking powder to form carbon dioxide.
   B. Coagulate the egg whites in the mixture.
   C. Increase the volume by stabilizing the egg whites.
   D. Reduce the acidity of the mixture.

62. Which of the following should be purchased to make oven fried chicken?
   A. Fryer.
   B. Hen.
   C. Rooster.
   D. Roaster.

63. Which of the following fresh fruits should NOT be added to gelatin salad?
   A. Raspberries.
   B. Pineapple.
   C. Cantaloupe.
   D. Red cherries.
64. A whole wheat bread recipe produces a very dense, small loaf. The recipe uses graham flour, yeast, sugar, salt, and water. What is the best way to change the recipe to produce a larger and lighter bread?
   A. Substitute whole wheat flour for the graham flour.
   B. Use finely milled cake flour for half of the flour.
   C. Add one teaspoon of baking powder for every pound of flour.
   D. Use a higher protein hard wheat flour to replace half the graham flour.

65. Yeast breads are normally made from flour, yeast, and:
   A. Water and baking powder.
   B. Water and sugar.
   C. Milk and salt.
   D. Water and baking soda.

66. Which of the following is NOT a cause of off flavors in coffee?
   A. The coffee urns were not rinsed properly after cleaning.
   B. No weekly cleaning schedule had been followed for the coffee urn.
   C. There was a buildup of coffee oils and acids in the coffee urn.
   D. The line filter for the water had just been replaced.
1. The most popular type of tea in the United States is:
   A. Herb.
   B. Decaffeinated.
   C. Green.
   D. Black.

2. The proper proportion of ground coffee to water for large pour-over coffee urns is one pound of coffee to:
   A. One gallon of water.
   B. Two gallons of water.
   C. Three gallons of water.
   D. Four gallons of water.

3. How should broccoli be cooked?
   A. Slowly, in a covered container.
   B. Slowly, at medium heat in large amounts of water.
   C. Rapidly, at high heat in a small amount of water.
   D. Rapidly, in unvented steam.

4. Red cabbage and beets should be cooked in which of the following solutions to prevent color changes?
   A. Acidic.
   B. Alkaline.
   C. Basic.
   D. Neutral.

5. Oven fried breaded fish fillets should be placed on a sheet pan and:
   A. Coated with fat on the bottom side.
   B. Crushed lightly with fat on the top surface.
   C. Coated lightly with fat on both sides.
   D. Brushed with lemon juice.

6. The addition of vinegar to the water for cooking cauliflower will:
   A. Tenderize the cauliflower.
   B. Toughen the cauliflower.
   C. Turn the cauliflower light brown.
   D. Help retain the white color.

7. Coffee brewed in a 1-2 quart pour-over coffee maker requires a brewing time of:
   A. 2-5 minutes.
   B. 4-6 minutes.
   C. 8-10 minutes.
   D. 10-12 minutes.
8. Fish with a series of jointed shells are called:
   A. Mollusks.
   B. Crustaceans.
   C. Oculars.
   D. Encrustedans.

9. Hot coffee can be held at:
   A. 185-190°F for less than 1 hour.
   B. 185-190°F up to 2 hours.
   C. 190-200°F for less than 1 hour.
   D. 190-200°F up to 2 hours.

10. Which of the following shortens the shelf life of whole wheat flour?
    A. Gluten.
    B. Endosperm.
    C. Bran.
    D. Wheat germ.

11. Which of the following would be best for preventing oxidation in freshly cut apples?
    A. Water.
    B. Apple juice.
    C. Lemon juice.
    D. Vinegar and water.

12. Which would be the best temperature range for optimum proofing of yeast bread?
    A. 72-80°F.
    B. 85-95°F.
    C. 75-100°F.
    D. 95-115°F.

13. A beef brisket should be cooked by which of the following methods?
    A. Simmering.
    B. Broasting.
    C. Frying.
    D. Steaming.

14. Which of the following describes the best method for mixing muffins?
    A. Fat is cut into the dry ingredients before the addition of the liquid.
    B. Oil and sugar are creamed before the addition of the dry ingredients and liquid.
    C. Dry ingredients are mixed together then the eggs, milk, and oil are all added at once.
    D. The fat and liquids are mixed together before the dry ingredients are added.
15. The following Italian dressing recipe is an example of: Recipe
   Ingredients: Salad oil, vinegar, dry mustard, salt, black pepper, ground oregano, garlic salt, and onion salt.
   A. A vinaigrette dressing.
   B. A permanent emulsion.
   C. A temporary emulsion.
   D. A non-permanent emulsion.

16. If citrus juice was used to replace half of the cold liquid in a sweetened lime gelatin and grapefruit salad, what adjustment in the basic recipe would be needed?
   A. The total cold liquid would be increased because of the additional water necessary to dilute the citrus juice.
   B. Extra gelatin would be needed to compensate for the fruit juice.
   C. Additional sugar would be necessary to offset the effects of the fruit juice.
   D. All of the above.

17. The inside of meat cooked to medium is:
   A. Deep pink and somewhat warm.
   B. Pink and hot.
   C. Light brown and hot.
   D. Pink and warm.

18. All-purpose flour, when compared to bread flour, is:
   A. Slightly higher in gluten content than bread flour.
   B. Much higher in gluten content than bread flour.
   C. Equal in gluten content to bread flour.
   D. Slightly lower in gluten content than bread flour.

19. When doing the daily inventory of the walk-in refrigerator, you notice a pan of cooked lasagna that was heated and held for 1 hour two days ago. The lasagna is a convenience food. What should you do with this food?
   A. Serve the lasagna that same day.
   B. Dispose of the lasagna as soon as possible.
   C. Keep the lasagna refrigerated and serve within 2 days.
   D. Keep the lasagna refrigerated and serve within 3 days.

20. Vitamin C in cabbage is destroyed when placed in cooking water that:
   A. Has baking soda added.
   B. Has acid added.
   C. Is basic.
   D. Is neutral.
21. Green peppers, summer squash, and cucumbers are examples of which type of vegetable?
A. Tuber.
B. Root.
C. Flower.
D. Fruit.

22. Which one of the following statements is FALSE?
A. Angelfood cakes are more delicate than chiffon cakes.
B. Angelfood cakes and chiffon cakes use beaten egg whites.
C. Egg yolks used in chiffon cakes should be beaten to the soft peak stage.
D. The beaten egg whites in chiffon cakes help add volume to the egg yolk mixture.

23. Why do many fruits like bananas, apples, and pears turn brown after they are cut?
A. Ascorbic acid interaction with fructose.
B. Oxidizing action with fruit enzymes.
C. Contamination by bacteria.

24. As the foodservice manager, you decide that the yeast bread appears too dense and the loaf size is only one-half of what it should be. Which of the following is most likely to have happened?
A. The baking temperature was too high.
B. The flour had too little gluten.
C. There was too little yeast in the dough.
D. The pans were overgreased.

25. In making a cake, the sugar and fat are beaten together to form small bubbles of air. This process is called:
A. Foaming.
B. Creaming.
C. Whipping.
D. Extruding.

26. When the convenience food directions specify thawing before cooking, which of the following defrosting procedures is best? Thaw:
A. In the microwave.
B. Submersed in hot water.
C. In cool water.
D. In the refrigerator.

27. Quick breads were given this name because they:
A. Are easily assembled.
B. Must be mixed rapidly to form strong gluten.
C. Are baked immediately due to the leavening.
28. How often should the Brix of carbonated beverages be checked?
   A. Daily.
   B. Weekly.
   C. Monthly.
   D. Biweekly.

29. What should you do if you receive a shipment of green bananas?
   A. Place them under refrigeration in the original container until the desired color and ripeness are achieved.
   B. Keep them sealed inside the plastic bags in which they are shipped and store at room temperature.
   C. Open the plastic shipping bags and allow them to ripen at room temperature.

30. In you have patent flour on hand, in which of the following products should it be used?
   A. Cakes and delicate baked goods.
   B. High fiber breads and muffins.
   C. Rye breads and pie doughs.
   D. White bread and whole wheat bread.

31. The marbling in meat refers to its:
   A. Fat conformation.
   B. Interior collagen.
   C. Exterior collagen.
   D. Interior fat.

32. Which of the following is the best holding time for cooked vegetables?
   A. 30 minutes.
   B. 45 minutes.
   C. 1 hour.
   D. None of the above, serve at once.

33. Upon receiving a flat of fresh strawberries to be served the next day, what procedure should you follow?
   A. Wash and refrigerate in sealed plastic containers.
   B. Refrigerate unwashed in the shipping container.
   C. Remove stems, and refrigerate in sealed plastic containers.
   D. Wash and refrigerate in unsealed containers.

34. Which one of the following methods is NOT a recommended way to prepare yeast doughs? The:
   A. Biscuit method.
   B. Straight dough method.
   C. Sponge method.
   D. Modified straight dough method.
35. Which of the following vegetables are the best source of vitamin C?
   A. Broccoli and brussels sprouts.
   B. Carrots and yams.
   C. Peas and green beans.
   D. Zucchini and beets.

36. If you notice large blisters on the upper crust of a fresh loaf of yeast bread, which one of the following might be responsible?
   A. There was not enough liquid in the recipe.
   B. The baking time was too long.
   C. There was too little yeast in the recipe.
   D. The dough was allowed to proof too long.

37. What percentage of meat muscle is water?
   A. 25%.
   B. 50%.
   C. 65%.
   D. 75%.

38. Which one of the following statements about oolong, green, and black tea is TRUE? All:
   A. Originate from different parts of the world.
   B. Can be made from the same tea plant.
   C. Are named for their place of origin.
   D. Are produced from different tea plants.

39. Heat causes the protein in meat to:
   A. Gelatinize.
   B. Dissolve.
   C. Coagulate.
   D. Caramelize.

40. To maintain the quality of canned fruit in a quantity foodservice operation, which of the following is NOT true?
   A. Canned fruit should be stored in a dry environment not to exceed 85°F.
   B. A dry, cool, dark storage area should be provided.
   C. Cases of canned fruit should be stored and used on a first-in, first-out basis.
   D. Opened fruit should be stored in its original can.

41. Fats in bakery products provide:
   A. Structure.
   B. A source of food for leaveners.
   C. Extension of shelf life.
   D. Tenderness.
42. Which of the following is a leavener used in waffle batter?
   A. Baking soda.
   B. Baking powder.
   C. Dried milk.
   D. Brewer's yeast.

43. What color will asparagus turn if lemon juice is added to the cooking water?
   A. Mint green.
   B. Bright green.
   C. Olive green.
   D. Dark green.

44. Which of the following flours contains the most gluten?
   A. Whole wheat flour.
   B. Pastry flour.
   C. Bread flour.
   D. Pumpernickel flour.

45. Which of the following is an example of moist heat cooking?
   A. Sauteing.
   B. Broiling.
   C. Steaming.

46. Which of the following fish are classified as lean?
   A. Mackerel.
   B. Salmon.
   C. Tuna.
   D. Flounder.

47. The Brix scale for carbonated beverage dispensing refers to the concentration of:
   A. Carbon dioxide gas in the storage tank mixture.
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50. Cream of tartar is added to angel food cake to:
   A. React with baking powder to form carbon dioxide.
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   C. Increase the volume by stabilizing the egg whites.
   D. Reduce the acidity of the mixture.

51. Which of the following should be purchased to make oven fried chicken?
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53. A whole wheat bread recipe produces a very dense, small loaf. The recipe uses graham flour, yeast, sugar, salt, and water. What is the best way to change the recipe to produce a larger and lighter bread?
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   D. Use a higher protein hard wheat flour to replace half the graham flour.

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   B. Water and sugar.
   C. Milk and salt.
   D. Water and baking soda.

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   B. No weekly cleaning schedule had been followed for the coffee urn.
   C. There was a buildup of coffee oils and acids in the coffee urn.
   D. The line filter for the water had just been replaced.
1. What percentage of meat muscle is water?
   A. 25%.
   B. 50%.
   C. 65%.
   D. 75%.

2. Green peppers, summer squash, and cucumbers are examples of which type of vegetable?
   A. Tuber.
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11. Which of the following should be purchased to make oven fried chicken?
    A. Fryer.
    B. Hen.
    C. Rooster.
    D. Roaster.

12. To cook tenderloin of beef, you should use which of the following cooking methods?
    A. Simmering.
    B. Broiling.
    C. Either of the above methods.

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   A. One gallon of water.
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   A. The total cold liquid would be increased because of the additional water necessary to dilute the citrus juice.
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   C. Additional sugar would be necessary to offset the effects of the fruit juice.
   D. All of the above.

29. The following Italian dressing recipe is an example of: Recipe
   Ingredients: Salad oil, vinegar, dry mustard, salt, black pepper, ground oregano, garlic salt, and onion salt.
   A. A vinaigrette dressing.
   B. A permanent emulsion.
   C. A temporary emulsion.
   D. A non-permanent emulsion.
30. Which of the following would be best for preventing oxidation in freshly cut apples?
   A. Water.
   B. Apple juice.
   C. Lemon juice.
   D. Vinegar and water.
Today you are being asked to participate in a study designed to help future 380 students increase their knowledge of quantity food production. Please read the following instructions for the Learning Style Questionnaire and the Quantity Food Production Study Guide Test. You will receive further instructions prior to beginning.

INSTRUCTIONS:

1. Use a No. 2 pencil for both the questionnaire and the test. If you do not have the correct pencil, please obtain one from the test administrator or instructor. At the end of the test, please return pencils when you hand in your test.

2. Record your Student ID or Social Security Number in the upper left-hand corner of the Learning Style Questionnaire. Read the instructions very carefully. Circle all responses directly on the questionnaire.

3. For the Quantity Food Production Study Guide Test, record your Student ID or Social Security Number, and fill in the corresponding circles on the attached answer sheet.

4. Although your completion of the Learning Style Questionnaire, the Quantity Food Production Study Guide and the corresponding tests are 380 assignments, your participation in related Study Guide research is also requested.

5. If you agree to participate in the research, all you need to do is allow us to include your scores in the study. Indicate your agreement to participate by filling in YES where you normally place your name. If you prefer not to participate, write a NO in the space labeled name on the answer sheet.
6. If you participate in the study, we can post your test grades. If you want to know your test scores, please enter "post" one space after your YES or No response. Scores will be posted by the last 6 digits of your ID# on the 380 bulletin board.

7. Indicate your response to each test question by filling in the circle of your choice. If you are not certain of the correct answer, make your best guess. Do not dwell too long on one question, or you may not have enough time to complete the test. Finish the test and then go back to those questions you did not answer.

8. After completion, turn in your questionnaire, test, answer sheet, and pencils. You may take a 5 minute break, but return to class for a short discussion by Ms. Robson.
Today, you are being asked to participate in the final phase of research designed to help develop a study guide to be used by future students enrolled in quantity food preparation courses. You will be answering three questionnaires. The first will measure how much you know about some of the basics of food preparation mentioned in the quantity food preparation study guide. The second questionnaire will help researchers understand what might be the teaching method that is best suited to the way you like to learn. For example, some people like to learn on their own. Others prefer a teacher in a classroom. Whatever you choose, it is important to know the teaching method that best fits each particular person.

The third questionnaire asks some general information about your background along with some questions about your impressions of the study guide. Finally, those of you who have agreed to participate in the research will be asked to sign and date a consent form.

Your involvement with this study is strictly voluntary. However, your participation is very important to the success of the research. All questionnaire answers will be kept secret. Not even your instructor will know your answers. You will not be graded on any of the material you complete for the study. You can withdraw from the research at any time by contacting your instructor or Don M. Paulson at #11 MacKay Hall, Iowa State University, Ames, Iowa 50010.

Although your name is not needed for completing the research, it is needed to organize the material to provide you with your test scores. Please put your name and the last six digits of your social security number on the first page of each questionnaire. A number will later be assigned to you to keep all scores secret. Scores for the quantity food preparation study guide questionnaire will be posted by the last six digits of your social security number on the HRI 380 bulletin board. If you choose not to participate in the research, place a NO on the first page of each questionnaire under your name and social security number.
INSTRUCTIONS:

A. We will start with the Learning Style Questionnaire. Place your name and the last six digits of your social security number on the first page. Please read the Learning Style Questionnaire instructions with me. Raise your hand if you have any questions about how to answer any of the items.

B. Next, turn to the Quantity Food Preparation Questionnaire. Place your name and the last six digits of your social security number on the first page. Complete all questions. If you don't know the answer to one question, go on to the next and come back to that question when you have time later. If you still don't know the answer, make your best guess. Please don't leave any questions blank.

C. Next, turn to the demographic questionnaire. Please place you name and the last six digits of your social security number at the top of the first page. Complete all information requested. Your opinions relating to the study guide are very important to the research.

D. Finally, sign and date the consent form.

E. You should have plenty of time to complete the three questionnaires and the consent form. You have approximately one hour. You are free to leave the laboratory when you are finished.

F. If you have a question with any of the material, raise your hand for assistance.

G. Please begin.
Tonight, you are being asked to participate in research designed to help develop a study guide to be used by future students enrolled in quantity food preparation courses. You will be answering two questionnaires. One will measure how much you know about some of the basics of food preparation and how some of these principles apply to quantity food production. The other questionnaire will help me understand what might be the teaching method that is best suited to the way you like to learn. For example, some people like to learn on their own. Others prefer a teacher in a classroom. Whatever you choose, it is important to know the teaching method that best fits each particular person.

The Quantity Food Preparation Study Guide I am handing out is your personal copy. You may keep it. It covers some of the same material you will be discussing in your class. Feel free to make any notes or comments directly on the study guide. Your impressions of the way the material is presented and organized is an important part of the study. This evening you are being asked to fill out two questionnaires. When I return again at the end of the course, I will be asking you to complete the same two questionnaires. In addition, you also will be asked some general questions relating to your education, training, work experience, and your general feelings about the study guide.

Your involvement with this study is strictly voluntary. However, your participation is very important to the success of the research. All questionnaire answers will be kept secret. Not even your instructor will know your answers. You will not be graded on any of the material you complete for the study. You can withdraw from the research at any time by contacting your instructor or me at the address and phone number written on the board. If you agree to allow your answers to be used in the study, place the word YES in the upper left hand corner of each questionnaire. If you do not want our answers to be used, place the word NO in the same location.

Although I do not need to know your name in completing the research, I do need some way to organize the material. Please put your name on the first page of each questionnaire. I will assign you a number to be used in the research to keep all scores secret. If you want to know how well you did on the quantity food preparation questionnaire,
please fill in your address on the envelope I have attached to the last page of the questionnaire. The results will be mailed to you.

INSTRUCTIONS:

A. We will start with the Learning Style Questionnaire. Please read the Learning Style Questionnaire instructions with me. Raise your hand if you have any questions about how to answer any of the items.

B. Next, turn to the Quantity Food Preparation Questionnaire. Complete all questions. If you don’t know the answer to one question, go on to the next and come back to that question when you have time later. If you still don’t know the answer, make your best guess. Please don’t leave any questions blank.

C. Most people who have completed the two questionnaires took less than an hour to finish. You should have plenty of time. If you finish early, you may take a break, but please be back in your seat by the time class begins at 6:30.

E. If you have a question with either questionnaire, raise your hand and I will assist you.

F. Please begin.
Today, you are being asked to participate in the final phase of research designed to help develop a study guide to be used by future students enrolled in quantity food preparation courses. You will be answering three questionnaires. One will measure how much you know about some of the basics of food preparation and how some of these principles apply to quantity food production. The second questionnaire will help researchers understand what might be the teaching method that is best suited to the way you like to learn. For example, some people like to learn on their own. Others prefer a teacher in a classroom. Whatever you choose, it is important to know the teaching method that best fits each particular person.

The third questionnaire asks some general information about your background along with some questions about your impressions of the study guide. Finally, those of you who have agreed to participate in the research will be asked to sign and date a consent form.

Your involvement with this study is strictly voluntary. However, your participation is very important to the success of the research. All questionnaire answers will be kept secret. Not even your instructor will know your answers. You will not be graded on any of the material you complete for the study. You can withdraw from the research at any time by contacting your instructor or Don M. Paulson at #11 MacKay Hall, Iowa State University, Ames, Iowa 50010.

Although your name is not needed for completing the research, it is needed to organize the material to provide you with your test scores. Please put your name and social security number on the first page of each questionnaire. A number will later be assigned to you to keep all scores secret. If you want to know how well you did on the quantity food preparation questionnaire, please fill in your address on the envelope attached to the last page of the study guide questionnaire. The results will be mailed to you. If you choose not to participate in the research, place a NO on the first page of each questionnaire under your name and social security number.
INSTRUCTIONS:

A. We will start with the Learning Style Questionnaire. Please read the Learning Style Questionnaire instructions with me. Raise your hand if you have any questions about how to answer any of the items.

B. Next, turn to the Quantity Food Preparation Questionnaire. Complete all questions. If you don’t know the answer to one question, go on to the next and come back to that question when you have time later. If you still don’t know the answer, make your best guess. Please don’t leave any questions blank.

C. Next, turn to the demographic questionnaire. Please place your name and social security number at the top of the first page. Complete all information requested. Your opinions relating to the study guide are very important to the research.

D. Finally, sign and date the consent form.

E. You should have plenty of time to complete the three questionnaires and the consent form. You have approximately one hour. If you finish early, you may take a break, but please do not disturb your fellow classmates.

F. If you have a question with any of the material, raise your hand for assistance.

G. Please begin.
I agree to participate in the HRI 380 project relating to the development of a study guide for quantity food preparation. In order to insure confidentiality, I understand that my test scores will be assigned an anonymous code number. Finally, I am aware my participation in this research is not required and I may withdraw my permission at any time by contacting my 380 instructor or Don Paulson.

For further information you may contact Don Paulson, #11 MacKay Hall, or Dr. Lynne E. Baltzer, #10 MacKay Hall.

__________________________  Signature

__________________________  Date
I agree to participate in the research project relating to the development of a study guide for quantity food preparation. In order to insure confidentiality, I understand that my test scores will be assigned an anonymous code number. Finally, I am aware my participation in this research is not required and I may withdraw my permission at any time by contacting my instructor or Don Paulson.

For further information you may contact Don Paulson, #11 MacKay Hall, or Dr. Lynne E. Baltzer, #10 MacKay Hall, Department of Hotel, Restaurant, and Institution Management, Iowa State University, Ames, Iowa 50011. Telephone: 515-294-5912.

__________________________________Signature

__________________________________Date
PLEASE NOTE

Copyrighted materials in this document have not been filmed at the request of the author. They are available for consultation, however, in the author's university library.

Appendix C, Learning Style Questionnaire, 274-276

University Microfilms International
Directions: Please complete the following questionnaire as accurately as possible in the blanks provided:

AGE:__________
SEX:__________
MAJOR:______________

How many semesters of college have you completed?__________

What is your official classification? Freshman____
Sophomore____ Junior____ Senior____ Other(Specify)__________

How long did you spend reading and studying the Food Preparation Study Guide? _______Hours______Minutes

What type of work experience do you have? List the number of months)

Restaurant:

Formal Dining or Family Style: Full Time:______
Part Time:______
Fast Food
Full Time:______
Part Time:______
Other(Specify)__________
Full Time:______
Part Time:______

Hotel: Full Time:______
Part Time:______

Residence Hall Foodservice Full Time:______
Part Time:______

School Foodservice Full Time:______
Part Time:______

Hospital or Nursing Home Foodservice: Full Time:______
Part Time:______

Other (Specify) Full Time:______
Part Time:______
STUDY GUIDE EVALUATION QUESTIONS:

The following questions apply to the quantity food preparation study guide. Many of the questions ask you to circle the number that best represents your answer. Other questions ask you to list your personal feelings and judgements about the study guide. In addition, a few of the questions ask you to check the appropriate box. Please answer all questions.

The following is an example of one of the questions that asks you to circle one of five numbers:

Example: Was the information in the study guide helpful to you in understanding the related material in your course?

<table>
<thead>
<tr>
<th>Very little Help</th>
<th>Helpful</th>
<th>Very Helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

In this example, if you felt the study guide was very helpful to you in understanding the material discussed in your course, you would circle number five.

1. Was the study guide easy to understand?

<table>
<thead>
<tr>
<th>Difficult to Understand</th>
<th>Easy to Understand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

What made it either easy or hard to understand?

2. Did you find the information in the study guide helpful as a supplement to other HRI 380 assignments?

<table>
<thead>
<tr>
<th>Of Very Little Use in HRI 380</th>
<th>Very Useful in HRI 380</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

How was the study guide helpful as supplementary reading to your other assigned HRI 380 course assignments? Why wasn’t it helpful? (Continue of the back if you need more room.)
3. How do you feel about the time you spent reading the study guide? Check one of the following:

It took too much time.
It was just the right amount of time.
It took less time than I expected.

How much time did you spend reading the study guide? ________ Hours ________ Minutes

4. How much of each chapter did you read? (Please make a check behind each chapter.)

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Read all the chapter</th>
<th>Read half the chapter</th>
<th>Read none of the chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vegetables</td>
<td></td>
<td></td>
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<tr>
<td>2. Fruits</td>
<td></td>
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<td>3. Salads</td>
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<tr>
<td>4. Meats, Poultry, Fish, and Entrees</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>5. Bakery Products, Dough, Pastry and Batters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Beverages and Convenience Foods</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. What suggestions do you have for improving the study guide? Please use the back of the page if you need more room.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Directions: Please complete the following questionnaire. All responses will be kept confidential.

### PREVIOUS COURSE WORK:

<table>
<thead>
<tr>
<th>Course</th>
<th>Completion of Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meal Service</td>
<td>Yes      No</td>
</tr>
<tr>
<td>Modified Diets</td>
<td></td>
</tr>
<tr>
<td>Foodservice Management</td>
<td></td>
</tr>
<tr>
<td>Safety and Sanitation</td>
<td></td>
</tr>
<tr>
<td>Food Preparation/Production</td>
<td></td>
</tr>
<tr>
<td>Other: (Specify)</td>
<td></td>
</tr>
</tbody>
</table>

### OTHER COURSES OR WORKSHOPS ATTENDED RELATING TO YOUR JOB:

<table>
<thead>
<tr>
<th>Name of Course</th>
<th>Hours Attended</th>
<th>Year Attended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

### EDUCATION:

Check all levels of education you have completed. If a degree has not yet been earned, specify the number of semesters you have completed.

8th Grade

High school or GED

Community College AA Degree Semesters

Junior College AA Degree Semesters

College (4-Year) BS or BA Semesters Degree

Other

(Specify)
SEX:  M____  F____

Age in Years: (Check One)

<table>
<thead>
<tr>
<th>Less than 20</th>
<th>20 to 30</th>
<th>30 to 40</th>
<th>40 to 50</th>
<th>Over 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
</tr>
</tbody>
</table>

WORK EXPERIENCE:

<table>
<thead>
<tr>
<th></th>
<th>Full Time:</th>
<th>Part Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing Home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restaurant:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Formal Dining or Family Style:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Fast Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Other (Specify)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residence Hall Foodservice</td>
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<td></td>
<td></td>
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STUDY GUIDE EVALUATION QUESTIONS:

The following questions apply to the quantity food preparation study guide. Many of the questions ask you to circle the number that best represents your answer. Other questions ask you to list your personal feelings and judgements about the study guide. In addition, a few of the questions ask you to check the appropriate box. Please answer all questions.

The following is an example of one of the questions that asks you to circle one of five numbers:

Example: Was the information in the study guide helpful to you in understanding the related material in your course?

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<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

In this example, if your felt the study guide was very helpful to you in understanding the material discussed in your course, you would circle number five.

1. Was the study guide easy to understand?

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<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

What made it either easy or hard to understand?

2. Did you find the information in the study guide useful at work?

<table>
<thead>
<tr>
<th>Of Very Little Use at Work</th>
<th>Very Useful at Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

How was the study guide useful at work? Why wasn't it useful at work? (Continue of the back if you need more room.)
3. How do you feel about the time you spent reading the study guide? Check one of the following:

- It took too much time.
- It was just the right amount of time.
- It took less time than I expected.

How much time did you spend reading the study guide?
_________ Hours _________ Minutes

4. How much of each chapter did you read? (Please make a check behind each chapter.)

<table>
<thead>
<tr>
<th>Chapter Description</th>
<th>Read all the chapter</th>
<th>Read half the chapter</th>
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<td>and Entrees</td>
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<tr>
<td>5. Bakery Products, Dough,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pastry and Batters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Beverages and Convenience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foods</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. What suggestions do you have for improving the study guide? Please use the back of the page if you need more room.
NOTICE: More copies of the study guide are available.

Two copies of the Quantity Food Preparation Study Guide are now available for your use in room 6 MacKay Hall. Copies also are available on reserve in the library and at Kinko’s in campustown. The list price is $4.10.

Do You Know Why quantity foodservice managers should never allow whole turkeys to be stuffed? (See page 51 of the study guide) Without the stuffing, poultry will cook and cool faster. Extended cooking and cooling times allow microorganisms to multiply and contaminate the final product. Instead, dressing can be baked separately in shallow pans that allow the dressing to be thoroughly cooked and cooled appropriately.

REMEMBER:

You have until April 23rd to complete the study guide. Don’t wait too long. Your study guide test is only 30 days away.
APPENDIX D.

REVIEW QUESTIONS AND ANSWER KEYS,
AND EDUCATOR COGNITIVE RANKING
The following Quantity Food Preparation Study Guide review questions have been written to measure your comprehension of some of the major facts and concepts associated with quantity food preparation. Answer each question in the space provided. The assignment will be due April 2nd at the beginning of class.

Five bonus points can be earned for completing this exercise. Your scores and the answer key will be posted on the HRI 380 bulletin board.

QUESTIONS: 1. While walking through a salad production area one morning, you notice a part-time storekeeper putting 3 cases of fresh green bananas in the walk-in refrigerator.

(1 point) A. What would be the best conditions for storing the bananas? Discuss the temperature, light, and humidity. What should you instruct the storekeeper to do with the bananas?

(1 point) B. Once the bananas are ripe, what is the best way to store them for use by the bakery next week? What changes will occur in the green bananas if they are stored in the refrigerator?
Tonight, you are being asked to participate in research designed to help develop a study guide to be used by future students enrolled in quantity food preparation courses. You will be answering two questionnaires. One will measure how much you know about quantity food preparation. The other will measure the way you like to be taught.

The Quantity Food Preparation Guide I am handing out is your personal copy. You may keep it. It covers some of the same material you will be discussing in your class. Feel free to make any notes or comments directly on the study guide. Your impressions of the way the material is presented and organized is an important part of the study. When I return again at the end of the course, I will be asking you for your comments about how you felt the study guide was organized and how easy it was to read and understand.

This evening you are being asked to fill out two questionnaires. Your will fill out these same two questionnaires at your last scheduled class. In addition, you will also be asked some general questions that last session relating to your educational training, work experience, and your feelings about the study guide.

Your involvement with this study is strictly voluntary. However, your participation is very important to the success of the research. If you agree to allow your answers to be used in the study, place the word YES in the upper left hand corner of each questionnaire. If you do not want to share your answers, write in the word NO in the same location. You can withdraw from the research at any time by contacting your instructor or me at the address and phone number written on the board.

All questionnaire answers will be kept secret. Not even your instructor will know your results. You will not be graded on any of the material you complete for the study.

Although I do not need to know your name in completing the research, I do need some way to organize the material. Therefore, I am asking you to place the last six numbers of your social security number in the left hand corner of the first page of each questionnaire. If you do not have your social security number with you, please see me and I will assign a number to you. If you want to know how well you did on the questionnaires, please fill out your current
INSTRUCTIONS:

A. Please turn to the Learning Style Questionnaire. This questionnaire will help me understand what might be one of the best teaching methods you would prefer. For example, some people like to learn on their own. Others prefer a teacher in a classroom. Whatever you choose, it is important to know the method that best fits each particular person.

B. Please read the Learning Style Questionnaire instructions with me. Raise your hand if you have any difficulty understanding which word you feel describes you. I will be happy to help you with the meaning of the word.

C. Next, turn to the Quantity Food Preparation Questionnaire. Please answer all questions. If you do not know the answer to a question, make your best guess. Do not leave any questions blank.

D. You will have approximately one hour to complete the two questionnaires. If you have any questions at any time, raise your hand and I will assist you.

E. I have extra pencils if anyone needs one.

F. You can take a break after you finish, but please be back in your seat by 6:30, your regularly scheduled class time.

G. Again, your answers to tonight's questionnaires are very important to the success of the study. Thank you for your assistance.

H. Any questions? Please begin.
(1 point) 2. What change does baking soda cause when added to the cooking water of fresh or frozen green vegetables?

Color:

Vitamin C Content:

Texture:

(1/2 point) 3. Should yellow vegetables like carrots and corn be cooked in an acidic or an alkaline solution? Why?

(1/2 point) 4. Should red vegetables be cooked in a vented or an unvented steamer? Why?

(1/2 point) 5. List four fruit juices that would act as an antioxidant to prevent sliced bananas from turning brown:

___________   ___________

(1/2 point) 6. List five examples of tropical fruit:

___________   ___________
The following Quantity Food Preparation Study Guide review questions have been written to measure your comprehension of some of the major facts and concepts associated with quantity food preparation. This second exercise covers the Meats chapter. Answer each question in the space provided. The assignment will be due April 9th at the beginning of class.

Five bonus points can be earned for completing this exercise. Your score and the answer key will be posted on the HRI 380 bulletin board.

QUESTIONS: 1. Assume you are the manager of a large university cafeteria serving 2,000 clients. Two employees and three cafeteria clients report becoming sick 2 hours after eating turkey noodle casserole, a leftover that was served for lunch. The casserole was a convenience food that had been on the menu five days prior. The P.M. cook stated that the casserole was labeled, dated, refrigerated after it was served the first time. However, one morning the cook noticed a tear in the plastic film covering the casserole. In addition, it was observed that two pans of raw chicken had been stored above the turkey casserole for the last two days.

(1/2 point) A. What is the maximum suggested time leftovers can be refrigerated and then served again?

(1/2 point) B. Once the leftovers are reheated a second time, are convenience foods more or less stable than "from scratch" foods?

(1/2 point) C. How would you organize the walk-in refrigerator to prevent possible cross contamination from raw to cooked foods?

(1/2 point) D. After once being heated, could the turkey casserole have been refrozen?
2. List the three major factors considered in judging and grading meat:
   A. ____________________
   B. ____________________
   C. ____________________

3. List the five major causes for shrinkage in cooked meat?
   A. ____________________
   B. ____________________
   C. ____________________
   D. ____________________
   E. ____________________

4. What are the best cuts of poultry to use for broiled chicken?

5. Describe what precautions should be taken when serving sandwiches made from egg products and salad dressing.

6. Describe the desired characteristics of fresh fish.

7. List three fish classified as mollusks:
   1. _________ 2. _________ 3. _________
The following Quantity Food Preparation Study Guide review questions have been written to measure your comprehension of some of the major facts and concepts associated with quantity food preparation. This third exercise covers the Bakery Products, Dough, Pastry and Batters chapter. Answer each question in the space provided. The assignment will be due April 16th at the beginning of class.

FIVE BONUS POINTS can be earned for completing this exercise. Your score and the answer key will be posted on the HRI 380 bulletin board.

QUESTIONS: 1. On the Friday before Spring break, an employee assigned to serve desserts for the cafeteria brings in a portion of white frosted cake to the office. The texture of the cake was not as good as expected. Later, it was discovered that the baker had used bread flour instead of cake flour in the recipe. By mistake, a new storekeeper had placed bread flour in the cake flour bin.

(1/2 point) A. How would bread flour affect the structure and texture of cake?

(1/2 point) B. What is the protein found in flour that helps form the structure of bakery products?

(1/2 point) C. How might you prevent the flour from being placed in the wrong bin?
D. List three ingredients in cake that contribute to the tenderness of the final product:

1. 
2. 
3. 

2. List three appropriate uses for pastry flour:

1. 
2. 
3. 

3. Which ingredient in whole wheat bread causes it to become rancid very easily?

4. List the three methods for preparing yeast dough and describe each method:

1. 
2. 
3. 

Briefly describe each method:

1. 
2. 
3. 

5. List the three basic methods for mixing quick breads:

1. 
2. 
3. 

6. Describe the optimum texture of pie dough and the changes that would occur from overmixing:
Review Questions

The following Quantity Food Preparation Study Guide review questions have been written to measure your comprehension of some of the major facts and concepts associated with quantity food preparation. This fourth and final exercise covers the Beverage and Convenience Foods chapter. Answer each question in the space provided. The assignment will be due April 23rd at the beginning of class.

FIVE BONUS POINTS can be earned for completing this exercise. Your score and the answer key will be posted on the HRI 380 bulletin board.

QUESTIONS:
1. (1/2 point) Coffee beans are selected and blended to contribute to three characteristics of coffee. List the three:

2. (1/2 point) How many 8 ounce cups of coffee will one pound of ground coffee make using the pour-over method?

3. (1/2 point) Where should coffee urn cleaners be stored?

4. (1/2 point) What is an easy method for cleaning glass coffee pots?

5. (1/2 point) Name four soluble forms of coffee:
   A.
   B.
   C.
   D.

6. (1/2 point) What is the optimum water temperature brewing coffee?
7. (1/2 point) List three common varieties of tea:
   A.
   B.
   C.

8. (1/2 point) What is the approximate percentage of butterfat in whole milk?

9. (1/2 point) Define the term BRIX as it applies to carbonated beverages:

10. (1/2 point) A. What temperature should frozen convenience foods be stored.

   B. Once a frozen convenience food has been thawed, how soon should it be used?
Exercise #1 ANSWER KEY

1. (1 point) A. Bananas should be stored in a well-ventilated area at room temperature. Intense light should be avoided.

   Instruct the storekeeper to remove the bananas from refrigeration and store on a rack inside the dry storage area.

   (1 point) B. The bananas can be peeled and frozen in the freezer for use by the bakery next week. Frozen bananas can be used in banana bread recipes.

2. (1 point) Color: Baking soda will produce a bright green color.
   Vitamin C Content: Baking soda will destroy most water-soluble vitamins.
   Texture: Baking soda will produce a mushy texture.

3. (1/2 point) An acidic solution would be preferred for retention of water soluble vitamins.

4. (1/2 point) The red pigment, anthocyanin, in red vegetables is stable in acid. Therefore, the cooking container with a lid or compartmental steamer under pressure to retain volatile acidic compounds.

5. (1/2 point) Orange juice  Pineapple juice
   Apple juice  Lemon juice
   Grapefruit juice

6. (1/2 point) Avocado, banana, dates, kiwi, and pineapple.
HRI 380 Quantity Food Preparation Study Guide

Exercise #2 ANSWER KEY

1. (1/2 point) A. Leftovers should be rotated while being stored under refrigeration to ensure they are used within 48 hours.

(1/2 point) B. Convenience foods, already partially cooked, can spoil rapidly. They are usually less stable than "from scratch" foods.

(1/2 point) C. Refrigerators and freezer should be organized so all foods can be easily retrieved. Raw poultry products should never be placed in areas of the refrigerator where leftovers are stored. Storage of all leftover beef products on one rack separate from other meat products would be an example of a proper storage procedure.

(1/2 point) D. Since the turkey roll was at least 60 hours old, it violated the rule that leftover convenience food should not be stored under refrigeration longer than 48 hours.

2. (1/2 point) A. Conformation B. Quality C. Cutability

3. (1/2 point) A. Character of the meat cut.
   B. Method of cooking.
   C. Cooking temperature.
   D. Length of cooking period.
   E. Degree of doneness.

4. (1/2 point) Young chicken quarters from broilers and fryers or chicken breasts.

5. (1/2 point) Sandwiches made from egg products and salad dressing with a mayonnaise base provide a medium for microorganism growth. These sandwiches should be refrigerated if not served immediately. If not used within 24 hours, these leftover sandwiches should be disposed of properly.

6. (1/2 point) Fresh fish should have shiny and unfaded skin, clear eyes, and red gills. The odor should be fresh and not have a strong smell.

HRI 380 Quantity Food Preparation Study Guide

Exercise #3 ANSWER KEY

1. (1/2 point) A. Bread flour would produce a texture that would be more irregular causing tunneling in the cake. The bread flour would provide more structure in the cake because of its higher gluten content.

   (1/2 point) B. Gluten is the protein in flour primarily responsible for structure in bakery products.

   (1/2 point) C. Locate the bread flour bin in a separate area of the kitchen. Be certain each bin is clearly labeled. Ensure all storeroom personnel have proper orientation to the various storage areas for all foods and supplies.

   (1/2 point) D. 1. Fat  2. Sugar  3. Liquid  4. Egg yolks

2. (1/2 point) A. Pie doughs.
   B. Cookies.
   C. Biscuits.
   D. Muffins.

3. (1/2 point) The wheat germ.

4. (1 point)
   1. Straight dough method. The yeast is softened in a little water before it is added to the other ingredients. Then the ingredients are placed in a mixing bowl and mixed in one step. A dough hook attachment should be used for mixing. This method produces a high quality white bread.

   2. Modified straight dough method. This is used primarily for rich sweet doughs. Like the straight dough method. The yeast is pre-softened. The fat, dry milk solids, salt, and sugar are mixed together with a whip until they are combined. The eggs are added slowly to ensure even distribution. Liquid is added all at once and then the flour and yeast are added. The dough is mixed with a dough hook until it is smooth.

   3. Sponge method. This mixes the dough in two stages to give the yeast extra time to leaven the bread. The liquid, yeast, and part of the flour are mixed to form a soft dough. This dough is allowed to proof to double in bulk before being punched down. The remaining flour and ingredients are added and the dough is kneaded using a dough hook.
5. (1/2 point) 1. Biscuit method.
3. Creaming or cake method.

6. (1/2 point) Desirable pie dough should be light and flaky. Overmixing of pie dough will result in a crust that has a mealy texture.
1. (1/2 point) A. Color  B. Aroma  C. Flavor

2. (1/2 point) Two gallons of coffee or 32 eight ounce cups.

3. (1/2 point) Cleaners should be stored in a separate area away from all foods and beverages.

4. (1/2 point) Glass coffee pots can be cleaned by swirling crushed ice and a mild soap solution in each pot and rinsing with clean water.

5. (1/2 point) A. Flakes  B. Crystals  C. Frozen liquid  D. Powders

6. (1/2 point) Between 185 and 200 degrees F.

7. (1/2 point) A. Black  B. Oolong  C. Green

8. (1/2 point) Approximately 3.5 % butterfat.

9. (1/2 point) BIX is the syrup to water ratio in the carbonated drink.

10. (1/2 point) A. 0 degrees F. or lower.  
    B. It should be used within 72 hours.
November 16, 1992

To:

From: Don M. Paulson

Dear

As I continue with my research, "Development and Evaluation of Selected Content of a Quantity Food Preparation Study Course and Cognitive Achievement Device," I am asking for assistance from you. Presently, I am in the final stages of the development of a condensed cognitive achievement test to accompany the Quantity Food Preparation Study (QFPS) guide.

In order to design a cognitive test that is representative of the written text, I need the opinions of experts regarding what importance or weight they would place on the three factors of nutritive retention, cost, and complexity of the six chapters in the study guide. The attached table has been developed to help you make these decisions in this analysis.

Each of the six chapters of the study guide is listed on the left side of the table. You are being asked to rank each chapter based on the criteria and then assign a (%) weight for factors A, B, and C. The (%) weights for each chapter should total 100%.

If you would like to have another copy of the QFPS guide to assist you with this exercise, please notify me. My campus phone number is (515)-294-2380 (days) and (515)-738-2757 (after 9:00 p.m.). If I am not available, leave a message.

Please return the completed table by November 30 in the enclosed envelope.

Thank you for your assistance.

Don M. Paulson, M.S., R.D., L.D.
HRIM/Hg Ed Ph.D. Candidate
RR #1, Box 2-A
Dana, Iowa 50064-8701
Directions: 1. Rank the chapters for each criterion; 1 for Most Important and 6 for Least Important.
2. Indicate the relative importance of the chapter for this criterion expressed as a percentage of the total study guide.

<table>
<thead>
<tr>
<th></th>
<th>A. Nutritive Retention</th>
<th>B. Controlling Cost</th>
<th>C. Complexity</th>
<th>D. Overall Rank</th>
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<tr>
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<td>(% Relative Rank)</td>
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<tr>
<td>1. Vegetables</td>
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<td>2. Salads</td>
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<td>3. Fruits</td>
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<tr>
<td>4. Meats</td>
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<tr>
<td>5. Bakery Products</td>
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<tr>
<td>6. Beverages &amp; Convenience Foods</td>
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(100%) (100%) (100%) (100%)
APPENDIX E.

COMMUNITY COLLEGE RESEARCH CASE STUDIES
The following quantity food preparation case studies are designed to assist you comprehend material in the Quantity Food Preparation Study Guide. In all the examples, assume you are the manager of a large cafeteria catering to 1200 clients. Use the material in the study guide to respond to the questions in each case scenario.

Case #1:

While walking through the salad production area one morning, you notice a part-time storekeeper putting 10 cases of fresh green bananas in the walk-in refrigerator.

1. What should you instruct the storekeeper to do with the bananas?

2. Should the plastic wrapping around the bananas inside each box remain sealed, or should it be opened? Why?

3. Once the bananas are ripe, could they be frozen for later use by the bakery?

Case #2:

The following day at lunch, you are served succotash by one of the employees on the cafeteria line. The succotash is cold and portions of it are still uncooked. Upon investigation, you discover the new A.M. cook had prepared the vegetables in a perforated pan using a vented compartmental steamer. According to the cook, the correct cooking time had been followed.

1. Who should have checked the temperature of the succotash before it was served?

2. What could cause this uneven cooking of vegetables in the steamer?

3. What safeguards would you initiate to prevent this problem from reoccurring?
Case #3:

Two employees and three cafeteria clients report becoming sick 2 hours after eating turkey noodle casserole, a leftover that was served for lunch. The casserole was a convenience food that had been on the menu five days prior. The P.M. cook states that the casserole was labeled, dated, and refrigerated after it was served the first time. However, one morning the cook noticed a tear in the plastic film covering the casserole. In addition, two pans of raw chicken had been stored above the turkey casserole for the last two days.

1. List the dangers in the above situation:

2. What is the maximum suggested time leftovers can be refrigerated and then served again?

3. Once they are reheated a second time, are convenience foods more or less stable than "from scratch" foods?

4. How would you organize the walk-in to prevent possible cross contamination from raw to cooked foods?

5. After once being heated, could the turkey casserole have been refrozen?

Case #4:

One day at lunch you notice that the sliced roast beef being served on the hot roast beef sandwiches is extremely rare. The A.M. cook admits that he forgot to take the roasts out of the freezer and put them in the cook's refrigerator yesterday to thaw. Instead, he put the frozen roasts directly in the oven and increased the cooking temperature to 450 degrees F. Each of the roasts weighed approximately 10 pounds.

1. Why is it best to thaw the roasts before placing them in the oven?

2. How would you have corrected the above situation?

3. List one advantage and one disadvantage for keeping precooked roasts or smaller convenience products like breaded veal cutlets on hand in the freezer:

<table>
<thead>
<tr>
<th>Disadvantage</th>
<th>Advantage</th>
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</table>
4. Could the remaining undercooked roasts have been used for the hot roast beef sandwiches? What could you have done to help reduce the rare appearance of the meat?

5. How do high cooking temperature affect a roast's:
   A. Tenderness:
   B. Juiciness:
   C. Appearance:
   D. Yield:

Case #5:

One evening during dinner, a cafeteria client asked to see the cafeteria supervisor concerning an undercooked portion of fried chicken. The line coordinator acknowledged that there was blood in the joint of the chicken between the leg and the thigh. Later, other chicken is returned to the serving with similar complaints. An investigation was made to check into how the chicken was prepared.

1. The outside of the chicken appeared done, crisp and golden brown, but the inside was uncooked and bloody. Was the temperature of the oil in the deep fat fryer too hot or too cold?

2. What is the correct method for testing doneness in chicken?

3. What is the desired internal temperature for cooked poultry products?

4. Who should be responsible for checking the serving temperature of the fried chicken?
Case #6:

On the Friday before Easter break, an employee assigned to dish desserts for the cafeteria brings in a portion of white frosted cake to the office. The cake looks acceptable, but its texture resembles corn bread. Later, it was discovered that the baker had used bread flour instead of cake flour in the recipe. By mistake, a new storekeeper had placed bread flour in the cake flour bin.

1. How would bread flour affect the structure and texture of cake?

2. What element in the flour is most responsible for this characteristic?

3. How might you prevent this from reoccurring?

4. List the ingredients in cake that contribute to the tenderness of the final product:
   - 
   - 
   - 


APPENDIX F.

HUMAN SUBJECTS, LEARNING STYLE SCORING AND APPROVAL
Information for Review of Research Involving Human Subjects
Iowa State University
(Please type and use the attached instructions for completing this form)

1. Title of Project: Development and Evaluation of a Self-Instructional Quantity Foodservice and Production Test.

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are protected. I will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I agree to request renewal of approval for any project continuing more than one year.

Don M. Paulson 12/11/90
Typed Name of Principal Investigator Date Signature of Principal Investigator

Hotel, Restaurant, and Institution: Department

12/11/90 #11 MacKay Hall I.S.U. 294-1730
Date Campus Address Campus Telephone

3. Signatures of other investigators

Lynn & Bart
Date 12/11/90 Relationship to Principal Investigator Co-Major Professor

4. Principal Investigator(s) (check all that apply)

☐ Faculty ☐ Staff ☑ Graduate Student ☐ Undergraduate Student

5. Project (check all that apply)

☑ Research ☑ Thesis or dissertation ☐ Class project ☐ Independent Study (490, 590, Honors project)

6. Number of subjects (complete all that apply)

30 # Adults, non-students 60 # ISU student # minors under 14 # minors 14-17 other (explain)

7. Brief description of proposed research involving human subjects: (See instructions, Item 7. Use an additional page if needed.)

See attached description (Item # 7)

(Please do not send research, thesis, or dissertation proposals.)

8. Informed Consent: ☐ Signed informed consent will be obtained. (Attach a copy of your form.)

☒ Modified informed consent will be obtained. (See instructions, item 8.)

☐ Not applicable to this project.
9. Confidentiality of Data: Describe below the methods to be used to ensure the confidentiality of data obtained. (See instructions, item 9.)

See attached (Item # 9)

10. What risks or discomfort will be part of the study? Will subjects in the research be placed at risk or incur discomfort? Describe any risks to the subjects and precautions that will be taken to minimize them. (The concept of risk goes beyond physical risk and includes risks to subjects' dignity and self-respect as well as psychological or emotional risk. See instructions, item 10.)

See attached (Item # 10)

11. CHECK ALL of the following that apply to your research:

☐ A. Medical clearance necessary before subjects can participate
☐ B. Samples (Blood, tissue, etc.) from subjects
☐ C. Administration of substances (foods, drugs, etc.) to subjects
☐ D. Physical exercise or conditioning for subjects
☐ E. Deception of subjects
☐ F. Subjects under 14 years of age and/or ☐ Subjects 14 - 17 years of age
☐ G. Subjects in institutions (nursing homes, prisons, etc.)
☐ H. Research must be approved by another institution or agency (Attach letters of approval)

If you checked any of the items in 11, please complete the following in the space below (include any attachments):

Items A - D Describe the procedures and note the safety precautions being taken.

Item E Describe how subjects will be deceived; justify the deception; indicate the debriefing procedure, including the timing and information to be presented to subjects.

Item F For subjects under the age of 14, indicate how informed consent from parents or legally authorized representatives as well as from subjects will be obtained.

Items G & H Specify the agency or institution that must approve the project. If subjects in any outside agency or institution are involved, approval must be obtained prior to beginning the research, and the letter of approval should be filed.
Checklist for Attachments and Time Schedule

The following are attached (please check):

12. [ ] Letter or written statement to subjects indicating clearly:
   a) purpose of the research
   b) the use of any identifier codes (names, #’s), how they will be used, and when they will be removed (see Item 17)
   c) an estimate of time needed for participation in the research and the place
   d) if applicable, location of the research activity
   e) how you will ensure confidentiality
   f) in a longitudinal study, note when and how you will contact subjects later
   g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. [ ] Consent form (if applicable)

14. [ ] Letter of approval for research from cooperating organizations or institutions (if applicable)

15. [ ] Data-gathering instruments

16. Anticipated dates for contact with subjects:

<table>
<thead>
<tr>
<th>First Contact</th>
<th>Last Contact</th>
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<tr>
<td>2/6/90</td>
<td>5/20/90</td>
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<tr>
<td>Month / Day / Year</td>
<td>Month / Day / Year</td>
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</tbody>
</table>

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

| 5/20/90 | Month / Day / Year |

18. Signature of Departmental Executive Officer

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<tr>
<th>Signature</th>
<th>Date</th>
<th>Department or Administrative Unit</th>
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<tbody>
<tr>
<td>Thomas Incalal</td>
<td>12/13/90</td>
<td>HHS/10 Dept</td>
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19. Decision of the University Human Subjects Review Committee:

<table>
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<th>Project Not Approved</th>
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<tr>
<th>Name of Committee Chairperson</th>
<th>Date</th>
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<tbody>
<tr>
<td>Patricia M. Keith</td>
<td>12/28/90</td>
<td>OM (coy)</td>
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Human Subjects Approval Form.

Item #7:

The proposed research is being conducted to develop a food preparation study guide applying the principles of food science. Approximately 60 students enrolled in HRI 380 will be the potential subjects of the research. These subjects were chosen since the study guide will be recommended as supplementary reading for future HRI 380 classes.

A pre-test and posttest will be administered in conjunction with the proposed study guide as part of the 380 course Spring, 1991 curriculum. This test will evaluate cognitive achievement following study of the food preparation guide.

A consent form requesting permission to use the subjects’ test scores, a letter explaining the study, and a demographic questionnaire will be passed out after completion of the posttest. To avoid and limit pre-test affect on posttest, students will not be notified prior to the pre-test. Since tests are required for the course, permission to use scores is requested. Students will be allowed to withdraw their participation from the research at any time.

Item #9:

The original test responses will be identified by the last six digits of the participant’s student ID number on the computerized answer sheet. Participants requesting test results will have their score posted by their six-digit ID number. The test scores and demographic data will be identified by code number for recording in data files for later statistical analysis. All research data, coding sheets, and original test answer sheets will be kept secure during the research. Finally, student ID numbers will be used only to assign matching code numbers to the pre- and posttest results and demographic data from each subject. Once code numbers are assigned, all ID identification will be destroyed.

Item #10:

The only discomfort that research subjects might experience is test anxiety. Although the students are frequently subjected to assigned reading and testing during HRI 380, some self-induced anxiety is always present in a testing environment.
February 22, 1991

To: Patricia M. Keith
Committee Chairperson
Human Subjects in Research

From: Don M. Paulson
Hotel, Restaurant, & Institution Management
#11 MacKay Hall
Iowa State University

Subject: Research Population Expansion

The sample from the population being used in my research will be expanded by approximately 30 new subjects. In addition to the use of 60 students enrolled in HRI 380 approved on December 28, 1990 by the Human Subjects in Research Committee, the study will now include 30 subjects from at least two community colleges in Iowa. These subjects will be enrolled in courses using the study guide developed for my research model.

This study guide will later become part of a manual that will be used by these new subjects in actual work settings. Therefore, measurement of existing cognitive levels and learning styles from this sample would add an important dimension to the research and help in statistical applications.

Both my major professors, Dr. Larry Ebbers and Dr. Lynne Baltzer, have approved the expansion of the research sample. Approval from my other committee members will be obtained after I receive your clearance.

Revised research forms to be used with the new sample are attached:

1. Revised consent form.
2. Verbal instructions to participate.
3. Written instructions to participants.
4. Revised demographic questionnaire.
Confidentiality is guaranteed to all research participants from this new sample. Withdrawal from the research is permitted at any time during the study.

Attached is a copy of the original application approved by your office. Please signify your approval by initialing your name. Thank you.

Sincerely,

Don M. Paulson, M.S.
Higher Education/Hotel, Restaurant, & Institution Management
May 14, 1991

Dear student:

Thank you for participating in the Quantity Food Preparation Study Guide research. Your study guide questionnaire scores were:

Pretest: ________  Posttest: ________

Your involvement with the study was essential to the success of the research project. If you have any further questions about the project, please contact Don Paulson at the address on the letterhead, or by calling 515/738-2757.

Sincerely,

Don M. Paulson, MS, RD, LD
Researcher

Lynne E. Baltzer, PhD, RD, LD
Associate Professor
September 12, 1991

Dr. Sharon Merritt  
Box 6998  
Department of Medical/Surgical Nursing  
M/C 802  
College of Nursing  
University of Illinois  
Chicago, Illinois 60680

Dear Dr. Merritt:

There appears to be some controversy concerning the correct scoring procedure relating to your most recent LSQ. Could you please explain your technique a bit more thoroughly?

I scored your LSQ measurement instrument according to the values you directed Dr. Cathy Hsu to follow. Before I can proceed further with my research, I need confirmation so that I will not score the questionnaires incorrectly.

I will also be searching the literature for any new three-dimensional learning style models that might be in existence. If you have literature relating to such, would you please let me know the sources? The literature review, as you probably already know, is an ever on-going process.

Thank you again for your permission allowing us to use the LSQ. Be assured I will share all research results with you.

Sincerely,

Don M. Paulson, M.S., R.D., L.D.  
Higher Education/Hotel and Restaurant Management Ph.D. Candidate  
RR #1, Box 2-A  
Dana, Iowa 50064-8701
TO: Don M. Paulson  
FROM: Sharon L. Merritt, Ed.D., RN  
SUBJECT: Learning Style Questionnaire, 1985

A sample copy of the form you requested is enclosed. Permission is granted for you to use the form under the following conditions:

1. The instrument is used only for your research project.

2. Use of the instrument and all relevant publications by Dr. Marshall and I are correctly cited in your research.

3. If the questionnaire is used as part of the instrumentation for your research, the section containing the LSQ are fully cited with authors' names and addresses, and the following phrase;

"Permission granted to for exclusive and sole use in his/her research project."

4. Upon completion of the study, we receive a copy of all raw data collected in your study.

5. If publication(s) result(s) from your study, we receive full and complete credit as authors of the LSQ.

6. Reprint(s) of article(s) that include(s) discussion of results using the LSQ are forwarded to us.

Your agreement to these conditions for use of the LSQ is indicated by your signature below and return of this form to Dr. Merritt at the address above. Upon receipt of the signed form a copy of the scoring instructions will be forwarded to you.

SIGNATURE: _____________________________

NAME: Don M. Paulson

ADDRESS: RR #1 Box 2-A

Dana, WA 98634-8761

TITLE OF PROPOSED RESEARCH: ________________________________