TEXAS AGRICULTURAL EXPERIMENT STATION

BULLETIN NO. 185 FEBRUARY, 1916

DIVISION OF CHEMISTRY

The Production Coefficients of Feeds

POSTOFFICE:
COLLEGE STATION, BRAZOS COUNTY, TEXAS

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BY

G. S. FRAPS, Ph. D.

CHEMIST IN CHARGE; STATE CHEMIST

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**In cooperation with the United States Department of Agriculture.

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THE PRODUCTION COEFFICIENTS OF FEEDS.

By G. S. Fraps, Ph. D., Chemist in Charge; State Chemist.

The value of a feeding stuff consists in its *volume,* which satisfies the appetite of the animal, its *digestible protein,* which furnishes material for muscular and other similar tissue, and its *productive value,* which represents its value for the purpose of supplying energy for work, or bodily activities, heat, or material for the production of fat, etc.

The object of this bulletin is to describe a method of calculating the productive values of feeds from their chemical composition.

VOLUME AND PROTEIN.

The ration must have a certain volume in order to satisfy the appetite of an animal. The required volume is somewhat variable, but if the animal does not receive sufficient to distend the digestive organs, he is not satisfied, is uneasy, and when used for productive purposes, the results are not as good as if the appetite were satisfied. Bulk or volume has a definite commercial value. That is to say, the prices of coarse feeding stuffs are at times so high as to make it cheaper to buy the digestible protein and the productive value in concentrated feeding stuffs than in roughages, but on account of the bulk necessary for the ration, coarse feeding stuff must be purchased to a certain extent. Under such circumstances the bulk of a feed has a definite feeding value in addition to its productive value and digestible protein, and this fact must be taken into consideration when making the purchase.

Protein.—As stated above, protein is used by the animal for the purpose of upbuilding or repairing muscular tissue, and organs of the body, in the composition of hair, and so forth. It is also necessary as a constituent of milk and eggs. For this reason animals producing flesh, such as young animals, and animals giving milk or laying eggs, require more protein than do full grown animals which are being fattened, or which are doing work, or which are merely being maintained.

The proportion of protein to the other constituents of the feed affect the digestibilities of the feed within certain limits. If the ratio of digestible protein to digestible non-protein in the ration be as high as 1 to 10, the digestibility of the ration will be diminished to some extent. The most favorable ratio, so far as digestion is concerned, is 1 to 8. In the case of swine, the ratio may be as high as 1 to 12 without affecting the digestion.

This fact must be taken into consideration particularly with animals on maintenance, working animals, and full grown animals which are being fattened, as these animals are fed on feeds which may have too wide a nutritive ratio unless care is taken. Young growing animals,

animals giving milk, and animals laying eggs, require such quantities of protein for productive purposes that the ratio of protein to non-protein is not likely to come near to 1 to 10, and thereby affect the digestibility of the feed.

On the other hand, an excess of protein causes trouble in the organs which excrete the nitrogen, and if too much protein is fed, it may in time cause disturbances of health.

PRODUCTIVE VALUE.

We define the productive value of a feed as the amount of fat that the feed will produce upon a fattening animal, when it is fed in addition to a basal ration already sufficient for the bodily needs of the animal. Thus the basal ration will supply enough material to furnish heat, bodily motion, etc., and all the value of the addition may go towards the production of fat. By fat we do not mean body weight, but fat in the chemical sense. When fed in this manner, the entire productive value of the feed may be used in the formation of fat, and none of it would be used to sustain the life of the animal.

The productive value of a feed has also been stated in terms of the quantity of starch which would produce the quantity of fat that the feed would produce; that is to say, if 100 pounds of the feed produced 20 pounds fat, its *starch value* would be the amount of starch that would produce 20 pounds of fat, and this would be very near 80 pounds of starch; that is to say, the productive value would be 80 expressed in terms of starch. This is the method used by Kellner, who expresses the productive value in terms of starch. One pound starch *will produce 0.25 pounds fat.*

The productive value may also be stated in terms of the energy contained in the quantity of fat formed by the animal. That is to say, if 100 pounds of a feed produces 20 pounds of fat, the productive value in terms of energy would be the amount of heat generated by burning 20 pounds of fat. This method is used by Armsby, the unit being the *therm,* equal to one million small calories or one thousand large calories. Armsby's figures are based upon a direct determination of heat evolved by the animal as well as on the estimation of the income and outcome of carbon and nitrogen. The value secured from the measurement of the income and outcome of carbon and nitrogen is practically identical with the values secured by the direct measurement of energy according to Armsby's work; so there is no advantage in the direct measurement of energy for the purpose of obtaining the productive value of a feed. The measurement of energy serves only as a check upon the determination of the income and outgo of carbon and nitrogen, and however much value such measurement may have for other purposes, it is not necessary in the estimation of productive value.

Armsby also assumes that the amount of energy in tissue protected by an addition to rations below the maintenance is equal to the energy stored up in fat when the ration is above maintenance. In terms of matter this means that the productive value of a feeding stuff may be measured either by the flesh protected (expressed in terms of fat) when the ration is added to a ration below maintenance, or by the fat stored up when the ration is added to a ration above maintenance. There is, however, evidence from other lines of work that such is not the case (see Armsby's "Principles of Animal Nutrition") and before this assumption can be accepted, it must be supported by additional evidence. sufficient to offset the evidence already existing against this assumption.

The transformation of the products from the digestion of feeds into fat, undoubtedly involves a consumption of energy. This loss of energy is entirely disregarded when the assumption is made that the energy value of the feed is equivalent to the heat produced by burning the fat produced from it by the animal. Furthermore, there is no evidence that the amount of nutrients used in producing milk, or work, or eggs, is the same as that used for producing fat. There may be a greater loss of energy in utilizing the feed for this purpose, or there may be a smaller loss of energy. The losses of energy may be in proportion to the value measured in terms of fat, but this is a fact that we can only establish by experiment. The assumption that the productive value in terms of energy is represented by the energy stored up by the animal in the form of fat is thus not correct, since it does not take into consideration the losses of energy due to the transformation of feed nutrients into fat.

We prefer to express the productive value of a feed in terms of fat for the reason that it represents as nearly as is possible the exact substance measured in the experiments. That is to say, the productive value of a feed is measured by the quantity of fat actually secured in the experiments, and the use of this method does not involve any assumption as to the quantity of productive energy consumed in forming fat, or other similar assumptions.

SIGNIFICANCE OF THE PRODUCTVE VALUE.

The value of a feed for building or repair of flesh is measured by means of its content of digestible protein.

The value of a feed for heat, bodily movements, or energy, or for productive purposes, is not so easily measured. The best measure that we have at present is the quantity of fat that it will produce upon a fattening animal. This we call the productive value of the food, or its fat-producing value, and it indicates not only the quantity of a fat that the food may be able to produce, but the relative value of the food for other purposes, such as for work, for energy, for uses of the animal body, etc.

The productive value of a food is experimentally ascertained by first feeding an animal a ration which should produce a little fat and estimating exactly how much fat is produced with this ration. Then to this ration the food to be tested is added, and the quantity of fat produced is again estimated exactly. This cannot be done by weighing the animal, as such a method is too crude for exact work. The difference between the first quantity of fat produced and the second quantity of fat produced shows how much fat the food is capable of producing when it is fed to an animal that is already receiving enough food to take care of its bodily needs. It is then a simple matter to calculate the productive value of the feed tested in terms of fat.

The productive value, stated in terms of fat, is the most advanced method of measuring the energy value of a feed stuff. In the calculation of rations for animals, it was formerly assumed that the digestible nutrients of one food are equally as good as the digestible nutrients of any other food. As a matter of fact, this is not true. Different feeds vary considerably in the value of the digested nutrients contained in them, due to differences in losses, and in the work involved in chewing and digestion. The use of the productive value is a decided step forward in the calculation of rations for feeding animals.

According to Kellner, 100 pounds of the digested ether extract of roughages will produce 47.4 pounds of fat on a fattening animal; 100 pounds of starch will produce 24.8 pounds fat; 100 pounds of protein will produce 23.5 pounds fat; 100 pounds crude fiber will produce 24.8 pounds of fat. These, then, are the productive values of these constituents of feeds.

If we assume that the digestible nutrients of all feeds have an equal value, we can calculate, from the above figures, that a certain wheat straw should produce 10.4 pounds of fat. But by experiment Kellner found that 100 pounds of this particular wheat straw produced only 2.1 pounds of fat. Hence the value calculated merely from the productive value of the nutrients without correction is incorrect. On the other hand, the fat produced from cottonseed meal was found to be equal to that calculated. For this reason it is plain that the digested constituents of wheat straw are quite different in productive value from the digested constituents of cottonseed meal, and correction must be made for the nature of the feed.

Other tests have given similar results and proven conclusively that the digested nutrients of one feed may have a different value to the animal, pound for pound, from the digested nutrients of another feed. The relations between the values actually found and those calculated from the digested nutrients only, as found by Kellner, are given in Table 1.

TABLE 1—RELATION OF FAT CALCULATED FROM TOTAL DIGESTIBLE NUTRIENTS ONLY, TO FAT ACTUALLY PRODUCED. (KELLNER.)

	Calculated from digestible nutrients.	Found by experiment.	Percentage of Calculated.
Peanut meal	18.9	18.9	100
Palm nut meal	17.9	18.3	102
Linseed cake meal	19.7	19.2	98
Rice meal	16.8	18.3	108
Rye meal	18.1	16.9	93
Bean meal	17.3	16.3	94
Rye bran	15.8	12.5	79
Wheat bran	15.4	11.9	77
Brewers' grain (dry)	15.4	13.0	84
Potatoes	18.5	18.1	88
Sugar beets	15.0	13.1	87
Beet residue (wet)	18.1	17.4	94
Beet residue (dried)	18.1	14.2	78
Wheat straw I	10.4	2.1	20
Wheat straw II	8.4	2.4	29
Oat straw	10.9	6.6	59
Barley straw	11.7	7.8	64
Meadow hay I	12.9	8.1	54
Meadow hay II	15.6	10.9	55
Clover hay	12.4	8.5	63
Grass hay	13.3	8.5	64

It is quite possible that different animals may have different powers of utilizing the digested nutrients of feeds, and that some animals may put on a different quantity of fat from the steers used by Kellner in ascertaining the productive values. This has indeed been found to be the case with pigs, which produced about 32 per cent. more fat from proteids, fats, or starch than steers from the same digestible nutrients; but the quantities of fat produced were in *proportion* to the productive values as determined on steers.

It is also possible that, for other energy uses, the value of a feed may not be equal to its productive value, but more probably might be in proportion to it. That is to say, the quantity of fat that the feed may produce on a fattening animal may not represent the absolute value of the feed to animals for another purpose, but its value for such purpose may be in proportion to the productive value, or fat formed.

CALCULATION OF THE PRODUCTIVE VALUE.

The following method for the calculation of the productive value in terms of fat is based upon Kellner's method in terms of starch, as outlined in Fraps' "Principles of Agricultural Chemistry," page 425.

Knowing the composition and coefficients of digestibility, the productive value in terms of fat of a given feeding stuff may be calculated so as to be in accord with the experimental work. The results are expressed in pounds fat which may be produced by 100 pounds of feed.

Concentrated Feeding Stuffs.—Multiply digestible proteids in 100 pounds feed by 0.235. Multiply digestible fat by 0.598. Multiply digestible nitrogen-free extract and crude fiber, taken together, by 0.25. Add the products, and multiply by the percentage of fat produced by the feeding stuff in question as per Table 1. If the feeding stuff is not named in the table, it will be necessary to use the factor for the feed most closely resembling it. The result is approximately the productive value in terms of fat. Chaff, rice hulls, and and other by-products high in crude fiber are not considered as being concentrated feeding stuffs.

Roughage.—Proceed as directed above, using the factor 0.526 for digestible ether extract in grasses, and 0.474 for all other roughages, and sum up the fat values of the nutrients. Then if the roughage is not ground to a meal, multiply the total quantity of crude fiber present in 100 pounds by 0.14 and subtract this quantity from the sum. If the roughage is ground to a meal, multiply the crude fiber by 0.07 and proceed as before. With green feeds containing 8 per cent. or less crude fiber, deduct 0.085 grams fat from the sum of the fat values for each gram crude fiber; with those containing 8 to 10 per cent., deduct 0.095; with those containing 10 to 12 per cent., deduct 0.108; with those containing 12 to 14 per cent., deduct 0.12; with those containing 14 to 16 per cent., deduct 0.135; over 16 per cent., deduct 0.14.

The following is an example of the method of calculating the fat value of a roughage:

JOHNSON GRASS HAY, 100 POUNDS.

Digestible protein	$3.3 \times 0.235 =$	0.78
Digestible fat	$0.7 \times 0.474 =$	0.33
Digestible crude fiber............	22.6	
Digestible nitrogen free extract..	28.1	
	$50.7 \times 0.25 =$	12.42
Total		13.53
Total crude fiber..........	$38.0 \times 0.14 =$	5.32
Productive value		8.21 lbs. fat.

This means that 100 pounds of the Johnson grass hay added to a ration already sufficient to maintain the animal should produce 8.21 pounds fat. The fat value is the productive value for fattening, when the feed is used for fat and for no other purpose.

THE PRODUCTION COEFFICIENT.

If expression of the value of feed in terms of their productive values is to come into general use, it is necessary that we have some simple method of calculating the productive value from the chemical analysis with approximate accuracy. The method of calculation described above is somewhat complicated and takes a considerable amount of time.

In order to simplify the calculation, we propose to use a factor to be known as the *production coefficient* for calculating the productive value of a feeding stuff in terms of fat. We define the production coefficient of a feeding stuff as the factor, which, multiplied by the percentage of the nutrient, gives the productive value of that nutrient in terms of fat. In order to secure the productive value of a feeding stuff it is then merely necessary to multiply the percentage composition by the production coefficient of each constituent and to add up the result. This method greatly simplifies the method of calculating the productive value of a feeding stuff. The method of calculation is shown by the following example:

Suppose we have a sample of corn chops containing 9 per cent. protein, 4 per cent. fat, 2 per cent. crude fiber, and 70 per cent. nitrogen free extract. In order to calculate the productive value of this feed, multiply each constituent by the production coefficient of corn chops as shown in Table 3 and add up the results. The total is the productive value expressed in pounds of fat produced per 100 pounds of feeding stuff.

Protein	9×.158 production coefficient=	1.42 productive value
Fat	4×.538 production coefficient=	2.15 productive value
Crude fiber......	2×0 production coefficient=	0 productive value
Nitrogen free extract	70×.230 production coefficient=	16.10 productive value
Total		19.67 productive value

In some cases the factor for crude fiber is negative. It should, of course, be subtracted instead of being added. Example:

ALFALFA HAY.

Protein	14.0×.177=2.48
Ether extract	2.0×.202= .40
Nitrogen free extract.........	36.0×.172=5.92
Total	8.80
Crude fiber	30.0×—.025=—0.75
Productive value of 100 lbs. in terms of fat=	8.05

METHOD OF CALCULATING THE PRODUCTION COEFFICIENT.

The production coefficients are found by multiplying the coefficient of digestibility by the fat producing value of each constituent. In the case of crude fiber, correction is made by subtracting such a quantity as may be necessary according to the method previously given for calculating the productive value. In the case of concentrated feeding stuffs the productive value is multiplied by a factor found in Table 1. We have, however, modified the method of Kellner by applying a factor only to the nitrogen free extract, since it is probably this constituent in which the difference is due. The factor for the nitrogen free extract is different from that given in Table 1, and is such a factor as will give the total fat value of the feed as calculated and corrected.

The following is a method of calculating the production coefficient of alfalfa hay, using the average coefficients of digestibility given in Bulletin No. 170.

Protein—Coefficient of digestibility, $.75 \times .235 = .177$ production coefficient for protein.

Ether Extract—$.384 \times .526 = .202$ production coefficient.

Nitrogen Free Extract—$.688 \times .25 = .172$ production coefficient.

Crude Fiber—$.462 \times .25 = .115 - .14$ correction for fiber $= -.025$ production coefficient.

Table No. 3 shows the production coefficients of a number of feeds, based upon the average coefficients of digestibility in Bulletin 170 of this Experiment Station. The last column shows the method of correction used for the crude fiber, or nitrogen free extract, or both, as the case may be.

INFLUENCE OF DIFFERENT CONDITIONS UPON THE PRODUCTION COEFFICIENT.

As the production coefficient is calculated from the coefficient of digestibility, it is clear that anything that will affect the digestion will also affect the production coefficient. The production coefficients given are based upon experiments with ruminants and not with horses, pigs, or similar animals, which have different powers of digestion from ruminants. Thus a pig seems to have very little power to digest crude fiber.

Since different animals may have different digestive powers, due to faulty teeth, too rapid consumption of the food, chewing too rapidly, or defective digestive organs, the productive value may also vary for the individual animal. We may, therefore, expect variations from the average. The digestion of a food is in general most complete when for from 7 to 8 parts nitrogen free nutrient, including fat, multiplied by .25, not less than one part digestible crude protein is present. An excess of nitrogen free nutrient would decrease the coefficient of digestibility.

The stage of growth, which affects the digestibility, will also affect the production coefficient. This is illustrated with timothy hay. (Table 3.)

Cooking decreases the digestibility of a food and thus decreases the production coefficient. The difference for raw and roasted cottonseed is given in Table 3. Unground grain is liable to escape mastication and thus reduce the quantity digested. Such is the case with corn. When whole corn is fed a portion passes through undigested. Corn which is ground or chopped is much more thoroughly digested. Whether or not it will pay to grind corn depends upon the cost of grinding and the possibility of utilizing the droppings for hogs. Small seeds are liable to escape mastication, and there is much greater loss of nutrient which would otherwise be digested. Seeds like kafir, millet, milo, are liable to escape digestion unless ground or crushed. Grinding and cooking both affect the production coefficient. These factors, with respect to the production coefficient, require much study.

In addition to the factors which directly affect the digestion and thereby affect the production coefficient, there are also factors which affect the production coefficient through the correction to be applied to the crude fiber or the nitrogen free extract. Thus the grinding of a hay to a meal decreases the labor expended in digestion and decreases the correction which is to be subtracted for the quantity of crude fiber present. In this way the grinding increases the productive value and the production coefficient.

There are also factors included in the nature of the chemical composition of the nutrient, particularly of nitrogen free extract. But upon these points we have at present little information.

THE RELATION OF CHEMICAL COMPOSITION TO THE PRODUCTION COEFFICIENT.

Some feeds may be regarded as mixtures of two or more constituents which have different coefficients of digestibility and different production values. Cottonseed meal, for example, may be considered as composed of cottonseed kernel residue and cottonseed hulls, and the amount of cottonseed hulls may be calculated from the quantity of crude fiber present. Since cottonseed kernels and cottonseed hulls have different production coefficients, the quantity of crude fiber will thus affect the production coefficient of the feeding stuff.

Rice bran may be considered as being composed of the rice bran proper, which is the outer covering of the rice grain, and of rice hulls, and sometimes it contains rice. These substances have different coefficients of digestibility and different productive values. The difference, however, is greatest for the rice hulls, and the quantity of rice hulls may be estimated from the percentage of crude fiber with a fair degree of accuracy. The production coefficient of rice bran will thus vary to some extent with the quantity of crude fiber present.

Wheat bran may be composed of the outer skin of the grain only, or it may contain some of the interior bran of the grain, or it may contain some of the inner layers. These have different feeding values and different coefficients of digestibility. Sometimes wheat shorts are also present, and these have a higher coefficient of digestibility than wheat bran. The percentage of crude fiber is not a delicate evidence of the different constituents of wheat bran and the relation of composition to the nature of the constituents has not been worked out for this feed.

There are similar variations in the composition of other feeding stuffs which are related to different constituents having different digestive coefficients and different productive values.

As pointed out above, the stage of growth affects the digestibility of hays and fodders. It may be possible to trace the changes in chemical composition of hay at its different stages of growth and to prepare production coefficients which vary with the chemical composition. It is our intention to study further the relations outlined in this bulletin.

THE EFFECT OF THE CRUDE FIBER CONTENT UPON THE PRODUCTION COEFFICIENT OF COTTONSEED MEAL.

Cottonseed meal may be considered as being composed of the kernel residue and of the hulls. The kernel residue contains about 3 per cent. crude fiber and the hulls about 48 per cent. The amount of crude fiber is an indication of the amount of hulls present. Bulletin No. 166 contains digestion experiments with cottonseed meal, also with cold pressed cottonseed and cottonseed meal and hulls. The average cottonseed meal used contained 7.5 per cent. crude fiber. The average amount of crude fiber in the meal rich in hulls was 26 per cent. Table No. 2 shows the coefficients of digestibility for these separate products. The difference in the coefficients of digestibility is also given. By dividing the difference in digestibility by the difference in the crude fiber we get the effect of 1 per cent. crude fiber upon the coefficient of digestibility, which is also given in the table. This may be calculated to the production value as given. Thus an increase of 1 per cent. crude fiber gives the differences in the table. There is an increase in the production coefficient of the crude fiber. Using these figures, we have calculated the production coefficients of the various grades of cottonseed meal given in Table 3.

TABLE 2—EFFECT OF CRUDE FIBER ON PRODUCTION COEFFICIENT OF COTTON SEED MEAL.

	Protein.	Ether Extract.	Crude Fiber.	Nitrogen Free Extract.
Meal, coefficient of digestibility	86	95	15	72
Meal and hulls digestibility	73	91	37	62
Difference for 18.5% crude fiber	13	4	—22	10
Difference for 1% crude fiber	0.7	0.2	1.2	0.5
Difference in production coefficient for 1% crude fiber	—.0016	—.0012	+.003	—.0013

REMARKS ON THE TABLE OF PRODUCTION COEFFICIENTS.

The following are the factors for correction used in Table 4. Correction applied to crude fiber:

A—0.140.
B— .070.
C— .085.
D— .095.
E— .108.
F— .120.
G— .135.

Corrections applied to nitrogen free extract:

The product of the digestibility and 0.25 is further multiplied by the factor given in figures.

On account of insufficient data as to the proteid content of feeds, the production coefficients are based upon their protein content. This introduces a small error, especially with hays or fodders, but low with concentrates.

TABLE 3—PRODUCTION COEFFICIENTS.

	Protein	Ether Extract.	Crude Fiber.	Nitrogen Free Extract.	Factor.	Coefficient of digestibility of Protein.
Alfalfa Hay	0.177	0.202	—.025	.172	A	75
Alfalfa chops	0.177	0.202	—.025	.172	A	75
Alfalfa meal	0.177	0.202	.045	.172	B	75
Alfalfa (green)	.174	.205	.023	.180	C	74
Bermuda hay	.125	.219	0	.125	A	53
Buffalo grass hay	.126	.258	.014	.15	A	54
Barley chops	.181	.460	.070	.230	B	77
Brewers' grains	.190	.540	.050	.106	B.75	81
Blood meal	.197	....	....	....	....	84
Burr clover hay	.190	.028	.020	.190	A	81
Corn Bran	.137	.458	.080	.145	B.75	58
Corn meal	.158	.538	0	.230	....	67
Corn and cob meal	.122	.503	.043	.220	B	52
Corn cob	.040	.237	.022	.150	A	17
Corn fodder, green	.552	.356	.063	.188	C	54
Corn fodder, dry	.118	.308	.028	.155	A	50
Corn silage	.118	.365	.093	.173	B	50
Corn shucks	.029	.183	.033	.152	A	12
Corn stover	.087	.327	.020	.148	A	37
Cold pressed cotton seed	.175	.514	.029	.158	B	74
Cotton seed (whole), raw	.160	.520	.050	.125	A	68
Cottonseed, roasted	.110	.430	.025	.128	A	47
Cottonseed hulls	.03	.327	.053	.119	B	14
Cottonseed meal, 7% fiber	.203	.567	—.033	.181	B	86.2
Cottonseed meal, 9% fiber	0.20	.565	—.027	.178	B	85.5
Cottonseed meal, 11% fiber (meal and hulls.)	0.197	.563	—.021	.175	B	84.8
Cottonseed feed, 13% fiber	.194	.560	—.015	.172	B	84.1
Cottonseed feed, 15% fiber	.190	.558	—.009	.170	B	83.4
Cowpea meal	.193	.443	.09	.210	B.90	82
Cowpea hay	.161	.211	—.021	.17	A	69
Cowpea vines, green	.179	.310	.065	.203	C	76
Crimson clover, green	.181	.347	.055	.185	C	77
Crimson clover hay	.162	.231	—.028	.155	A	69
Ear corn chops	.167	.52	.050	.208	B	71
Guam grass hay	.119	.301	.003	.135	A	51
Hominy meal	.153	.55	.098	.223	B	65
Johnson grass hay	.103	.235	.026	.142	A	44
Kafir chops	.132	.282	00	.172	B	56
Kafir head chops	.149	.444	.013	.202	A	63
Kafir fodder	.155	.252	.028	.174	A	63
Milk (whole)	.223	.58	....	....	0	95
Milk (skimmed)	.223	.598	....	.25	0	95
Mangel wurzels	.153	0	.038	.198	B	75
Molasses, cane	0	0	....	.185	.70	57
Millet hay	.123	.261	0	.142	A	52
Milo chops	.155	.538	.18	.213	B	66
Orchard grass hay	.141	.289	.01	.138	A	60
Oats, grain	.181	.532	0	.162	B.9	77
Oat hay	.128	.331	—.01	.142	A	54
Oat straw	.049	.199	.013	.138	A	21
Para grass hay	.023	.237	—.01	.117	A	9.9
Prairie hay (Texas average)	.235	.206	—.007	.117	A	0
Peanut cake (whole pressed)	.213	.538	—.05	.21	B	90
Peanut hay	.167	.183	—.01	.18	A	71.0
Potatoes	.103	.077	0	.228	....	44
Rice bran, 12% fiber	.151	.538	—.02	.205	B	64
Rice hulls	.024	.318	—.07	.087	B	10
Rice polish	.158	.49	—.01	.227	B	67
Rice straw (Japan)	.04	.03	.01	.113	A	19
Rice straw (Honduras)	.06	.173	.005	.11	A	27
Red clover, green	.158	.331	.048	.18	C	67
Red clover hay	.136	.295	.007	.163	A	58
Rye meal	.197	.387	0	.207	.9	84
Rye fodder, green	.186	.351	.115	.178	C	79
Sorghum silage	.021	.218	.060	.160	C	9
Silage, sorghum and cowpea	.056	.274	.038	.159	C	24
Sorghum fodder	.083	.295	.012	.154	A	36
Salt Bush	.155	.247	—.10	.123	A	66
Tabosa grass hay	.057	.195	—.007	.126	A	20
Timothy grass	.113	.274	.055	.165	C	48
Timothy hay (average)	.113	.263	—.015	.155	A	48
Timothy hay, full bloom	.142	.271	.0153	.180	A	60
Timothy hay, past bloom	.105	.182	—.011	.153	A	45
Turnips	.172	.305	0	.161	0.7	73

TABLE 3—PRODUCTION COEFFICIENTS.

	Protein	Ether Extract.	Crude Fiber.	Nitrogen Free Extract.	Factor.	Coefficient of digestibility of Protein.
Vetch hay	.159	.29	0	.182	A	68
Wheat chops	.174	.245	....	.207	.9	74
Wheat bran	.181	.377	.028	.136	B.7	77
Wheat middlings	.181	.526	0	.195	B	77
Wheat screenings	.176	.562	.023	.213	A	75
Wheat shorts	.206	.514	0	.220	B	88
Wheat straw	.054	.147	.015	.093	A	.24