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# A chemical study of blue grass. Changes in composition during growth—Its value for pasturage and hay

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# A CHEMICAL STUDY OF BLUE GRASS.

## Changes in Composition During Growth—Its Value for Pasturage and Hay.

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During the past few years it has been evident that Iowa is fast becoming a blue grass state.

Many of our prominent agriculturists hold blue grass to be the most reliable pasture grass now grown within the state, and by many it is highly prized as a crop for hay. Considering its value to the practical farmers of Iowa I have made a study of its composition by means of a series of chemical analyses on samples collected at different stages of growth.

In making a chemical analysis, with a view to determine the nutritive value of any grass or other feed-stuff, it is customary to determine the amount of water, crude ash, fat, crude fiber, and nitrogen. The crude protein is obtained by multiplying the total nitrogen by 6.25, as protein contains about sixteen per cent of nitrogen.

By subtracting the sum of these from the total, the amount of nitrogen-free extract is obtained, which includes starch, sugar, gums and a few other less important constituents.

Of late years it has been known that a certain part of the nitrogen of the plant does not exist as pure protein but in the form of amides and other less nutritious compounds; hence it has been considered necessary to make an additional determination of the protein or albuminoids, upon which the nutritive value of the plant largely depends. For farther information regarding the above terms I will refer the readers to an article by Professor Patrick in Bulletin No. 2 of this Station, and for the feeding value of the several constituents to an article by Director Speer in Bulletin No. 9.

For the purpose of making these analyses a plot of blue grass sod was selected, on the Agricultural College campus, from which the first sample was taken on April 28, 1890; after which samples were taken at intervals of about ten days until the grass had passed well out of the blooming stage,

then no sample was taken until the seed was well formed and the grass beginning to ripen. In every case care was taken to mark the exact spot from which each sample was taken and avoid cropping the same spot twice. The early samples were taken by plucking the grass with the hand after the fashion of grazing; the later samples were cut as if for hay.

The samples were weighed quickly after cutting and then dried at a temperature of 60° to 70° C, and again weighed to determine the loss of moisture; after which they were ground to fine powders and analyzed by careful duplicate determinations according to the methods endorsed by the American Association of Agricultural Chemists. It is perhaps worthy of remark that these samples were taken from old sod that had been cropped for many years. Had the sod been newer a higher per cent of protein and a greater amount of water might have been expected.

Following are the results calculated in per cents on the original samples and also on water-free substance, together with the stage of growth at which each sample was taken.

| | | | | ORIGINAL SAMPLE. | | | | | | DRY SUBSTANCE. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | When cut. | Moisture. | Dry matter. | Crude Ash. | Crude Fat. | Nitrogen-free Extract. | Crude Fiber. | Crude Protein. | Albuminoids. | Crude Ash. | Crude Fat. | Nitrogen-free Extract. | Crude Fiber. | Crude Protein. | Albuminoids. |
| 3 to 6 inches high.. | Apr. 28 | 68.05 | 31.95 | 3.67 | 1.77 | 13.66 | 7.09 | 5.76 | 4.91 | 11.49 | 5.55 | 42.74 | 22.19 | 18.03 | 15.37 |
| 8 inches high..... | May 8 | 66 71 | 33.29 | 3.55 | 1.38 | 16 27 | 7.57 | 4.52 | 4 06 | 10.67 | 4.14 | 48 87 | 22.74 | 13.58 | 12.21 |
| Panicle spreading. | May 18 | 63.30 | 36.70 | 3.21 | 1.43 | 19 04 | 8.94 | 4 08 | 3 32 | 8.75 | 3.89 | 51.89 | 24.36 | 11.11 | 9.31 |
| Early bloom. ..... | May 28 | 62.91 | 37.09 | 3.14 | .84 | 18.72 | 10.80 | 3 59 | 3.20 | 8.47 | 2.25 | 50 50 | 29.11 | 9.67 | 8.64 |
| After bloom..... | June 7 | 61 24 | 38 76 | 3.36 | 1.06 | 19.70 | 11.60 | 3.06 | 2.49 | 8.66 | 2 75 | 51 79 | 29 92 | 7.88 | 6.43 |
| In seed; brown.... | July 5 | 51.67 | 48.33 | 4.82 | 1.47 | 23.46 | 14.77 | 3.81 | 3.57 | 9.98 | 3 05 | 48.53 | 30.55 | 7.89 | 7.39 |

## Changes in Composition.

From the above table it is observed that the moisture is most abundant during the earliest period of plant life and decreases constantly as the grass advances in growth. The most marked decrease is during the formation of the seed, at which period the plant ceases to take nourishment from the soil and the "drying up process" is most rapid. Necessarily there is a corresponding increase of dry matter.

The *Crude Ash* decreases constantly until the plant has passed well out of the flowering stage, then an increase is observed, mainly accounted for by a decrease in moisture.

*Crude Fat* is abundant in the earliest sample but runs down rapidly until the blooming period, then increases slightly, indicating a tendency toward the formation of fat during the seeding time.

The *nitrogen free extract* is low in the young plant but increases with marked rapidity during the early stages of growth after which the increase is much slower; and after flowering a decrease is observed owing perhaps to the fact that a portion of it is transformed into fat and fiber.

*Crude Fiber* is very low at first but increases constantly throughout the entire development of the plant. The most rapid increase is during the growth of the panicle and stem, when the plant needs cellular tissue to support the heavy head which soon forms.

*Crude Protein* undergoes the most remarkable change of all the constituent of the plant, being at first very high and decreasing with regularity until the blooming season is over, after which it changes but little. The albuminoids decrease nearly in proportion to the crude protein, the difference between which grows less, indicating that part of the non-albuminoid principles become albuminoids before passing into the seed.

From the foregoing we conclude: (1) That since the nitrogen-free extract and crude fiber increase from the first and albuminoids diminish; the nutritive value of the grass is highest when it is very young and runs down rapidly as the grass develops. (2) That until bloom the gain in dry matter and the growth of the plant, counteract the loss in per cent of nutritive constituents. (3) That after blooming the grass loses value through an increase of fiber and a decrease of carbhydrates which probably become fiber; however it is believed that at this period the grass suffers more through a loss of digestibility and palatability.

## Blue Grass for Pasturage.

A fairly accurate idea of the nutritive value of blue grass for pasturage may be obtained by taking an average of three

analyses, made at different stages of growth before blooming, which give the following results:

| | |
|---|---|
| Moisture | 66.02 |
| Dry Matter | 33.98 |

| 100 PARTS CONTAIN. | ORIGINAL SAMPLE. | DRY SUBSTANCE. |
|---|---|---|
| Crude Ash | 3.48 | 10.30 |
| Ether Extract (crude fat) | 1.53 | 4.53 |
| Nitrogen-free Extract (carbhydrates) | 16.32 | 47.83 |
| Crude Fiber | 7.83 | 23.09 |
| Crude Protein (N x 6.25) | 4.79 | 14.24 |
| True Albuminoids—Albuminoid N x 6.25 | 4.10 | 12.30 |

By comparing the above table with the following analysis of "pasture grass" copied from Stewart, it is evident that blue grass has a high value owing to its remarkably low percentage of moisture, although the water-free substance is not so rich.

| | |
|---|---|
| Moisture | 80.00 |
| Dry Matter | 20.00 |

| 100 PARTS CONTAIN. | ORIGINAL SAMPLE. | DRY SUBSTANCE. |
|---|---|---|
| Crude Ash | 2.0 | 10.0 |
| Ether Extract (crude fat) | .8 | 4.0 |
| Nitrogen-free Extract (carbhydrates) | 9.7 | 48.5 |
| Crude Fiber | 4.0 | 20.0 |
| Crude Protein (N x 6.25) | 3.5 | 17.5 |

## Blue Grass for Hay.

The average results of the two analyses made in early bloom and after bloom may be taken as a representative of blue grass as ordinarily cut for hay. They are as follows:

Moisture... .....62.07

Dry Substance.....37.93

| 100 parts contain. | Original Sample. | Dry Substance. |
|---|---|---|
| Crude Ash..... | 3.25 | 8.56 |
| Ether Extract (crude fat)..... ..... | .95 | 2.50 |
| Nitrogen-free Extract (carbhydrates)..... | 19.21 | 57.15 |
| Crude Fiber..... | 11.20 | 29.51 |
| Crude Protein (n x 6.25)..... | 3.32 | 8.78 |
| True Albuminoid—Albuminoid N x 6.25..... | 2.85 | 7.54 |

The following analyses from reports of the Connecticut Experiment Station furnish a means of comparison from which we can learn the relative value of the blue grass hay.

Our results on blue grass are repeated in last line of table.

| | Dry Substance | | | | |
|---|---|---|---|---|---|
| | Crude Ash. | Ether Extract. | Nitrogen-free Extract. | Crude Fiber. | Crude Protein. |
| Timothy hay | 4.70 | 2.35 | 52.42 | 33.79 | 6.84 |
| Red Top | 6.57 | 1.86 | 51.17 | 32.24 | 8.16 |
| Orchard Grass | 6.23 | 2.15 | 47.22 | 37.12 | 7.28 |
| Low meadow hay | 6.48 | 2.46 | 48.77 | 33.74 | 8.55 |
| Blue Grass (two analyses) | 8.56 | 2.50 | 57.15 | 29.51 | 8.78 |

Not having results on the green samples we can only compare this table with the water-free substance of the blue grass hay.

It is observed that blue grass hay is much richer in protein than Timothy or Orchard Grass and somewhat richer than Red Top and low meadow hays. It also has another advantage in containing several per cent less of the indigestible crude fiber. In nitrogen-free extract it does not differ from Red Top but is somewhat lower than Timothy. In comparing these results it must be remembered that these grasses were grown on different soils and possibly under very different circumstances, which may have had some effect on their composition.

## Best Time for Cutting.

It would seem at first thought from figures given in the table that very early cut hay has a decided advantage but the questions of quantity, digestibility and palatability have equal prominence with the percentage of nutritive principles.

The object is to produce the greatest possible amount of digestible nutrients on a given area of land. The young plant contains a large amount of protein and a correspond-

ingly small amount of fiber. As it grows older but little protein is added while the fiber rapidly increases. After a time there seems to be almost no increase in the total amount of protein in the plant; especially is this true after blooming when the process of growth is one of translocation of nutrients from the blades and stalk to the seed, accompanied by an increase of fiber.

The stalks become hard, woody, and suffer a serious loss in digestibility, while the small seeds stored with nutrients fall off and are lost or escape mastication in feeding. We conclude that the best period for cutting is about the time of early bloom or shortly afterward, for at that time the total amount of nutrients has reached its maximum and the digestibility has not been seriously impaired.