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CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

BULLETIN 128, APRIL, 1899.

Commercial Feeding Stuffs in the Connecticut Market.

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CORRECTION.

Chittenden's Potato Phosphate. On page 73 of the Report of this Station for 1898 the guaranteed percentage of potash in this brand is given as ten per cent. This is a misstatement; the percentage of potash guaranteed by the manufacturer is eight per cent.

NOTICE AS TO BULLETINS.

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the limited editions permit.

Applications should be renewed annually before January 1st.

The matter of all the Bulletins of this Station, in so far as it is new or of permanent value, will be made part of the Annual Report of the Station Staff.

All Bulletins earlier than No. 71 and Nos. 72, 83, 86, 93, 100, 101, 102, 111 and 118 are exhausted and cannot be supplied.

NOTICE AS TO SUPPLY OF STATION REPORTS.

The Station has no supply of its Annual Reports for the years 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1887 and 1891.

The Annual Report of this Station, printed at State expense, is by law limited to an edition of 7,000 copies.

After exchanging with other Experiment Stations and Agricultural Journals, the Reports remaining at the disposal of the Station will be sent to citizens of Connecticut who shall seasonably apply for them, and to others as long as the supply lasts.

FORMER REPORTS WANTED.

There is frequent call for our earlier Annual Reports on the part of public libraries, students, chemists, naturalists, and station workers.

Persons who can supply copies of Reports of this Station for any of the years above named, will be likely to find purchasers by communicating with the Director.

USES OF COMMERCIAL FEEDING STUFFS.

Commercial Feeding Stuffs are bought to supply certain deficiencies in the cattle food which is raised upon the farm.

Hay, corn fodder, ensilage and stover with corn meal, raised at home, form the basis and make up the bulk of the cattle food and supply all of the coarse feed and of the starch, sugar and fat which are required. They are, however, deficient in digestible protein.*

Few farmers are now raising as much protein, in concentrated form, as is required to bring cattle up to and maintain them in the most profitable condition. Two chief defects in our present farm management are that little care is given to the raising of crops rich in protein and that, as a rule, insufficient protein goes into the food of our cattle.

If the quantity of digestible protein in the food is too small, the animals produce less beef or milk than they easily would with a proper supply of protein. Furthermore, when protein is deficient, the other (non-nitrogenous) matters of the ration are in excess of the animal's capacity for assimilating them and are therefore to some extent wasted. The latter (starch, sugar, etc.) in part pass through the body, incompletely digested and—unlike the protein—give little value to the manure.

* Protein is the name now commonly given to a class of substances (also termed "proteids" or "albuminoids") of which the muscles, brain, nerves, tendons and all other working or necessary organs and parts of the animal body largely and essentially consist. Protein contains from 14 to 19 per cent. of nitrogen.

The white of eggs, the fiber of lean beef, the clot of blood, the curd of milk and the gluten of wheat are familiar examples of protein. Other similar matters are found in all animals and in all plants.

The animal cannot grow or long exist without constantly renewed supplies of protein in its food. The animal itself is totally unable to create protein. Only plants can originate protein, which they do from the plant-food of air, soil and fertilizers or manures. Animals can produce or create blood-protein, brain-protein, flesh-protein and milk-protein, but only by appropriating and transforming or making over the similar but different protein of plants.

Other needful food-substances or nutrients, such as cellulose (woody fiber), starch, sugars, gums, pentosans (that yield gums and jellies), acids and fats or fat oils, contain no nitrogen and collectively are commonly termed "non-nitrogenous matters"; we shall usually designate them as "non-protein."

To meet and overcome these defects in home-grown cattle food, dairymen and keepers of live-stock buy commercial feeds; they should buy them *chiefly* with the purpose of getting digestible protein in cheap and concentrated forms.

A feed rich in digestible protein is, when properly used, "milk-producing"; a feed rather poor in protein, however highly endorsed, cannot prove permanently satisfactory, or be a "milk producer" in any way superior to home-raised coarse feed and corn meal.

Every farm on which cattle are kept for profit should yield all the *hay, corn fodder, corn ensilage, corn stover* and *corn meal* which the live stock on it need to eat.

One hundred pounds of each of the feeds just named contain, on the average, the following quantities of *digestible nutrients* or elements of food:

TABLE I.—QUANTITIES OF DIGESTIBLE NUTRIENTS IN ONE HUNDRED POUNDS OF THE FEEDS NAMED.

(From Armsby, Penn. Ag'l Ex. Sta. Rep., 1897-98, p. 45.)

	Red Top Hay.	Corn Fodder Field-cured.	Corn Stover Field-cured.	Corn Ensilage.	Corn Meal.
Total dry matter.....	91.1	57.8	59.9	27.9	85.0
Digestible protein.....	4.8	2.5	2.0	1.1	5.5
Digestible non-protein*....	49.2	36.1	34.8	18.2	71.1
Ratio of digestible protein to digestible non-protein, ("Nutritive Ratio").....	1:10.3	1:14.4	1:17.4	1:16.5	1:12.9

Observation and careful experiment have shown that milk cows need, per day and per 1,000 pounds of live weight, about 24 pounds of dry matter including 2 to 2½ pounds of digestible protein and from 13½ to 15 pounds of digestible non-protein (sugar, starch, fat, etc.), and that the quantity of digestible non-protein in this *standard ration* should be between five and one-half and seven times as great as the digestible protein.

Now a glance at the table above shows that no one of these staple farm products, nor any combination of them, can furnish the most profitable cattle food.

*Since fat is believed to have about 2½ times the nutritive effect of starch and similar non-nitrogenous matters, the digestible fat is, in these calculations, reduced to its "starch equivalent" by multiplying by 2½.

All of them have from ten to seventeen times as much non-protein as protein, and hence a properly balanced ration cannot be made up from them without adding some feed much richer in protein and poorer in non-protein than any one of them.

Feeds rich in protein are what the stock owner most commonly needs to buy, and they are the ones the purchase of which is most likely to be profitable. All feeds contain non-nitrogenous matters, starch, sugar, etc., but those best worth buying *should* have a considerably larger proportion of protein than any which are commonly raised on the farm.

In the preparation of vegetable foods for human consumption and in the manufacture of cotton seed and linseed oils, certain by-products are produced, unfit for human food, but rich in protein and valuable as feed for horses and cattle. There are also certain other products which are of very little value as cattle food because of the small amount of protein in them, or they are uneconomical to buy, because they contain no larger *proportion* of protein than corn meal which is raised on the farm.

Both kinds of by-products are now offered for sale, frequently without an analysis or other statement to inform the buyer as to the real nature or value of what he is purchasing, and in consequence a good deal of money is spent for cattle feeds uneconomically.

Within the last few weeks the station has gathered from the Connecticut market about one hundred samples of feeds, which have been examined chemically and microscopically.

In what follows is given a general summary of the results. The individual analyses will be given in the next Annual Report of this Station.

FEEDING STUFFS IN THE CONNECTICUT MARKET.

I. FEEDS MADE FROM A SINGLE FOOD PRODUCT.

COTTON SEED MEAL.

The eight samples examined were all of good quality, the percentages of protein ranging from 49.38 to 44.20 and of fat from 12.77 to 8.55. The *average* composition of these eight samples and the digestible matter in 100 pounds are given in Table II.

Undecorticated cotton seed meal, full of black hulls and with only 30 per cent. of protein, and cotton seed meal adulterated with rice refuse, have been found in this State in times past. At present much more cotton seed meal is used in Connecticut as a fertilizer,—chiefly for tobacco,—than as a feed, and the frequent publication of analyses made in the interest of tobacco growers has driven out the inferior grades of cotton seed meal.

The price at present ranges from \$23 to \$25 per ton. Since one ton contains 820 pounds of digestible protein, the cost of digestible protein in this article is about three cents per pound, even if no value is attached to the non-nitrogenous matter in it.

LINSEED MEAL OR OIL MEAL.

Of the five samples examined all were pure and contained percentages of protein ranging from 38.13 to 33.76, and of fat, from 9.59 to 1.83.

Linseed meal costs at present four or five dollars more per ton than cotton seed meal, and contains about ten per cent. less of digestible protein.

The average composition of the five samples analyzed appears in Table II.

GLUTEN, GLUTEN MEAL, GLUTEN FEED.

These names are applied to certain by-products obtained from corn meal in the process of making starch. The feeds are very various in composition and the name often gives no clue whatever to the chemical composition.

Thus the "Atlantic gluten meal," made at Westport, is a more concentrated feed than any other recently examined, containing

49 per cent. of protein; but another sample of "Gluten meal" contained only 18.9 per cent.

Three samples of "Chicago gluten" contained on the average 37.8 per cent. of protein and 1.69 per cent. of fat; but "Diamond Chicago Gluten Feed" contains only 23.7 per cent. of protein and 3.57 per cent. of fat. It is evident, that without some definite statement of chemical composition, the names gluten, gluten meal and gluten feed convey to the buyers no idea of their probable composition or value.

The composition of a number of these feeds is given in the table. All of them were corn products unmixed with other material.

The "Atlantic gluten meal" was offered at \$21 per ton. It contains, per ton, 834 pounds of digestible protein, so that, allowing nothing for the carbohydrates or fat in it, digestible protein in this material costs little over 2½ cents per pound.

WHEAT FEEDS.

Wheat Bran.

The eight samples examined consisted entirely of wheat and were of very similar composition, containing protein ranging from 16.94 to 15.00 per cent. and fat ranging from 5.14 to 4.29 per cent. Occasionally "cheap" bran is offered for three dollars a ton below the regular market rates. In a cheap bran referred to us from another State, microscopic examination showed the presence of finely ground corn cobs.

Middlings.

The thirteen samples analyzed were all pure, containing nothing but wheat. Middlings have a wider range of composition than bran, some sorts closely resembling bran while others are very fine and starchy, having much the look and composition of wheat flour. As appears from the figures given in the table, the samples of middlings contained about $\frac{4}{10}$ per cent. more of protein, $3\frac{3}{4}$ per cent. more of nitrogen-free extract, starch, etc. and 3.4 per cent. less of fiber than those of bran.

Mixed Wheat Feed.

Twenty-one samples have lately been examined and all consisted wholly of wheat and were quite uniform in quality, being

quite like the average of wheat middlings in chemical composition, as appears by the table.

RYE BRAN.

The four samples examined were all genuine, and of very similar composition.

CORN MEAL.

The eight samples examined had the usual composition, and were free from admixture with cobs or any adulterant.

OATS AND OAT FEEDS.

In Table II is given the average composition of whole oats. They are seen to be a much more concentrated food than the samples of corn meal recently analyzed; they contain 3.4 per cent. more of digestible protein and one per cent. more of fat than the corn meal.

When the composition of pure oats is compared with that of the various oat feeds given in Table II and with that of the mixed feeds given in Table III, it is clear that "oat feeds" are greatly inferior in actual feeding value to whole oats or to corn meal. The reason for this is clear. The "oat feeds" are the manufacturing outlet for oats hulls and light oats. They contain two or three times as much woody fiber as belongs to oats of good quality.

The last article but two in Table II is an "oat feed" costing \$15.00 per ton, which contains less protein than the next article, sold under its true name—"oat chaff"—for \$7.00 per ton. Such oat feeds as these it will not pay the farmer to buy at any price. **They ought not to have a place in the feed market.**

It appears that the three most concentrated feeds, the three which, pound for pound, will go further in "balancing" or piecing out the ration made from home-grown feed, viz: cotton seed, linseed and Atlantic gluten meal, are the most costly. This is as it should be. Yet of these, the one which contains the most protein, "Atlantic gluten meal," is the cheapest. It does not follow that it should be bought to the exclusion of the others. Linseed meal, though a very expensive feed, is greatly relished by cattle, flavors the food and is generally regarded as an excellent thing to keep cows "in condition."

But evidently the wise feeder will endeavor to use the cheaper forms of protein, *as far as possible*.

An examination of the prices and analyses of the feeds given in the table also shows that the market prices bear very little if any relation to their feeding value. That is, "feed" costs from \$17.00 to \$20.00 per ton at retail, whether it is concentrated, rich in protein, and well suited to supplement the home-grown feed, or whether it is a starchy food and of much less value in compounding suitable cattle rations. In this condition of the market, special care in the purchase of feeds and some knowledge of their chemical composition will be found highly advantageous in keeping the cost of milk production down to a point which will admit of profit in the business.

In Table II the statements of composition are the averages of analyses recently made at this Station.

The percentages of digestible matters have been calculated with the digestion coefficients obtained from American experiments, given by Jordan in the Experiment Station Record, vol. vi, pp. 7 and 8. For oat "feed" and oat chaff the same digestion coefficients have been used as for whole oats.

Where American coefficients were not obtainable, those given in Mentzel's Kalendar have been used.

It should be noticed that all the feeds as far down Table II as corn meal, can be used to increase the proportion of protein in the ration, but the feeds below, including corn meal, contain a smaller proportion of protein to non-protein than the correct ration requires. This proportion, called the "nutritive ratio," is one part by weight of digestible protein to between five and one half and seven parts of digestible non-protein.

The last column of the table gives this ratio for each of the feeds.

Whole oats, as represented by the average given in Table II, are a well balanced cattle ration, having the nutritive ratio 1 : 6.1 and containing in 100 pounds, 89 pounds of dry matter, of which 9.2 are digestible protein and 56 are digestible non-protein. By rule of three, 27 pounds of whole oats (with 11 per cent. of moisture) contain 24 pounds of dry matter, in which are 2.48 pounds of protein and 15.1 pounds of non-protein. These quantities are practically the same as those stated on page 4 as forming the *standard ration* for milk cows.

II. FEEDS PREPARED FROM TWO OR MORE FOOD PRODUCTS.

PROVENDER.

Of the four samples of "provender" analyzed, two were ground in this State, one was made by the American Cereal Co., and the fourth was Champion Bell Fodder, made by Hollister, Crane & Co., N. Y. These samples contained:

	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Average of two samples ground in Connecticut ----	10.29	4.64	66.64	4.47
American Cereal Co's -----	9.25	9.52	61.44	4.15
Champion Bell Fodder -----	9.88	12.88	59.75	5.04

It appears that the last two samples contain considerably more fiber (oat hulls) than the two samples ground in Connecticut, and less of protein and starchy matter.

They were sold for \$18 and \$19 per ton respectively, while the Connecticut samples cost \$20.00.

Three of the four consisted wholly of oats and corn.

The Cereal Co's provender contained some wheat.

MIXTURES OF OATS AND WHEAT, OR OF OATS, CORN AND WHEAT.

These are apparently wastes from the manufacture of "cereal foods" or "breakfast foods." Some are quite inferior to corn meal in feeding value, and all of them contain considerably less protein than wheat bran, but a much larger percentage of fiber, coming chiefly from the oat hulls. They cost little if any less than wheat bran however.

They cannot be used to any advantage to balance the ration when corn meal, or corn and cob meal, is raised on the farm in sufficient quantity.

TABLE II.—ANALYSES OF FEEDS MADE FROM A SINGLE FOOD PRODUCT.

Number of Analyses.	Feed	Prices per Ton.	ANALYSIS.						DIGESTIBLE.		Nutritive Ratio.	
			Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract (Starch, Gum, etc.)	Fat.	Total Dry Matter.	Protein.		Fiber, Nitrogen-free Extract and Fat.
8	Cotton Seed Meal	\$23.00-25.00	8.58	6.09	46.64	5.20	23.55	9.94	91.4	41.0	36.7	1:0.9
5	Linseed Meal	26.00-29.00	10.46	5.92	35.86	7.33	34.73	5.10	89.5	31.5	43.5	1:1.4
1	Atlantic Gluten Meal, Westport, Conn.	21.00	7.26	1.07	49.06	0.88	39.69	2.04	92.7	42.7	40.2	1:0.9
3	Chicago Gluten	23.00-24.00	13.09	1.03	37.83	1.34	45.02	1.69	86.9	32.9	44.3	1:1.4
1	Cream Gluten	20.00	11.25	0.95	34.94	1.35	47.73	3.78	88.7	30.4	50.9	1:1.7
1	King's Gluten	-----	8.15	0.89	32.07	1.93	41.69	15.27	91.8	27.9	68.2	1:2.5
1	Rockford Gluten Meal	19.00	8.77	0.90	25.19	7.07	54.30	3.77	91.2	21.9	56.9	1:2.6
2	Buffalo Gluten Feed	18.50-19.00	9.92	2.73	27.45	6.33	50.49	3.08	90.6	23.3	49.2	1:2.1
8	Wheat Bran	18.00-19.00	10.30	6.36	15.98	9.30	53.23	4.83	89.7	12.5	46.3	1:3.7
13	Wheat Middlings	16.00-20.00	11.82	4.31	16.39	5.89	56.95	4.64	88.1	13.4	59.0	1:4.4
21	Wheat Feed	14.00-19.00	10.52	5.60	16.80	7.26	55.02	4.80	89.4	13.4	53.2	1:4.0
4	Rye Bran	18.00-19.00	12.23	3.19	14.56	3.01	64.19	2.82	87.7	11.4	56.7	1:4.9
30	Whole Oats, Average Composition	24.25	11.00	3.00	11.80	9.50	59.70	5.00	89.0	9.2	56.6	1:6.1
8	Corn Meal	19.00	14.75	1.48	9.64	1.78	68.31	4.94	85.2	5.8	71.9	1:12.3
2	No. 2 Oat Feed	16.00-19.00	6.47	5.85	6.75	25.76	52.45	2.72	93.5	5.3	50.1	1:9.5
1	"Oat Feed"	15.00	9.03	4.19	4.37	28.11	52.81	1.49	91.0	3.4	48.5	1:14.3
1	Oat Chaff	7.00	7.80	7.48	5.12	28.53	49.47	1.60	92.2	4.0	46.3	1:11.6
1	Malt Hulls	12.00†	7.73	6.14	10.44	22.77	51.76	1.16	-----	-----	-----	-----

* Fat reduced to Starch Equivalent by multiplying by 2½.

† Car Lot.

TABLE III.—ANALYSES OF VARIOUS MIXED FEEDS.

	Dealer.	Price per Ton.	ANALYSIS.						Composed of
			Water.	Ash.	Pro- tein.	Fiber.	Nitrogen- Free Extract.	Fat.	
<i>Out Feeds, Wheat and Out Feeds.</i>									
Quaker Dairy Feed, American Cereal Co.	New Haven, R. H. Davis	\$17.00	8.02	5.30	11.69	15.66	54.98	4.35	Oats and wheat.
Quaker Oat Feed, American Cereal Co.	Hartford, C. A. Pease & Co.	19.50	7.92	5.31	11.08	17.52	54.61	3.56	Oats and wheat.
(Average of three analyses)	Daniels Mills Co.	18.00							
	New Haven, Abner Hendee	17.00							
Stock food, American Cereal Co.	East Hartford, G. N. White & Co.	20.00	9.33	4.46	12.50	11.33	57.71	4.67	Oats, corn and wheat.
Schumacher's Starch Feed, American Cereal Co.	Hartford, Cummings & Garvan.	21.00	9.32	4.82	12.69	9.78	58.84	4.55	Oats, corn and wheat.
Oat Feed, T. B. Chase & Son, N. Y.	Bridgeport, Taylor & Clark	16.00	7.24	5.77	8.75	21.88	53.50	2.86	Oats and wheat.
Joliet Oat Feed.	Hartford, E. P. Yates & Co.	19.00	8.26	5.12	7.88	20.55	55.14	3.05	Oats and wheat.
Provender		18.00-20.00	11.00	3.00	9.92	7.92	63.63	4.53	Oats and corn.
<i>Other Mixed Feeds.</i>									
Standard Dairy Feed, The H. O. Co., Buffalo, N. Y.	New Haven, R. G. Davis	19.00	9.67	4.50	20.22	12.46	48.88	4.17	Oats, corn, wheat and cotton seed.
H. O. Horse Feed, The H. O. Co., Buffalo, N. Y.	Bristol, Geo. Eaton	---	9.21	3.23	12.07	10.34	61.04	4.11	Oats, corn, wheat and linseed.
(Average of two analyses)	New Haven, Abner Hendee	24.00	10.21	3.07	11.38	10.56	60.43	4.35	Oats, corn, wheat and linseed.
Blatchford's Calf Meal	R. G. Davis	21.00	8.93	5.46	24.75	5.06	51.11†	4.69	Linseed, beans, wheat, carob bean, cotton seed, fenugrek.
Baum's Horse and Stock Food, Baum's Castorine Co., Syracuse, N. Y.	Canaan, Ives & Pierce	---	8.18	13.64	27.50	9.34	34.00	7.34	Linseed, charcoal, sulphur and salt.

† Starch 26.15. Sugars, dextrin, etc. (water-soluble carbohydrates) 8.78 per cent.

* Per Cwt.