Consumer preferences for pork, Des Moines, Iowa

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Consumer Preferences for Pork, Des Moines, Iowa

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SUMMARY

The declining demand for pork is of concern to the residents of Iowa and the other states where pork production is important. To determine consumer preferences and attitudes regarding pork and to obtain information on factors affecting consumption of pork and other meats, a probability sample of households in Des Moines, Iowa was selected for interview. An interview was obtained during June 1955 from the person in each of 499 households who generally bought the meat for the family.

Income and family size were the principal determinants of pork consumption patterns among the survey households. For a given income, total pork consumption increased sharply as the size of family increased. As income increased for a given size of household, however, pork consumption gradually declined. No differences related to occupation were detected.

The pork cut or pork dish listed as the family's favorite was usually pork chops or ham. Thirty-two percent of the homemakers indicated that their families preferred chops, and 28 percent indicated a preference for ham. Pork roast was listed as the favorite by 12 percent, while bacon was the favorite with 10 percent. No other pork cut or pork dish was listed as preferred by more than 2 percent of the respondents.

Respondents were asked to comment on the quality of some of the major pork cuts. Chops and ham received fewer complaints about fatness than did bacon, pork roast and sausage. Although pork roast was characterized by the smallest number of users and by the largest percentage of user complaints about fatness, it also ranked near the top in percentage of unqualified "good" and "excellent" comments from users—with fewer "in-between" comments. The percentage of users complaining about fatness of bacon and sausage approximated the average percentage for all five cuts—about 14 percent. Another 34 percent of the bacon users said they could find the type of bacon they desired if they searched for it or paid a higher price.

Opinions on the health value of pork were obtained to ascertain the nature and extent of misinformation, if any, that may have contributed to unfavorable attitudes toward pork. Sixty percent of the respondents had heard or read something about the health value of pork. About two-thirds of the respondents who had heard comments favorable to pork, and who remembered the source of information, cited mass media, school or college as the source of their favorable opinions. Most of the remainder cited childhood, conversation, doctor or "own idea." Nearly all of the unfavorable ideas regarding pork were attributed to the latter group of information sources.

The findings showed that the respondents were able to differentiate between pork chops in terms of their preference for fat chops or for lean chops. Eighty-nine percent of the respondents preferred the lean or medium chops over the fat chops. Bone and texture were relatively unimportant secondary factors cited as reasons for the preference rankings.

The respondents indicated satisfaction with the thickness of pork chops as they found them in the market, but were less satisfied with the size of chops. A larger-than-average chop with an eye muscle area of about 6 square inches was preferred over an average chop.

Forty-seven percent of the households served chops more than twice a month, including 6 percent serving chops at least once a week. Altogether, 83 percent of the households served pork chops at frequencies ranging from once a month to once a week.

According to the findings, the prospects of forestalling the present decline in demand for pork are not promising unless pork is made more attractive to those households with the means to buy the meats they prefer.
Consumer Preferences for Pork, Des Moines, Iowa

by Raymond O. Gaarder, Norman V. Strand and Wilbur R. Maki

The declining demand for pork is of concern to the residents of Iowa and of the other states where pork production is an important element of the economy. The north-central states produce over 80 percent of all the pork in the United States. Iowa, the leading state in pork production, produces more pork than the combined output of all the states outside the north-central region. Hence, the impact of a declining demand for pork, in terms of reduced income from hog marketing, is of greatest importance to the north-central region and especially to Iowa.

There are two problems concerning the demand for pork. One problem is the declining demand for lard. As fig. 1 shows, since the beginning of this century, a widening gap has grown between the prices of the important lean cuts of pork and of fat for lard.

The second problem, and probably the more serious one, is the declining demand for pork, especially in relation to competing meats. The relative demand changes are illustrated in fig. 2, which shows pork prices and consumption as percentages of those for beef. According to the figure, per-capita pork consumption has varied sharply relative to beef consumption. Year-to-year changes in hog or cattle marketings are responsible for these sharp variations in the pork-beef consumption ratio. Nevertheless, the general tendency during the period shown in fig. 2 has been a relative decline in pork products consumed per person. This means, of course, that per-capita beef consumption has tended to increase relative to that of pork.

Fig. 1. Average annual wholesale pork and lard prices compared with live hog values, United States, 1905-59.

Fig. 2. Average annual retail pork prices and total pork consumption compared with beef prices and consumption, United States, 1920-59.
Economic analyses have indicated that both have occurred. To develop means of increasing the demand for pork, more knowledge is needed of consumer preferences and the factors affecting these preferences. The pattern of preferences must be determined in terms of the degrees or amounts of attributes, such as fatness, tenderness and color, that are desired by consumers. A knowledge of the pattern of preferences for pork would be required both for the development of a satisfactory method of sorting or grading pork cuts, if that should be needed, and for the setting of goals and guides for breeding, trimming and merchandising.

OBJECTIVES AND PROCEDURES

The specific purposes of this study were:
(1) To determine consumers' preferences for various cuts and qualities of pork;
(2) To determine consumers' willingness to accept price differentials for different qualities of a particular pork cut; and
(3) To determine the factors affecting family consumption of pork and other meats and meat substitutes.

With the limited funds and personnel available, it was decided that the study would pertain largely to consumer preferences and attitudes with respect to center-cut pork chops. Some information also was obtained on consumers' attitudes toward other cuts of pork. Specifically, this report pertains to the findings from a survey of a sample of households randomly selected to represent the population of the urbanized area of Des Moines, Iowa. The interviews were taken during June 1955.

Of the 560 households in the sample, interviewers were able to obtain useful information from 499, or 89.1 percent. This and other facts about the households in the sample are shown in table 1. Appendix A discusses the household selection procedure and field procedure. In estimating totals, the mean value of the responses was assigned to each of the nonresponses (see Appendix B for detailed account). This procedure requires the assumption that, had these noninterviewees responded, they would not have differed as a group from those who did respond. Appendix B discusses the methods used in estimating means and totals and the sampling error of these estimates.

Many of the estimates in this report are given as proportions of various groups within the sample. The population proportion in a given group is estimated directly by the corresponding sample proportion inasmuch as the sample is self-weighting (see Appendix C for details). Table 1 shows the number from the sample in each of these groups or classes.

CHARACTERISTICS OF THE DES MOINES SAMPLE OF HOUSEHOLDS

Socio-economic characteristics of the households included in the sample are given for the benefit of those who may wish to compare the findings of this study with the findings of other studies dealing with consumer preferences and meat consumption.

Three socio-economic characteristics of the households in the sample — family income, occupation of the household head and household composition (number of children, adults, etc.) — are described and discussed briefly in this section. A later section on consumption, income and size of families contains an analysis of the effect of these household characteristics on meat consumption.

Information on family income was obtained from a total of 467 households, of which 49 were households of one person. Over half of the 418 households consisting of two or more persons reported weekly incomes of $75 or more, but only one-tenth of the one-person households reported weekly incomes of $75 or more. As the total income increased, food expenditures for each household group increased, but less than proportionately. It was found that a 10-percent change in income, using the income classes in table 2, was associated with about a 5-percent change in food expenditures. The expenditure-income relationship was larger for one-person households than for households of two or more persons.

A second classification of 443 households was based on income and showed the number of persons 2 years or older eating solid food and the number of meals eaten at home (table 2).

Except in the case of the highest income group, the average size of household increased as average family income increased (table 2). In all income groups except the two lowest, the average age of the household head was between 40 and 45 years. For households with a reported weekly income of less than $50, the average age was nearly 60 years. A relatively large number of persons in the latter households were retired or unemployed.

On the average, one or more family members ate at home or ate a home-prepared meal for 19 of the 21 possible meals in the interview week. An average of 92 meals included meat servings. Only small differences according to income class were found in the total number of meals and the number of meals with meat served.

The sample of 443 households was sorted into five household composition groups: single adults and four different classes of multi-person households (table 3). Half of the households included children (dependent persons 18 years of age and under). Eighty percent of the children were under 11 years of age. House-
TABLE 2. SELECTED CHARACTERISTICS OF HOUSEHOLDS IN DES MOINES, IOWA, BY INCOME CLASS, JUNE 1955.

<table>
<thead>
<tr>
<th>Average weekly income</th>
<th>Households*</th>
<th>Average number of persons per household</th>
<th>Average age of household head</th>
<th>Meals eaten at home in 1 week*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $25</td>
<td>7.0</td>
<td>1.6</td>
<td>60</td>
<td>18.9</td>
</tr>
<tr>
<td>$25 to $50</td>
<td>15.8</td>
<td>2.4</td>
<td>57</td>
<td>19.5</td>
</tr>
<tr>
<td>$50 to $75</td>
<td>25.3</td>
<td>3.0</td>
<td>43</td>
<td>18.8</td>
</tr>
<tr>
<td>$75 to $100</td>
<td>19.4</td>
<td>3.4</td>
<td>40</td>
<td>19.0</td>
</tr>
<tr>
<td>$100 to $125</td>
<td>13.1</td>
<td>3.7</td>
<td>41</td>
<td>19.9</td>
</tr>
<tr>
<td>$125 and over</td>
<td>19.4</td>
<td>3.3</td>
<td>45</td>
<td>18.5</td>
</tr>
<tr>
<td>Total or average</td>
<td>100.0</td>
<td>3.0</td>
<td>46</td>
<td>19.0</td>
</tr>
</tbody>
</table>

* Percentage of 443 households. See Appendix C for statistical methods to test the significance of the difference between any two percentages.

TABLE 3. SELECTED CHARACTERISTICS OF SAMPLE OF 443 HOUSEHOLDS IN DES MOINES, IOWA, BY HOUSEHOLD COMPOSITION, JUNE 1955.

<table>
<thead>
<tr>
<th>Household composition</th>
<th>Total households</th>
<th>Average age of household head (years)</th>
<th>Proportion having average weekly income under $75*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single adults</td>
<td>9</td>
<td>55</td>
<td>92</td>
</tr>
<tr>
<td>Couple and/or all adults</td>
<td>42</td>
<td>52</td>
<td>56</td>
</tr>
<tr>
<td>Children all under 11 years</td>
<td>27</td>
<td>53</td>
<td>66</td>
</tr>
<tr>
<td>Children all over 11 years</td>
<td>12</td>
<td>48</td>
<td>72</td>
</tr>
<tr>
<td>Children all ages</td>
<td>10</td>
<td>43</td>
<td>76</td>
</tr>
<tr>
<td>Total or average</td>
<td>100</td>
<td>48</td>
<td>82</td>
</tr>
</tbody>
</table>

* Remainder having average weekly income of $75 and over.

TABLE 4. SELECTED CHARACTERISTICS OF SAMPLE OF 443 HOUSEHOLDS IN DES MOINES, IOWA, BY OCCUPATION OF HOUSEHOLD HEAD, JUNE 1955.

<table>
<thead>
<tr>
<th>Occupation of head</th>
<th>Total households</th>
<th>Average age of household head (years)</th>
<th>Proportion having average weekly income under $75*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional and semi-professional</td>
<td>14</td>
<td>63</td>
<td>78</td>
</tr>
<tr>
<td>Proprietors, managers officials, farmers</td>
<td>9</td>
<td>39</td>
<td>12</td>
</tr>
<tr>
<td>Clerical, sales and kindred workers</td>
<td>13</td>
<td>47</td>
<td>23</td>
</tr>
<tr>
<td>Craftsmen and foremen</td>
<td>20</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>Operative and kindred workers</td>
<td>20</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>Service workers, including domestic</td>
<td>7</td>
<td>49</td>
<td>74</td>
</tr>
<tr>
<td>Laborers, including farm laborers</td>
<td>3</td>
<td>42</td>
<td>47</td>
</tr>
<tr>
<td>Housewives and own housework</td>
<td>100</td>
<td>55</td>
<td>96</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>5</td>
<td>55</td>
<td>96</td>
</tr>
<tr>
<td>Total or average</td>
<td>100</td>
<td>46</td>
<td>48</td>
</tr>
</tbody>
</table>

* Remainder having average weekly income of $75 and over.

TABLE 5. FAMILIES' FAVORITE PORK CUTS OR PORK DISHES, EITHER FRESH, CURED, CANNED OR A SAUSAGE PRODUCT, DES MOINES, IOWA, JUNE 1955.

<table>
<thead>
<tr>
<th>Favorite pork cut or dish</th>
<th>Number preferring</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chops</td>
<td>144</td>
<td>32</td>
</tr>
<tr>
<td>Ham</td>
<td>158</td>
<td>32</td>
</tr>
<tr>
<td>Roast</td>
<td>81</td>
<td>19</td>
</tr>
<tr>
<td>Bacon</td>
<td>68</td>
<td>15</td>
</tr>
<tr>
<td>Others</td>
<td>46</td>
<td>10</td>
</tr>
<tr>
<td>Two cuts equally preferred</td>
<td>80</td>
<td>18</td>
</tr>
<tr>
<td>No preference</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>451</td>
<td>100</td>
</tr>
</tbody>
</table>

OPINIONS AND PREFERENCES FOR PORK

FAVORITE PORK CUT OR PORK DISH

Respondents in the 456 households where pork was eaten were asked the question, "What is your family's favorite pork cut or pork dish, either fresh, cured, canned or a sausage product?" The pork cut or pork dish listed as the family's favorite was usually pork chops or ham among the 451 respondents of this question (table 5). Thirty-two percent of the homemakers indicated that their families preferred chops, and 28 percent indicated a preference for ham. Pork roast was listed as the favorite with 12 percent, while bacon was the favorite with 10 percent. No other pork cut or pork dish was listed as a favorite by more than 2 percent of the respondents. Of the 53 house-
holds which preferred two pork cuts equally well, only two did not list either chops or ham as one of their preferences.

At least two interpretations might be made of the data in table 5: The respondents had in mind their favorite dish for the most important meal, presumably dinner, or the respondents had in mind breakfast, lunch and dinner, and the favorite dish among the three meals was selected. (At least some of the respondents must have had breakfast in mind, because it is improbable that 10 percent of the respondents would select bacon as their favorite cut for dinner.)

**OPINIONS ON QUALITY OF FIVE MAJOR PORK CUTS**

Opinions on the quality of bacon, ham, pork chops, pork roast and sausage are summarized in table 6. A number of respondents had previously listed their favorite pork cut or dish. Those who had listed bacon as their favorite dish did not answer the bacon part of the question significantly differently from those who had not. This finding was also true for the other meats. Moreover, the question about a particular meat was asked only if the household purchased that meat occasionally in retail stores. Therefore, 429 respondents were asked the question concerning bacon, and only 268 were asked the question about pork roast.

Pork roast not only had the smallest number of users but also had the largest percentage of complaints about fattiness. It had significantly more good and excellent ratings, as well as significantly more "too fat" ratings than did sausage. Ham and pork chops had a smaller percentage of "too fat" comments than did the other products. The opinions regarding the quality of bacon were characterized by two pronounced differences from the responses for ham and pork chops: (1) more respondents thought bacon was too fat and (2) more respondents thought they had to search or pay higher prices to find satisfactory bacon.

**OPINIONS ON THE HEALTH VALUE OF PORK**

If opinions of the health value of pork could be determined and traced to their sources, the usefulness of pork promotional and educational activities might be evaluated. All 475 homemakers in households eating meat were asked the questions, "What have you heard or read about the health value of pork?" and "Where did you hear or read this?" Two hundred and seventy-five homemakers who were members of households where pork was eaten had given a response, and 190 did not remember having heard anything. Fifty-eight, or 12 percent of the respondents, mentioned trichinosis or the fact that pork must be well done. The replies obtained from the remaining 225 households are summarized in table 7.

The two principal sources of information about the health value of pork were "mass media" and "from childhood" or words to that effect. Each source was cited by 27 percent of all the respondents who remembered having heard something that could be classed as either favorable or unfavorable (table 7). Mass media included such means of communication as magazines, books, television, newspapers, radio and pamphlets. Magazines and books were listed by about half of those citing mass media. Over 60 percent of the respondents who had comments favorable to pork and who remembered the source of information cited mass media and institutions as the source of their information. Most of the unfavorable notions regarding pork were attributed to childhood and conversation.

A breakdown of the comments of the 129 respondents giving replies favorable to pork shows the following: "Nutritious" or "good for you" was the comment of nearly half. Vitamins were mentioned by a third and protein by 15 percent of the 129 respondents. Few respondents giving favorable comments without qualification mentioned anything other than vitamins, protein or "nutritious."

Of the 70 respondents who gave comments partially unfavorable to pork, 40 percent said pork was not good if too much was eaten, 20 percent said it was hard to digest, while the remainder gave various replies such as "not as good as beef" or "don't eat too much if old or ill."

**REASONS FOR SPECIAL DIETS OR DIETS NOT HAVING PORK**

Table 8 lists the households with one or more members on a special diet, or with members who were not permitted to eat pork, according to the reason given and the household member or members affected. Of the 475 households with meat eaten, all but one answered the question. No special diets excluding or limiting pork were in effect in 362 of
TABLE 8. HOUSEHOLDS WITH ONE OR MORE MEMBERS ON A SPECIAL PORK DIET, OR NOT PERMITTED TO EAT PORK, ACCORDING TO THE REASON GIVEN AND HOUSEHOLD MEMBER AFFECTED, DES MOINES, IOWA, JUNE, 1955.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Man (number)</th>
<th>Woman (number)</th>
<th>Both (number)</th>
<th>Total (number)</th>
<th>Proportion of all households* (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nervous stomach or allergy</td>
<td>11</td>
<td>12</td>
<td>6</td>
<td>29</td>
<td>6.1</td>
</tr>
<tr>
<td>Ulcer</td>
<td>12</td>
<td>4</td>
<td>6</td>
<td>22</td>
<td>5.4</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>13</td>
<td>2.7</td>
</tr>
<tr>
<td>Gall bladder</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Doctor's orders</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>10</td>
<td>2.1</td>
</tr>
<tr>
<td>Colon</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td>16</td>
<td>3.4</td>
</tr>
<tr>
<td>Trying to lose weight</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td>2.1</td>
</tr>
<tr>
<td>Heart</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>1.7</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>13</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>59</td>
<td>15</td>
<td>110</td>
<td>23.1b</td>
</tr>
</tbody>
</table>

* Based on 474 respondents who answered the question.

In addition, two households reported members on special diet without specifying sex of person affected, for a total of 23.6 percent of all respondents who answered the question.

These households, while in the remaining 112 households one or more members were on a special diet with partial or complete restrictions on pork consumption.

Stomach ailments, allergy and ulcers topped the list of reasons for men. For women, stomach ailments, allergy, high blood pressure and gall bladder trouble were the most common reasons. It is not known how many of these diets were self-imposed as a result of misinformation.

OPINIONS AND PREFERENCES FOR PORK CHOPS

USE OF PHOTOGRAPHS

In the preliminary work on the questionnaire, it was decided that either samples of meat or photographs of samples of meat were to be used along with the questionnaire. The samples were to represent lean, medium and fat pork chops. Each respondent who would eat pork chops was asked which of the three she would prefer to eat and which she liked less than the others.

An experiment was conducted to see whether photographs would be satisfactory substitutes for actual meat samples. This experiment has been described in detail by Gaarder and Strand. On the basis of this experiment, it was decided to use photographs in the Des Moines survey of households.

In this study, “rib” and “loin” chops were sufficiently different in appearance that it was considered necessary to eliminate this source of variation by collecting information on rib and loin chops separately. Hence, photographs of two kinds of pork chops were used in the Des Moines survey.

Table 9 should aid in describing the differences between center-cut loin chops and center-cut rib chops. Twelve loin chops cut from six pork loins were compared with 12 rib chops cut from the same six loins.

Even if all the extra 9 percent of fat on the rib chops were added to the 46 percent lean, the loin chops still would contain more lean meat per pound because of their smaller bone content.

DESCRIPTION OF PORK CHOPS SHOWN TO RESPONDENTS

Table 10 gives the fat, bone and lean content of the six chops whose photographs were used in the survey. These six chops were chosen from the 24 chops whose average analysis is shown in table 9.

During the interview, nonsense symbols were used to identify the photographs to the respondent. In an “original” set of photographs, the lean, medium and fat chops were identified to the respondent by a triangle, a square and an arrow, respectively. Replicas of these photographs were shown to obtain a measure of response consistency. In the replicate set of photographs (of the same chops with the photos rearranged and the negatives turned over) the symbols were a cross, a check and a wavy line. The symbols presumably were not quality-ordered in the respondents’ minds. The “original set” and the “replicate set” will be referred to as photo set A and photo set B, respectively.

Each set of three photographs was arranged on a circular viewing holder which could easily display them in such a fashion that they were in no apparent order. The interviewers were instructed to use only rib chop photographs with the questionnaire at one household and only loin chop photographs with the questionnaire at the next household.

Of the 402 respondents who viewed the photographs and ranked them, 208 were shown loin chop photo sets A and B, and 194 were shown rib chop photo sets A and B. Most of the remaining 97 households did not use fresh pork at home and were not asked to rank the chop photographs.

CONSISTENCY OF RESPONSES

After the respondent had indicated which chop shown in photo set A was preferred and which chop was liked less than the others, the original set of

TABLE 9. AVERAGE ANALYSIS OF 24 PORK CHOPS AS A PERCENT OF TOTAL COOKED WEIGHT, DES MOINES, IOWA, JUNE 1955.

<table>
<thead>
<tr>
<th>Part of chop</th>
<th>12 loin chops from 6 loins</th>
<th>12 rib chops from 6 loins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean</td>
<td>61</td>
<td>48</td>
</tr>
<tr>
<td>Bone</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Fat</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* Percentage of total cooked weight.
TABLE 11. CONSISTENCY OF RESPONSE TO PHOTOGRAPHS USED IN DES MOINES SURVEY, JUNE 1955.

<table>
<thead>
<tr>
<th>Consistency of respondents</th>
<th>Number of respondents</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranked photo set B same as photo set A</td>
<td>322</td>
<td>80</td>
</tr>
<tr>
<td>Chose same chop as best both times but switched the other two</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>Chose the same chop as poorest both times but switched the other two</td>
<td>50</td>
<td>12</td>
</tr>
<tr>
<td>Chose the same chop as medium both times, others switched; rankings all switched; or tied in one ranking or a tie in both that disagrees</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>403</td>
<td>100</td>
</tr>
</tbody>
</table>

*Six nonresponses and one improperly recorded.

photographs was put away. Then the replicate set (photo set B) was shown. Set B consisted of pictures of the same three chops, but with the photographs arranged differently, and with the negatives turned over. The B photo sets were used to test repeatability of the selection, or the ability of the respondent to distinguish consistently between fatness and leanness.

The respondents again were asked to select, from a different set of pictures of the same chops, the chop they would personally prefer to eat and the one they would least prefer to eat. No hint as to the purpose of the second photo set was given.

There were some inconsistencies in the replies with reference to photo set B as compared with those with reference to photo set A. Table 11 shows the consistency of response between the two sets of photographs. There did not appear to be any significant difference between the consistency scores of persons viewing rib chops and the scores of those viewing loin chops. As table 11 indicates, there are a number of ways in which the photo set B chops could have been ranked differently from the ranking given the photo set A chops by the same respondent. In 80 percent of the cases, however, the chops in photo sets A and B were ranked in the same order. In most cases of inconsistency, the respondents were at least consistent in their choice of which chop was poorest.

PREFERENCES FOR LEAN, FAT AND MEDIUM CHOPS

Table 12 shows the number and percentage of respondents who preferred lean, medium and fat chops and the reasons for their preference. The table includes only the 322 respondents who ranked all chops consistently and the 19 who chose the same chop as best both times but switched the other two.

Of the replies listed in table 12, 173 were made by respondents viewing the rib-chop photographs, while the remaining 188 replies were by respondents viewing the loin-chop photographs. Loin chops and rib chops were not kept separate in table 12, because there was no significant difference between the percentage of housewives preferring the lean loin chop and the percentage preferring the lean rib chop. The same was true for the medium chops. For example, of the 173 respondents shown the rib chops, 35 percent preferred the lean chop, and of the 168 respondents shown the loin chops, 32 percent preferred the lean chop. The other preferences were: medium rib, 61 percent; medium loin, 51 percent; fat rib, 4 percent; and fat loin, 14 percent.

Table 12 also shows that 56 percent of the 341 homemakers preferred the medium chop over the others. Of the 190 respondents preferring the medium chop, however, 130, or 67 percent, gave "less fat" as their reason for selecting that chop. In the case of both the rib chop and the loin chop, it may have been difficult for the respondents to see that the lean chop was leaner than the medium chop, but it certainly was easy for most of them to see that the fat chop was the fattest of the three. Respondents who would actually prefer the lean chop may not have been able to distinguish between the lean and the medium and, thus, made their choice on the basis of color or texture, still giving their primary reason as "less fat." The two main reasons given for the respondents' preferences were "less fat," 67 percent, and "need a little fat for flavor," 13 percent.

There was substantially more agreement as to which chop was the least preferred of the three shown each respondent. Also, there was more agreement as to the reason for choosing a certain chop as least preferred. Table 13 shows data for only the 372 respondents who were consistent in ranking all chops, including the 50 respondents who ranked the same chop as least preferred both times but switched otherwise. Even if these 50 had been left out of the table, 388, or 89 percent, of the remaining 322 liked the fat chop the least.

TABLE 12. NUMBER AND PERCENTAGE OF RESPONDENTS WHO PREFERRED LEAN, MEDIUM AND FAT CHOPS AND THE REASONS FOR THEIR PREFERENCE, DES MOINES, IOWA, JUNE 1955.*

<table>
<thead>
<tr>
<th>Chop photograph preferred</th>
<th>Reason most preferred</th>
<th>All respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less fat (number)</td>
<td>Need a little fat for flavor (number)</td>
</tr>
<tr>
<td>Lean</td>
<td>91</td>
<td>10</td>
</tr>
<tr>
<td>Medium</td>
<td>130</td>
<td>25</td>
</tr>
<tr>
<td>Fat</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Either lean or medium or no preference</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Total responses</td>
<td>228</td>
<td>46</td>
</tr>
<tr>
<td>Percent of all respondents</td>
<td>67</td>
<td>13</td>
</tr>
</tbody>
</table>

* Includes only those respondents who were consistent on all chops or who preferred the same chop both times but switched the other two.

b Better finish, more fat, color, shape and no preference.

c One no preference.

<table>
<thead>
<tr>
<th>Chop photograph</th>
<th>Fatter or too fat</th>
<th>Too much fat and/or bone</th>
<th>Poor texture looks stringy</th>
<th>Not enough fat</th>
<th>Other*</th>
<th>Total</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>20</td>
<td>5.5</td>
</tr>
<tr>
<td>Medium</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>11</td>
<td>3.5</td>
</tr>
<tr>
<td>Fat</td>
<td>306</td>
<td>23</td>
<td>8</td>
<td>...</td>
<td>1</td>
<td>398</td>
<td>91.6</td>
</tr>
<tr>
<td>Tie and no preference</td>
<td>1</td>
<td>...</td>
<td>...</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Total 312
Percent of all respondents 84

* Includes only those respondents who were consistent on all chops (ranked photo set A the same as photo set B) or least preferred the same chop both times but switched the other two.

Less tenderloin, pale color, not completely finished, no preference.

Several respondents did show a preference for the fat chop. At least 15 of the 29 respondents who selected the fat chop as the best, cited the presence of fat as the reason for their preference. The general dislike of fat is revealed, however, in the reasons for the low ranking of the fat chop by most respondents. Of the 338 respondents who ranked the fat chop as the least preferred, 329 cited excessive fat as a reason.

PREFERENCES FOR CHOP SIZE

Among the goals of the meat-type hog breeding programs are well-muscled loins and hams. If fat in the carcass could be replaced by muscle, the carcass would become more valuable (see fig. 1). Adding muscle to the loin increases pork chop size, since the loin muscle is the chop muscle. Evidence that consumers might prefer large chops has been reported.3

Respondents in this study were asked the size of chop they would prefer. Larger-than-ordinary-size pork chop color photographs (about 6 square inches of loin-eye area) were pasted on ½ inch plywood, and the wood was cut out following the outline of the chop. After painting the sides white, a reasonably satisfactory pork-chop model was obtained. Each interviewer had one of these models. By the time the survey was half finished, the interviewers were reporting that most of the respondents were answering that they preferred a chop the same size as the model. To test whether or not this was due to a natural positive response bias (respondents trying to be agreeable), smaller models were made. The "small" models had eye muscle areas of over 4 square inches, which is larger than the usually accepted minimum for offspring of certified meat-type sires. By the time these smaller models were placed in the hands of the interviewers and the larger models were taken from them, over two-thirds of the interviews had been completed. Even so, it is obvious from table 14 that after the "small" (4 square inch) models were used, considerably less satisfaction was expressed with the size of the model shown.

Table 14 shows that, if there was a bias in favor of answering "same," this bias did not overshadow unique responses to the different models. Of the 410 households with pork chops eaten, 393 gave answers as shown in the table. Of the 17 remaining households, 14 did not buy pork from a store, two stated that they bought whole loins only, and there was one respondent whose answer was not recorded.

The respondents were also questioned regarding their preferences for different thickness of pork chops —thicker, thinner or about the same size as the model chop, which was ½ inch thick. Answers to these questions were given by 394 households in which pork chops were eaten. Approximately 75 percent said they preferred the same thickness as the model, while 17 percent said "thinner than the model," and 10 percent said "thinner than the model." Only 5 percent of the respondents eating chops said they were unable to get the thickness they desired.

PORK CHOP PREFERENCES AS RELATED TO COST AND CONSUMPTION

QUALITY AND PRICE

Each respondent in the Des Moines survey was asked how many chops she would buy for a meal if chops like the ones in photo set B were available. When the respondents shown loin chops were asked questions about the price, 75 cents a pound was used as a base price. When the other respondents (those shown rib chops) were asked questions about price, 70 cents a pound was the base price. These two

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3 In a small retail sales test in which chops were sorted by size, over twice as many large chops were sold as small chops. G. O. Gardner and E. A. Kline, What do consumers want from pork? Iowa Farm Science. 11:390-392. Dec. 1956.

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TABLE 14. RESPONSES TO THE QUESTION, "WHICH SIZE OF PORK CHOP DO YOU PREFER IF THEY ARE ALL THE SAME PRICE PER POUND?", DES MOINES SURVEY, JUNE, 1955.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Large model used</th>
<th>Small model used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(number) (percent)</td>
<td>(number) (percent)</td>
</tr>
<tr>
<td>Prefer a chop smaller than the model</td>
<td>55 (19)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Prefer a chop the same size as the model</td>
<td>303 (71)</td>
<td>58 (55)</td>
</tr>
<tr>
<td>Prefer a chop larger than the model</td>
<td>27 (9)</td>
<td>45 (42)</td>
</tr>
<tr>
<td>Other*</td>
<td>4 (1)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Total</td>
<td>287 (100)</td>
<td>106 (100)</td>
</tr>
</tbody>
</table>

* Some smaller and some larger, some the same size and some larger, do not care.
prices were close to the prevailing retail prices of the two kinds of chops.

The interviewer was instructed to record the first answer given to the question, "Suppose chops like the 'check' (for medium) chop were available at 75c (or 70c) a pound and you were buying one of these two classes of chops for dinner, how much would you pay, at most, for chops like these?" (A lean-chop photograph was indicated.) The interviewer then probed by asking, "How about a couple of cents a pound more?" and kept this up until the respondent said "No," or words to that effect. The probing was done to make certain that the price finally arrived at was close to the price at which the respondent would be indifferent as to which chop to take.

The same procedure was used when comparing fat chops with medium chops. The respondent was asked "Would you now consider the 'wavy line' (for fat) chop. Suppose again that chops like the 'check' (for medium) chops were available at 75c (or 70c) a pound and you were buying one of these classes of chops for dinner, how much would you pay at most for chops like the 'wavy line' (for fat) chops?"

Certainly the respondent was not making a commitment to pay the "how much would you pay" price. The questions were hypothetical. Nevertheless, the responses to the questions posed were consistent with responses to earlier questions about the most and least preferred chops.

Tables 15 and 16 contain summaries of the replies to the questions previously quoted. Only "qualified" respondents are included. To qualify, the respondent had to be consistent in the order in which she had previously ranked the two chops in question; i.e., lean and medium for the first question, fat and medium for the second question. Both questions were asked of each respondent. This consistency was determined for each respondent by her ranking of the two sets of photographs, "A" and "B" (see table 11). In addition, only those who would pay at least 70 cents a pound for the center-cut rib chops or 75 cents a pound for the center-cut loin chops were considered to be "qualified" for inclusion in tables 15 and 16. Thus, if a respondent did not rank the chop photographs in a consistent manner or if she was not willing to pay prevailing prices for center-cut pork chops, her replies to the two questions were not considered to be meaningful. Responses of viewers of rib and loin chops were combined, again because they were not significantly different.

The average premium over 75c (or 70c) offered for the lean chop over the medium chop by those who had earlier stated a consistent preference for the lean chop over the medium was 6 cents a pound (table 15). The average discount offered by those who had preferred the medium chop was 9 cents a pound. In addition, table 15 shows the middle three-fourths range of premium (discount) offers.

The average premium over 75c (or 70c) offered for fat over medium by those who had earlier given a consistent preference for the fat chop over the medium was 2 cents a pound (table 16). The average discount offered by those who had preferred the medium chop over the fat chop was 30 cents a pound. Table 16 also shows the middle three-fourths range of premium (discount) offers.

Apparently, the few respondents who preferred the fat chop over the others (table 12) lacked the intensity of preference exhibited by those who preferred the medium or lean chop. Thus, the 8 percent preferring the fat chop were less important than the percentage figure indicates.

The 262 respondents who qualified for inclusion in table 15 represent 65 percent of the 403 households who answered the price premium questions. The 318 respondents qualifying for inclusion in table 16 represent 79 percent of the 403 responding households.

Forty viewers of rib-chop photographs and 40 viewers of loin-chop photographs replied that they would not pay as much as 75 cents for loin chops or 70 cents for rib chops. These 80 respondents were asked how much they would pay before changing to some meat other than these pork chops. The interviewer then probed by asking, "How about a couple of cents more?" and recorded the highest answer she obtained.

The average price mentioned by those who viewed loin chops was over 4.6 cents higher than the average price mentioned by those who viewed rib chops. Those who viewed rib chops stated a willingness

\[\begin{array}{lcccc}
\text{Order of preference} & \text{Respondents} & \text{Premium would pay for lean chop per pound (cents)} & \text{Average (cents)} \\
\hline
\text{Lean chop preferred over medium chop} & 100 & 38 & 6 & 0 \text{ to } +12 \\
\text{Medium chop preferred over lean chop} & 162 & 62 & -9 & -15 \text{ to } 0 \\
\text{Total} & 262 & 100 & 0 & 0 \\
\hline
\text{Order of preference} & \text{Premium would pay for fat chop per pound (cents)} & \text{Average (cents)} & \text{Percentage figure indicates.} \\
\hline
\text{Fat chop preferred over medium chop} & 24 & 8 & 3 & 0 \text{ to } +15 \\
\text{Medium chop preferred over fat chop} & 252 & -30 & -15 & -15 \text{ to } 0 \\
\text{Total} & 318 & 100 & 0 & 0 \\
\end{array}\]

\[\begin{array}{lcccc}
\text{**Qualified** respondents were those who had consistent preferences in reply to earlier questions of the questionnaire regarding their most and least preferred chop and who also would pay at least 75c (or 70c) a pound for center-cut chops.} \\
\text{b A negative premium can be considered a discount.} \\
\end{array}\]

\[\begin{array}{lcccc}
\text{**Table 15. Premiums or Discounts "Qualified" Respondents Would Pay for the Lean Chop if the Medium Chop Were Available at 75c (or 70c); A Pound, Classified by Order of Preference Given in Answer to an Earlier Question (Loin and Rib Chops Combined), Des Moines Survey, June 1955.} \\
\hline
\text{Order of preference} & \text{Respondents} & \text{Premium would pay for lean chop per pound (cents)} & \text{Average (cents)} & \text{Range} \\
\hline
\text{Lean chop preferred over medium chop} & 100 & 38 & 6 & 0 \text{ to } +12 \\
\text{Medium chop preferred over lean chop} & 162 & 62 & -9 & -15 \text{ to } 0 \\
\text{Total} & 262 & 100 & 0 & 0 \\
\hline
\text{**Table 16. Premiums or Discounts "Qualified" Respondents Would Pay for the Fat Chop if the Medium Chop Were Available at 75c (or 70c); A Pound, Classified by Order of Preference Given in Answer to an Earlier Question (Loin and Rib Chops Combined), Des Moines Survey, June 1955.} \\
\hline
\text{Order of preference} & \text{Respondents} & \text{Premium would pay for fat chop per pound (cents)} & \text{Average (cents)} & \text{Range} \\
\hline
\text{Fat chop preferred over medium chop} & 24 & 8 & 3 & 0 \text{ to } +15 \\
\text{Medium chop preferred over fat chop} & 252 & -30 & -15 & -15 \text{ to } 0 \\
\text{Total} & 318 & 100 & 0 & 0 \\
\hline
\end{array}\]

\[\begin{array}{lcccc}
\end{array}\]
to pay 56.5 cents a pound on the average. Those who viewed loin chops gave an average answer of 61.1 cents a pound. The loin chop viewers' replies were so consistently higher that the hypothesis of no difference in average prices mentioned can be rejected at the 5-percent level of significance.

Finally, the respondents were asked the number and kinds of pork chops they might buy for the next day's dinner. Although they were told they could take some of each, practically all the respondents selected only one of the three kinds of pork chops in the hypothetical purchase. The medium chop was the chop preferred by the largest number of respondents in answer to an earlier question. It was also the most popular in terms of intended purchases with four chops per purchase as the model number.

FREQUENCY OF SERVING PORK CHOPS

Table 17 shows the responses to the questions, "How often on the average have you served pork chops in the past 6 months?" and "Do you remember what kind of pork chops they were?" Of 410 households in which pork chops were eaten, 395 ate pork bought at a store.

The second column in table 17 (6-12) includes the households where pork chops were served from once to twice a month (6-12 times in past 6 months), while the third column (13-26) includes the households where chops were served more than twice a month but not more than once a week. In 83 percent of the households, pork chops were eaten from once a month to once a week.

Another question asked was, "How many chops did you usually serve at one meal?" This information, together with the replies in table 17, was used to estimate the total number of center-cut pork chops consumed at home in the past 6 months. The 395 households in table 17 were also asked, "How often would you have had them if you had been able to get chops like your most preferred ones (in photographs just shown you) at the prices you were paying?" The 45 families who did not remember what kind of pork chops they had eaten were counted as nonrespondents along with two families who did not answer the question. Since the photographs were of center-cut pork chops, the responses given by households eating rib end chops were not considered to be meaningful. Families who ate rib end chops were then considered as having given a zero response on both the number of center-cut chops eaten and the number they could have eaten.

ESTIMATED CONSUMPTION OF PORK CHOPS

The estimate of the total number of center-cut pork chops eaten in the Des Moines urban and urbanized areas in the previous 6 months is 3,638,762. A 95-percent confidence interval would range from 3,049,160 to 4,228,364 pork chops.

Of the 304 respondents who ate center-cut pork chops, 13.2 percent said they would have served chops more often if the quality were comparable with the center-cut chops shown to the respondents. The estimated increase in the number of center-cut pork chops which would have been served is 880,645, with a 95-percent confidence interval of 494,015 to 1,327,275 pork chops. Generally, pork chops weigh approximately ¼ pound each. The estimated increase, therefore, represents between 1 and 3 hundred thousand additional pounds of center-cut chops that would have been purchased. This response could be interpreted to mean that about 24 percent more center-cut chops might have been purchased in the Des Moines area in the preceding 6 months at existing prices if their quality had been at a level comparable with the center-cut chop the respondents preferred when viewing the photographs.8

Four to six pounds of center-cut chops can be made from each loin of a typical hog. Therefore, assuming 10 pounds of center-cut chops per hog (two loins per hog), the chops from 10 to 30 thousand more hogs would have been purchased in the Des Moines area. The fatness of the "fat" chop was due to less careful trimming as well as to the fact that its smaller "eye" muscle would have resulted in a smaller lean-fat ratio at the same trim. Therefore, to enhance pork demand, merchandising methods used for pork may rival the importance of the inherent quality of the hogs produced.

7 The method of estimation is shown in Appendix B.
8 It must be realized that there may be a considerable nonsampling error involved. The number of servings in the last 6 months is a rough statement at best.

<table>
<thead>
<tr>
<th>Kind of chop served</th>
<th>1-4</th>
<th>6-12</th>
<th>13-26</th>
<th>39-78</th>
<th>Total</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center-cut</td>
<td>13</td>
<td>48</td>
<td>57</td>
<td>12</td>
<td>128</td>
<td>32</td>
</tr>
<tr>
<td>Center-cut loin</td>
<td>14</td>
<td>48</td>
<td>46</td>
<td>9</td>
<td>117</td>
<td>30</td>
</tr>
<tr>
<td>Rib end</td>
<td>4</td>
<td>22</td>
<td>18</td>
<td>1</td>
<td>44</td>
<td>11</td>
</tr>
<tr>
<td>Center-cut rib</td>
<td>4</td>
<td>21</td>
<td>15</td>
<td>3</td>
<td>43</td>
<td>11</td>
</tr>
<tr>
<td>Don't remember</td>
<td>7</td>
<td>17</td>
<td>20</td>
<td>1</td>
<td>45</td>
<td>11</td>
</tr>
<tr>
<td>Others*</td>
<td>1</td>
<td>12</td>
<td>5</td>
<td>1</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>All chops</td>
<td>43</td>
<td>166</td>
<td>161</td>
<td>25</td>
<td>395</td>
<td>100</td>
</tr>
</tbody>
</table>

* Butterflies, center cuts and rib ends, depends on how cooked, etc.
CONSUMPTION, INCOME AND SIZE OF FAMILIES

In the Des Moines survey, income and size of family were related to pork consumption patterns. Lavell, in analyzing the results of a similar study commented: "It has long been known that family expenditures for food vary with income and expenditures differ by region in which the family resides because of the size of the community, the pattern of income distribution within the region and community, and, of course, family size."

MEALS EATEN AT HOME WITH MEAT SERVED

Each of the 443 households where meat was eaten for which complete information was obtained on weekly income, food expenditure, occupation, household composition, number of persons eating solid food and age of household head, reported the consumption of one or more meat items during the week of the interview.10 The average number of meals eaten at home with meat served ranged from 9 for the lowest income groups to 13 for the group with weekly incomes between $75 and $100, but declined to 11.3 for the highest income group. The frequency of meat servings was also related to the number of persons eating solid food, as shown by the increase from 8.8 meals for households with only one such person to 14.8 meals for households with six or more people eating solid food. The larger households also had the higher average weekly family income.

EFFECTS OF INCOME ON FREQUENCY OF MEAT SERVINGS AT HOME

The relationship of family income to frequency of selected meat servings is shown in fig. 3. The number of meals including fresh or cured pork was related only slightly to income. The frequency of meals at home which included specialty pork—chopped ham and other processed meat judged to contain at least 75 percent pork—increased with successively higher income, however, except for the highest income class. When all cuts of pork were included, the maximum frequency of meals served was reached at a lower income level than was the case for all cuts of meat. In comparison, the number of meals including beef and veal served at home increased with income—except for the highest income group. The smaller number of persons eating solid foods in the highest income group probably accounted for the smaller number of meat meals. Finally, it may be noted that the more frequent servings of the higher priced cuts of meat contributed to part of the higher levels of food expenditures.

A nation-wide survey of household food consumption was undertaken by the U. S. Department of Agriculture at about the same time as the Des Moines study. One of the many reports describing results from the USDA survey found the relationship between expenditure for food eaten at home and income to be quite like that shown in fig. 3, except that, with successively higher incomes, food expenditures went up faster, percentagewise, in the Des Moines study than in the USDA survey for the nation as a whole. In the Des Moines survey, food expenditures for meals eaten at home increased about 5 percent for each 10-percent difference (increase) in income group (income elasticity of about 0.5 for Des Moines compared with nearly 0.3 for the U.S.).11

In the USDA study, the income elasticity for purchased food eaten away from home (largely restaurant meals) was about unity, or over three times as great as for meals eaten at home. For all income groups, the USDA survey found beef consumption increasing faster than pork consumption in successively higher income groups.

The following statement was made in another analysis of the USDA survey, "Higher income families ate more beef, veal and lamb than did lower income families. On the average they ate slightly less pork. However, the relationship between pork eating and income was not uniform. In the West and on farms generally more pork was eaten by high income fami-

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10 Some aspects of these data have been studied in more detail in: Ardis Walter McMechan. Selected factors related to pork consumption in Des Moines, Iowa. Unpublished M. S. these, Iowa State University Library, Ames, Iowa. 1959.

lies. Among city families of North Central and South, those of higher income ate the least pork.12

In the USDA food consumption survey, urban households in the north-central region consumed about 5 ½ pounds of beef and 4 ½ pounds of pork in the survey week. According to fig. 3, however, pork was served in Des Moines, Iowa, about twice as frequently as beef. This could be explained if these households obtained more meals per pound of pork than per pound of beef. One pound of bacon or chopped ham supplies more servings than does a pound of beef roast. The Des Moines households may have consumed more pork compared with beef than other urban centers in the north-central region. Respondents in the Des Moines survey also may have found it easier to recall meals with pork than meals with beef because of having discussed pork at length with the interviewer. If the first of the hypotheses (relating to fig. 3) is true, the findings indicate that pork may lead in the number of meals at which one of the two meats is served, though beef consumption may exceed pork consumption in terms of pounds of meat purchased.

12 Harold F. Brienmyer and Charlotte A. Kause, Consumption patterns for meat. U. S. Dept. Agr. AMS-249, 1958. "... a comparison can be made showing to what extent families with higher incomes used their extra buying power to buy more meat, versus to choose higher-price meat. For veal and lamb, the chief effect was in larger quantity purchased, rather than in a higher price paid. For beef, the price paid increased almost as much as quantity. And for pork, the higher income families paid higher prices per pound even though they bought fewer pounds. For all meats combined, the effect of income was greater on price paid than on quantity bought. ... In a period of rising incomes ... producers and marketers may have much to gain by giving attention to turning out a desired product."

EFFECT OF HOUSEHOLD SIZE ON FREQUENCY OF MEAT SERVINGS

The USDA analysis mentioned earlier used a slightly different approach to the food consumption—family size relationship than shown in fig. 4 but yielded a similar conclusion. The value of pork consumption at home per person does not fall as fast when household size increases as does value of beef consumption at home per person.

Another important factor explaining differences in the frequency of servings of selected cuts of meat among the Des Moines households was the size of the household as measured by the number of persons eating solid foods (fig. 4). The frequency of pork servings was related directly to the number of persons eating solid foods. Fresh pork and specialty pork were served three times as often in households containing six or more persons eating solid foods than in households with only one such person. The frequency of servings of cured pork, however, was only slightly greater for the larger households. In comparison, the number of servings of beef and veal remained about the same, except for the smallest and the largest size groups. Weekly food expenditures failed to increase as the size of household changed from five to six or more persons eating solid foods.

EVALUATION OF FINDINGS ON FREQUENCY OF MEAT SERVINGS

The income-household size effect on household meat consumption probably was the most obvious finding regarding the factors affecting the frequency of meat servings. Since the number of individual servings was approximately equal to the number of meals served with meat times the number of persons eating solid foods, the number of individual servings of meat varied even more sharply among the different sizes of households than was shown by the data in fig. 4. Moreover, the "humped" shape of the pork consumption-income relationship in fig. 3 was more pronounced than indicated because of the smaller number of persons per household eating solid foods in the largest income group.

Further analyses were made of the effect of household size on the frequency of meat servings according to the reported household income. The number of meals at which pork was served increased most rapidly for the lowest income group as the number of persons eating solid foods increased (fig. 5). Beef and veal were consumed less frequently among the lower income households, particularly in the households with the largest number of persons eating solid foods (fig. 6). The more well-to-do households were able to serve beef and veal more frequently. Moreover, if family incomes were sufficiently high, the matter of household size was less important in determining the frequency of beef and veal consumption than in the case of the low-income households. Thus, the consumption of pork could decline as average family income increases and as average family size decreases. Indeed, the prospects for pork are not promising unless it is made more attractive to the higher income groups and to the households with the means to buy according to their likes and dislikes.
APPENDIX A:

SURVEY DESIGN AND FIELD PROCEDURE

TYPE OF SURVEY DESIGN USED

The design of this survey may be generally described as a stratified single-stage area sample in which the areas (clusters of dwelling units) were drawn at random. Fifty strata of equal size (in terms of dwelling units) were formed, and from each stratum, two clusters were drawn at random with replacement so that, for each cluster, the probability of being drawn into the sample was the same. Inasmuch as the strata were of equal size, and since each cluster had the same chance of being drawn, estimates of means and proportions were made directly from the sample without weighting. Likewise, estimates of totals were made by multiplying sample totals by the inverse of the sampling fraction.

THE UNIVERSE

All occupied dwelling units in the Des Moines urban and urbanized areas constituted the universe of this survey. An occupied dwelling unit was defined as a room or group of rooms occupied by a family or group of persons or by a person living alone. Only quarters containing fewer than 10 persons as residents were included in the universe. Thus, large rooming houses, hotels, dormitories, institutions, etc., were excluded.

The sampling frame for this universe was a list of the number of dwelling units in each block (or other small area of the zone) keyed to block maps of the central city (Des Moines) and other places contained in the entire urban and urbanized zone. Block data on the number of dwelling units were obtained from the 1950 Census of Housing for Des Moines itself. For West Des Moines, Windsor Heights, and Urbandale, each block was observed from a moving automobile, and counts were made of the number of dwelling units in the block. In other parts of the area, maps obtained from the Polk County Highway Office were used. These maps indicate the location of dwelling units by dots, making it possible to form block-like areas.

At the conclusion of this procedure, lists and maps were available to show the number of households per block for all the universe. These lists were not completely accurate, but they were believed to be highly correlated with the actual number and distribution of dwelling units per block at that time and, hence, effective in reducing the sampling error attached to the estimates desired. From this frame, the sample for this survey was drawn.

SELECTION OF SAMPLING UNITS

The 1950 United States Census of Housing indicated 62,665 households (occupied dwelling units) in the area to be sampled. The universe was divided into 50 strata by area in such a way as to have approximately 1,250 households, or 250 sampling units (clusters of 5 households) per stratum.

The number of dwelling units in each block was obtained as previously described. This information was used to prepare a table for each stratum listing the number of occupied dwelling units per block and a cumulative total.
Two random numbers between 1 and the cumulative total of households were drawn (with replacement) for each stratum. These numbers then designated the blocks from which sampling units were to be drawn. Each block had a probability of being drawn which was proportional to its size.

The Des Moines City Directory lists dwelling units by address. By means of this directory, a block map was made showing the location of the dwelling units listed for each sampled block.

If the address listings from the city directory indicated that a sampled block varied from the 1950 census count, the cluster size of five was scaled up or down accordingly. Having found the correct cluster size, a random number between 1 and the block size was drawn to determine a starting point. For example, if the block contained 24 households, the cluster size was 7 households, and the random number drawn was 14. Then all households in the area starting just at and including 14, up to but not including 21, would form the sampled segment or cluster. This half-open interval is necessary to give nonlisted households an equal chance of being drawn, because the number of "empty" spaces between houses equals the number of houses in the block, and using this half-open interval, one "empty" space is included in the sample along with each house.

In places outside Des Moines, the location of each household within blocks was already available for some areas. For others, mainly in incorporated places other than Des Moines, the sample blocks were visited and a map made of these blocks showing the location of the dwelling units within the block.

Drawing segments by first drawing blocks containing any number of dwellings (five or more) with probability proportional to size and then taking clusters of fixed size, five from within the block, is self-weighting, in that each household in the survey has an equal chance of being in the sample on each of the two draws made in each stratum.

A special rule was applied for segments in which the starting point, stopping point, or both happened to fall in an apartment house.

FIELD PROCEDURE

The interviewers were given block maps showing all households in each block which were listed in the city directory. Each interviewer drew another sketch of the part of the block between the start and stop points, entering the addresses and number of households actually found there. This actual count was used to give an estimate of the number of households in the stratum. An interview was to be taken at every household within the area so designated. The person who generally bought the meat for the family was to be interviewed. Dwellings in the block not actually fronting on the streets were to be included by rule with the street areas formed by the start-stop points such that they could be associated with only one of the possible clusters in each block. In this way the clusters become area segments, a step necessary to give each dwelling unit its proper chance of being included in the sample. Sample units (clusters) in parts of the universe other than Des Moines were actual areas designated as such on the maps.

It should not be construed from the statements of significance made in this report that the results of this study can be projected to other areas. The sample of households is representative of Des Moines only.

APPENDIX B:

ESTIMATION OF TOTALS AND THEIR SAMPLING ERROR

METHOD OF ESTIMATION

As stated previously, the 1950 census indicated 62,665 dwelling units in the Des Moines urbanized zone. These households were divided into 50 strata ranging in size from 1,234 to 1,273. The average stratum size was 1,253.3 households. For all practical purposes, these strata may be considered to be of equal size.

For each segment or cluster of five expected households in each of the 50 strata, the average segment sampling rate was $\frac{1}{5} \times 62,665 = 250.66$. Thus the raising factor, which is the reciprocal of the sampling rate, is 250.66. The total of any quantitative value actually found in a segment times 250.66 is an estimate of the total for that stratum. For example (250.66) (5) = 1,253.3, the average number of households per stratum according to the 1950 census. Two clusters of five expected households were drawn from each stratum for the purpose of making estimates of sampling errors.

If the address listings from the city directory indicated that a selected sample block contained more addresses than were shown by the 1950 census, the indicated percentage increase was applied to the cluster size to be selected from such a block; a similar procedure was followed for a decrease.

The following notation will be used for the remainder of this appendix:

\[ X_{hi} = \text{total value in the } i\text{th cluster of the } h\text{th stratum}, \]
\[ \hat{X}_{h1} = 250.66 X_{hi} = \text{estimate of total in the } h\text{th stratum estimated from the } i\text{th cluster}, \]
\[ \hat{X}_h = \frac{1}{2} (\hat{X}_{h1} + \hat{X}_{h2}) = \text{the total in the } h\text{th stratum estimated from the average of } \hat{X}_{h1} \text{ and } \hat{X}_{h2}, \]
\[ \hat{X} = \text{the estimate of the total for the population}. \]

(Note: \( h=1, 2, \ldots, 50 \) and \( i=1, 2 \).)

With the two sample segments drawn at random.
from each stratum (strata being of equal size), the estimate of a total for the population is
\[ \hat{X} = \sum_{h=1}^{50} \left( \frac{1}{2} \right) (\hat{x}_{h1} + \hat{x}_{h2}) = \sum_{h=1}^{50} (250.66) \left( \frac{1}{2} \right) (x_{h1} + x_{h2}) \]
and the estimate of its variance is
\[ \nu(\hat{X}) = \frac{1}{50} (250.66)^2 \sum_{h=1}^{50} (x_{h1} - x_{h2})^2. \]

The two estimate totals given in the main body of this manuscript will be shown, along with an estimate of the total number of households in the sampled area. These two estimates required additional weighting factors which will be explained along with the calculations.

**ESTIMATION OF NUMBER OF HOUSEHOLDS IN DES MOINES**

The interviewers took an actual count of the number of households in each cluster. Thus, even though an interview may not have been obtained from every household between the assigned start and stop points, the number of households in the sample is known.

Using the formulas just presented, an estimate can be obtained of the total number of households in the urbanized area of Des Moines, Iowa, in June of 1955.

Table 1-B illustrates the data used for this estimate and an estimate of the standard error. This shows that the total number of households actually found in the sample was 560, and the average total for the two clusters in each of the 50 strata was \(\frac{1}{50} (560)\),

TABLE 1-B. NUMBER OF HOUSEHOLDS IN EACH SAMPLED SEGMENT OF THE STRATA.

<table>
<thead>
<tr>
<th>Stratum</th>
<th>(x_{h1})</th>
<th>(x_{h2})</th>
<th>((x_{h1} - x_{h2})^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>6</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>292</td>
</tr>
</tbody>
</table>

The effect of weighting factors is to assign the mean value of the responses to each of the nonresponses. Since 89 of the households interviewed did not eat any pork chops, and 14 of the households where chops were eaten did not buy their pork at a store, the mean value was not assigned to these households. These households were counted as not applicable and, hence, the 348 responses were weighted up to the 396 applicable households interviewed by the factor 396/348. This result was weighted again by the factor 560/499 for the 61 noninterviews.

The estimate of the total number of center-cut pork chops eaten in the previous 6 months, the respondents who said they ate rib-end chops were counted as having given a zero for their answer.

The increase in the number of center-cut pork chops that would have been consumed if the respondents would have been able to get chops like the ones they most preferred in the photographs, at the price they had been paying.

**ESTIMATION OF NUMBER OF CENTER-CUT PORK CHOPS EATEN IN A SIX-MONTH PERIOD AND THE NUMBER WHICH WOULD HAVE BEEN EATEN**

Although the same formulas apply for the estimation of these totals, some additional weighting factors are required. The need for additional weighting factors arises from the fact that there were several nonresponses and "not applicables."

From the sample of 560, only 499 interviews were obtained. Eighty-nine of these households interviewed did not eat pork chops of any kind. Forty-four of the 410 households where chops were eaten bought their pork by the carcass or had it given to them, and 48 of them either did not answer one of the questions or did not remember what kind of pork chops they had purchased. This left only 348 applicable responses.

Table 2-B lists the total for these 348 respondents by segment for each stratum. Since the purpose was to estimate the total number of center-cut pork chops eaten in the previous 6 months, the respondents who said they ate rib-end chops were counted as having given a zero for their answer.

The effect of weighting factors is to assign the mean value of the responses to each of the nonresponses. Since 89 of the households interviewed did not eat any pork chops, and 14 of the households where chops were eaten did not buy their pork at a store, the mean value was not assigned to these households. These households were counted as not applicable and, hence, the 348 responses were weighted up to the 396 applicable households interviewed by the factor 396/348. This result was weighted again by the factor 560/499 for the 61 noninterviews.

The estimate of the total number of center-cut pork chops consumed in 6 months and the increase there would have been in the number of chops consumed in each sample segment, Des Moines, Iowa, June 1955.

**TABLE 2-B. NUMBER OF CENTER-CUT PORK CHOPS CONSUMED IN 6 MONTHS AND THE INCREASE THERE WOULD HAVE BEEN IN THE NUMBER OF CHOPS CONSUMED IN EACH SAMPLE SEGMENT, DES MOINES, IOWA, JUNE 1955.**

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Number of chops consumed</th>
<th>Increase in number of chops consumed*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>106</td>
<td>104</td>
</tr>
<tr>
<td>2</td>
<td>154</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>12,323</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>50 ((x_{h1}+x_{h2})^2 = 22,738)</th>
<th>50 ((y_{h1}+y_{h2})^2 = 5,503)</th>
<th>50 ((y_{h1}+y_{h2})^2 = 1,947,307)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\sum_{h=1}^{50} (x_{h1}+x_{h2}) = 22,738)</td>
<td>(\sum_{h=1}^{50} (y_{h1}+y_{h2}) = 5,503)</td>
<td>(\sum_{h=1}^{50} (y_{h1}+y_{h2})^2 = 1,947,307)</td>
</tr>
</tbody>
</table>

*Increase in the number of center-cut pork chops that would have been consumed if the respondents would have been able to get chops like the ones they most preferred in the photographs, at the price they had been paying.
chops eaten in the 6-month period before the survey by households in Des Moines which buy their pork at a store is

\[
\hat{X} = \frac{1}{50} \sum_{h=1}^{50} (x_{h1} + x_{h2})
\]

\[
\hat{X} = \frac{1}{50} \sum_{h=1}^{50} (160.03) (x_{h1} + x_{h2})
\]

\[
= (160.03) (22,738)
\]

\[
= 3,638,762 \text{ center-cut pork chops.}
\]

The variance of this estimate is given by

\[
v(\hat{X}) = \frac{1}{50} \sum_{h=1}^{50} (160.03)^2 (x_{h1} + x_{h2})^2
\]

\[
= (25,609.6) (3,393,552)
\]

\[
= 86,907,509,299,
\]

which gives a standard error of 294,801 pork chops.

The increase in the number of pork chops was computed by the same method. Table 2-B illustrates the information needed for this estimate. The values here were computed for each household by subtracting the number of servings they said they had from the number they would have had and multiplying this difference by the number of chops they usually served per meal. These quantities were then totaled for each cluster and listed in table 2-B.

The estimate of the increase in the number of center-cut pork chops eaten in 6 months, if the respondents had been able to get chops like their most preferred ones at the prices they were paying, is

\[
Y = \frac{1}{50} \sum_{h=1}^{50} (160.03) (y_{h1} + y_{h2})
\]

\[
= (160.03) (5,503)
\]

\[
= 880,645 \text{ center-cut pork chops.}
\]

The variance of this estimate is equal to

\[
v(Y) = \frac{1}{50} \sum_{h=1}^{50} (160.03)^2 (y_{h1} - y_{h2})^2
\]

\[
= (25,609.6) (1,947,307)
\]

\[
= 49,869,753,347,
\]

which gives a standard error of 223,315 pork chops.

The 95-percent confidence interval is 434,015 to 1,327,275.

**APPENDIX C:**

**SAMPLE ESTIMATES OF PROPORTIONS AND THEIR VARIANCES**

Many of the questions in this survey were asked to obtain estimates of the proportion of housewives in the population having certain preferences or the proportion of households possessing a certain characteristic. For example, it was desired to estimate the proportion of respondents who gave the answer “less fat” (table 12). Applying the formulas of Appendix B to the estimates of

(a) the total number of respondents, X, and
(b) the total number of respondents who have a certain characteristic, Y (e.g., gave the answer “less fat,” see table 12), the estimate of the proportion \(Y/X\) is given by

\[
p = \frac{Y}{\hat{X}} = \frac{1}{50} \sum_{h=1}^{50} y_h
\]

where

\[
x_h = \text{total respondents in sample of hth stratum}
\]

\[
y_h = \text{total respondents in sample of hth stratum having the characteristic.}
\]

The application of the principle of ratio estimation gives, then, the following estimate for the variance of \(p\):

\[
v(p) = \frac{1}{50^2} \left( \frac{1}{\hat{X}} \right)^2 \sum_{h=1}^{50} (y_{h1} - y_{h2})^2
\]

\[
+ \frac{p^2 \sum_{h=1}^{50} (x_{h1} - x_{h2})^2 - 2p \sum_{h=1}^{50} (x_{h1} - x_{h2}) (y_{h1} - y_{h2})}{50}
\]

The square root of the variance is the estimate of the standard error.

Inasmuch as considerable computation is required to derive the standard error in this manner, it was decided to compare, on a few characteristics, the standard error computed in this way with one available from the binomial approximation, which is much easier to compute. Theoretically, the binomial formula is not completely justified except in cases of simple random sampling, even when the distribution is binomial in nature. If the standard errors computed by the binomial approximation compare favorably with those computed by the correct method, however, it will then be feasible to use the binomial formula in place of the more exact one.

The binomial formula for the over-all standard deviation of a sample proportion, \(p\), is given by

\[
s_p = \sqrt{\frac{p(1-p)}{n}}
\]

where \(n\) is the number of units per sample. In the case of the 67 percent estimate in table 12, actually 66.9 percent, the approximation for the standard deviation of this percentage is

\[
s_p = \sqrt{\frac{(0.669)(1-0.669)}{341}} = 0.0255
\]

Table 1-C shows the items compared and the standard errors computed by both methods. Example 3 shows the greatest difference between the two estimators. The coefficient of variation given by the ratio estimate is 8.77 percent, while the coefficient of variation given by the binomial estimate is 6.92 percent. This is a difference of 1.85 percentage points between
TABLE 1-C. COMPARISON OF BINOMIAL APPROXIMATION WITH RATIO ESTIMATE IN OBTAINING STANDARD ERRORS OF PROPORTIONS, DES MOINES SURVEY, JUNE 1955.

<table>
<thead>
<tr>
<th>Example</th>
<th>Estimated proportion</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Table 12 - proportion answering &quot;less fat&quot;</td>
<td>0.669</td>
<td>0.0260</td>
</tr>
<tr>
<td>2. Table 8 - proportion of households represented</td>
<td>0.236</td>
<td>0.0175</td>
</tr>
<tr>
<td>3. Table 2 - proportion making $100 or more per week</td>
<td>0.325</td>
<td>0.0285</td>
</tr>
</tbody>
</table>

The coefficients of variation. The coefficients of variation differ by only 0.85 percentage points in example 2 and by only 0.07 in example 1. It would seem, therefore, that the use of the binomial approximation is satisfactory for the estimation of sampling errors of proportions and percentages.

Sometimes it is desirable to test differences between proportions to see whether they are significant; in which case it is necessary to obtain an estimate of the standard deviation of this difference. One or the other of the following two binomial formulas may be used to obtain such an estimate.

\[
\begin{align*}
(1) \quad s_4 &= \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}} \\
(2) \quad s_4 &= \sqrt{\frac{p_1(1-p_1)}{n} + \frac{p_2(1-p_2)}{n} + \frac{2p_1p_2}{n}}.
\end{align*}
\]

The first formula is used when the proportions being compared are independent tabulations from the same sample, such as the percentage having comparable opinions about different independent items within the same table where an individual may give a response for each pork cut that is independent of her response for the other cuts mentioned.

The second formula is used when the proportions being compared concern "mutually exclusive" classes within the same sample. As an example, consider table 5 in which the proportions represent the percentages of respondents naming a particular pork cut or dish as their favorite. Tied rankings, when they occurred, were treated as a separate classification. Thus, it is impossible for a respondent to be included in more than one of the classifications. Since the percentages in all classes must add up to 100 percent, they are not independent; an increase in one necessitates a corresponding decrease in one or more of the others. In such a case it is evident that the sample sizes \( n_1 \) and \( n_2 \) will be equal and will be called simply \( n \). The third term under the radical is known as the covariance term and enters the formula because the two proportions are not independent.

The preceding formulas give estimators and variance estimates for totals, means and proportions applicable to estimates for the city of Des Moines as a whole. They do not directly apply to the comparison of "groups of households" (e.g., income groups) arising in the analysis of the sample in what are called analytic studies. If such variance estimates for individual groups and group differences are required, reference is made to H. O. Hartley, "Analytic Studies of Sample Surveys," series of memoirs published by the University of Rome in honor of Professor Gini. Finally, it should be pointed out that any statistical inferences using the preceding formulas apply only to the city of Des Moines at the time of the survey, and additional information and statistical tests would be required to permit any wider inferences.