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The Composition of Rice By-Products.

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THE COMPOSITION OF RICE BY-PRODUCTS.

G. S. FRAPS, PH. D.
ASSOCIATE CHEMIST.

The rice industry in Texas has developed to great proportions in the last few years. Since 1895 the industry has grown from about 2000 acres to about 225,000 acres. There has been a corresponding demand on the Experiment Station for information in regard to the composition and value of rice by-products. A press bulletin on this subject was issued last year by Prof. Harrington. The object of the present bulletin is to give more detailed information in regard to rice bran, rice polish, and rice hulls.

RICE MILLING.

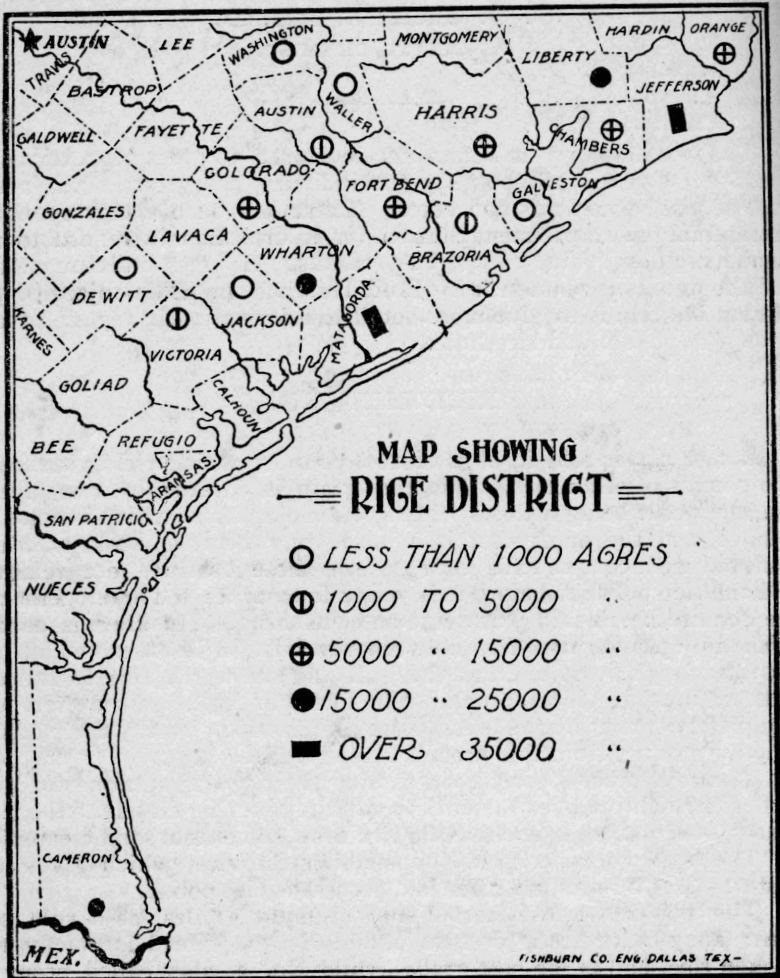
Rough rice is sold in bags of 162 pounds, which yield practically 100 pounds of clean rice. The rice grain is covered by two layers; the inner coat being a closely fitting cuticle or skin, which is hard to remove, and the outer coat is a hard, rough, brittle husk, which is removed with comparative ease. Both these coatings are removed and the rice polished before it is ready for market. Three operations are required: husking, hulling, and polishing. Husking is accomplished by passing the rice between revolving millstones, which are set far enough apart to crack the hull and allow the rice to fall out without breaking it too much. The husks or hulls are not removed completely, there always being some grains which retain their husks. The by-product from this process is rice hulls.

The next process consists in passing the rice through one or more hullers, which removes the cuticle or skin adhering closely to the rice. The products of this machine are rice bran, some flour, and clean rice.

The final process consists in polishing the rice, which gives it a luster. The by-product from this process is rice polish.

The polished rice is sorted into different grades, as a rule into four; fancy head, head, screenings, and No. 2. Head is chiefly unbroken rice, and is the best grade, while No. 2, also called brewers' rice, is the lowest and is used chiefly in brewing. The amount of the different grades obtained depends largely upon the quality of the rice, and the process of milling. If the rice is brittle and easily broken, a larger proportion of the lower grades will result than if the rice is not easily broken.

We are informed that about 62 parts fancy head, 23 parts head, 10 parts straights, and 5 parts brewers rice are produced from 100 parts clean rice. In reply to inquiry, five Texas mills informed the



RICE DISTRICT OF TEXAS.

writer how much of the different by-products are produced from a sack of rice (162 lbs). The answers are summarized in the following table:

PRODUCTS FROM A SACK OF RICE.

	Average pounds	Maximum pounds	Minimum pounds
Rice hulls.....	32.1	34.5	30
Rice bran.....	20.2	25.5	17.5
Rice polish.....	6.3	8	5
Clean rice.....	100	104	99
Loss.....	3.4	5	2

The loss consists of trash, etc. The amount of by-products varies considerably with different lots of rice; the above are considered average values.

The figures given by Dr. Stubbs of the Louisiana Experiment Station are somewhat different from these:

29 lbs. of hulls, straw, trash, etc.
30 " of bran.
8 " of polish.
95 " of clean rice of all grades.
<hr/>
162 lbs. total.

The rice crop of Texas for 1903 is estimated at two to two and a half million sacks, worth from \$5,500,000 to \$7,500,000. The production of different by-products from this crop would average as follows, figured on a two million sack crop:

	Tons.
Rice hulls.....	32,000
Rice bran.....	20,000
Rice polish.....	6,300

Estimating the rice bran at \$9.00 and the polish at \$18.00 a ton, the value of these by-products would be \$180,000 and \$113,000 respectively, a total of \$293,000 for the state of Texas.

The term rice meal is sometimes applied to rice bran. Ground hulls are also sold as rice meal, and also mixtures of rice bran and hulls are sold under this name.

CONSTITUENTS OF RICE PRODUCTS.

The constituents of rice by-products and other feeding-stuffs are divided by chemists into six groups: water, ash, protein, fat, crude fiber, and nitrogen-free extract.

Water is found in all feeding-stuffs. The amount varies. While necessary to the life of an animal, water in a feeding stuff is not con-

sidered of any value, since it is furnished most largely in a liquid form.

Ash is the residue left on burning the material. Ash constituents are necessary to the life of animals, since an animal fed on food from which the ash ingredients have been extracted will die. Young animals require more ash constituents than old ones, since they build up the bones. Feeding-stuffs contain an abundance of ash, however, and ash is little regarded in considering the food value of different materials.

Protein is the constituent of a food which builds up flesh, muscle, and tissues in the animal body. Lean meat is composed almost entirely of protein and water. Every animal uses up a certain amount of protein every day, and a certain amount must be digested to supply the loss, or the animal will lose flesh. In a growing animal, or one giving milk or forming some other product, an additional amount of protein is required, part of which is stored up as flesh, or elaborated into the protein of milk, etc. If at any time, the supply of protein is diminished, the result is a decrease in the amount of flesh laid on, or milk produced, etc. Protein is the most costly part of any food.

Fats, nitrogen-free extract, and crude fiber are burned in the animal to produce heat to keep it warm, to produce motion of different kinds, or to produce work. Just as the coal or petroleum burned in a locomotive enables it to move or to pull a train, so the food eaten by a horse or mule enables it to move, or to pull a wagon or plow. The burning in the two cases takes place in different ways, but the final products are the same. Any excess of these nutrients over the needs of the animal is partly stored up as fat or elaborated into the fat or sugar of milk, or in other products.

Crude fiber is the woody part of the plant, and is digested to a less extent than fat or nitrogen-free extract. Nitrogen-free extract contains sugars, starch, and other ingredients. Fats are more concentrated than crude fiber or nitrogen-free extract. A pound of digested fat is equal to $2\frac{1}{4}$ pounds digested nitrogen-free extract or crude fiber.

COMPOSITION OF RICE HULLS.

The samples analyzed were received in response to a request addressed to different Texas mills. Only three samples of rice hulls were received. The analyses are given in table 1, together with an analysis of "Star bran" (ground hulls) made by Dr. Fraenkel, and such other analyses made in the United States as we have been able to find.

Rice hulls contain little protein and fat, and are rich in ash and crude fiber. In no sense can they be considered as a concentrated feeding-stuff, but belong in the same class as wheat straw, rice straw, corn stalks and other roughage, being worth about \$3.00 a ton or less.

The average composition of rice hulls may be compared with that of corn stover, timothy hay, wheat straw and oat straw in table 1. Since it contains less fat, less protein, and less nitrogen-free extract (with the exception of corn stover) than any of these feeding-stuffs, it is not equal in value to any of them. Its composition approaches that of wheat straw.

TABLE I—COMPOSITION OF RICE HULLS.

	Water	Fat	Protein	Crude Fiber	Nitrogen- Free extract	Ash
No. 4 Seaboard Rice Mills, Galveston.....	9.10	2.21	4.50	34.04	32.46	17.69
No. 47 Port Arthur Rice Milling Co.....	8.11	.98	3.25	40.35	30.91	16.40
No. 48 Lane City Rice Milling Co.....	8.06	1.31	3.25	43.73	24.44	19.21
Average, 1903 samples.....	8.42	1.50	3.67	39.37	29.27	17.77

OTHER ANALYSES.						
Houston Rice Milling Co.—Star bran †.....	10.08	2.50	3.57	28.70	36.82	18.33
North Carolina Station, bulletin 90 b.....	8.42	.67	2.19	37.95	31.83	18.94
“ “ “ Report, 1882.....	9.32	.68	1.61	41.23	39.15	8.01
“ “ “ “ “ “.....	7.70	.65	4.68	30.27	41.60	15.10
“ “ “ “ “ “.....	8.50	.55	3.12	38.57	38.74	10.52
Louisiana Station Bulletin 24.....	8.27	.85	2.89	38.15	35.99	13.85
New Jersey Station Bulletin 160*.....	.92	2.14	32.90	.....	.....	.....
“ “ “ “ “ “.....	1.66	3.67	.....	.....	.....	.....
“ “ “ “ “ “.....	.90	2.26	35.32	.....	.....	.....
“ “ “ “ “ “.....	1.32	3.67	32.90	.....	.....	.....
Rhode Island Station, Bulletin 94.....	.48	2.19	.....	.....	.....	.....
Average, all analyses.....	8.62	1.12	3.07	36.17	34.66	15.38

Corn stover.....	40.1	1.1	3.8	19.7	31.9	3.4
Timothy hay.....	13.2	2.5	5.9	29.0	45.0	4.4
Wheat Straw.....	9.6	1.3	3.4	38.1	43.4	4.2
Oat Straw.....	9.2	2.3	4.0	37.0	42.4	5.1

† Analysis by Dr. Fraenkel.

* Termed rice meal.

FEEDING RICE HULLS.

The value of a feeding-stuff depends not so much upon the amount of protein, fat, and other nutrients which it contains, as on the amount which can be digested from it.

Feeding rice hulls in large quantity is attended with some danger. The rice hulls are composed of a large number of very sharply pointed fibers, which may produce irritation of the delicate mucous membranes of the stomach. Swenson Bros., of Stamford, Texas, attempted to use rice hulls to supply part of the roughage for some cattle, and were immediately troubled by vomiting on the part of their animals. This was probably caused by irritation of the stomach walls by the sharp membranes in the rice hulls. ** Feeding excessive quantities of rice hulls is no doubt dangerous, but moderate amounts have been fed without any ill effects.

Two of the rice mills informed us that they do not grind the rice hulls but use them for fuel.

COMPOSITION OF RICE POLISH.

Five samples of rice polish were analyzed in connection with this work, and the results are presented in table II. In addition analyses

** This case is quoted by Dr. C. A. Browne, Louisiana Planter, June 13, 1903, p. 383.

made by Dr. Fraenkel in 1902 have been placed in the table, and also such analyses as the writer has been able to find.

Rice polish does not contain much ash or crude fiber, and is comparatively rich in carbohydrates. Its composition does not vary to a great extent. In chemical composition rice bran is slightly better than corn, or corn meal, and is about equal to oats or wheat, though containing more fat. It does not contain as much protein, the flesh-forming nutrient, as wheat bran, but contains more fat and nitrogen-free extract.

TABLE II—COMPOSITION OF RICE POLISH.

	Water	Fat	Protein	Crude Fiber	Nitro.-Free extract	Ash
No. 3 Seaboard Rice Milling Co., Galveston.....	8.58	11.38	12.69	1.27	60.69	5.39
No. 43 McFadden-Weiss-Kyle Rice Milling Co....	10.24	5.38	10.75	.71	70.44	2.48
No. 44 Port Arthur Rice Milling Co.....	10.08	5.26	13.81	2.03	65.88	2.88
No. 45 Orange Rice Milling Co.....	8.75	10.11	14.13	1.47	59.41	6.03
No. 46 Lane City Rice Milling Co.....	10.02	5.01	11.75	.86	69.29	3.17
Average of 1903 samples.....	9.53	7.43	12.64	1.27	65.14	3.99
Analyses by Dr. Fraenkel, November, 1902.						
J. J. Thompson Co.....	11.71	8.02	11.68	1.98	61.66	4.95
Eagle Lake Co.....	12.97	5.81	12.37	1.87	63.65	3.33
Houston Rice Milling Co.....	12.79	7.05	13.50	1.73	61.65	3.42
Bayou City Mills A.....	12.01	5.87	10.62	2.01	63.04	5.45
Bayou City Mills B.....	12.28	5.71	11.00	2.10	66.10	2.81
Average of 1902 samples.....	12.34	6.49	12.03	1.94	63.22	3.98
OTHER ANALYSES.						
North Carolina Station, Bulletin 90b.....	11.20	2.10	11.20	6.59	64.99	3.92
North Carolina Station, Report 1882.....	11.21	7.69	12.93	2.41	62.96	2.80
Louisiana Station, Bulletin 9.....	9.00	6.50	11.37	5.86	59.90	7.37
.....	9.33	8.00	11.38	14.45	45.54	11.30
Louisiana Station, Bulletin 24.....	10.63	7.02	10.94	2.62	63.34	5.45
South Carolina Station, Bulletin 59.....	10.76	10.65	11.88	1.23	60.76	4.72
.....	10.51	8.47	10.38	6.63	56.74	7.27
Louisiana Station (Louisiana Planter).....	11.83	5.92	11.06	3.76	63.97	3.46
Average all analyses.....	10.77	6.98	11.86	3.31	62.22	4.86
OTHER FEEDING STUEFS.						
Corn.....	10.9	5.4	10.5	2.1	69.6	1.5
Oats.....	11.0	5.0	11.8	9.5	59.7	3.0
Cowpeas.....	14.8	1.4	20.8	4.1	55.7	3.2
Wheat bran.....	11.9	4.0	15.4	9.0	53.9	5.8

CLASSES OF COMMERCIAL RICE BRAN.

At least three different kinds of products are placed on the market as rice bran.

(1) Pure rice bran, properly so-called, consists most largely of the cuticle which adheres closely to the rice bran. It will also con-

tain some broken rice, and a certain quantity of hulls, since the hulls are never removed completely from the rice during the first process.

(2) "Rice bran" is sold which is a mixture of pure rice bran and from 25 to 75 per cent of rice hulls. The writer is informed by a prominent rice man that he does not consider this practice to be deceptive, since the market price of mixed rice bran is below that of the genuine article. In other words, if pure rice bran is selling for \$10.00 a ton, rice bran at \$8.00 will contain a certain amount of hulls, and bran at \$7.00 will contain larger quantities of hulls. The practice may not deceive the large buyer or the large consumer who is familiar with conditions, but it would certainly deceive those not acquainted with the practice. The practice of selling a mixed food under the name of an unmixed food is always to be condemned. Rice bran mixed with rice hulls should not be sold as rice bran any more than wheat bran mixed with rice hulls should be sold as wheat bran. If it is necessary to place the mixture on the market, let it be sold under its true name.

(3) A mixture of rice bran, rice polish, and rice hulls, in the proportions in which they come from the rough rice, is sold by certain mills under the name of "rice bran." This mixture was formerly sold as "rice feed" by several mills. It would contain on an average 54.7 per cent hulls, 34.5 per cent bran and 10.8 per cent polish. This mixture should also be sold under its true name, where sold. It cannot be regarded as rice bran any more than corn and corn cobs ground together can be regarded as corn meal. There is no objection to selling the mixture under its true name, and on its own merits, but there is decided objection to selling it under the name, and on the merits of a superior article.

(4) Rice hulls have been sold under the name of rice bran. This, however, is rare. It is needless to say that such a sale is a fraud pure and simple.

Thus we see that at least three different kinds of goods are passing under the name of rice bran; namely, pure rice bran, rice bran mixed with from 25 to 75 per cent of rice hulls, and a mixture of rice bran, rice polish and rice hulls. The composition and value of these products will be discussed in later paragraphs.

The term rice meal has been applied to pure rice bran, to rice hulls, and to various mixtures of bran and hulls, or bran, hulls, and polish.

COMPOSITION OF PURE RICE BRAN.

The samples of rice bran analyzed in 1903 were received in response to letters sent to the mills, and for this reason, taken in connection with their chemical composition, they are believed to represent rice bran which is pure from a mechanical standpoint. All the samples contain a certain amount of hulls, but the process of removing the hulls from the rough rice is always imperfect, so that a certain amount of hulls would be found in the bran.

Table III contains the results of the analyses of rice bran, and also the analyses made by Dr. Fraenkel, in 1902, under the direction of

Prof. Harrington, and in addition such analyses of rice bran made in this country that we have been able to find.

TABLE III—COMPOSITION OF RICE BRAN.

	Water	Fat	Protein	Crude Fiber	Nitro.-Free extract	Ash
No. 2 Seaboard Rice Milling Co., Galveston.....	10.00	12.92	12.50	10.19	46.89	8.00
No. 36 McFadden-Weiss-Kyle Co., Beaumont.....	9.34	6.31	10.12	20.30	42.52	11.41
No. 39 Orange Rice Milling Co., Orange.....	9.96	15.31	14.41	15.56	36.26	8.50
No. 40 Lane City Rice Milling Co., Houston.....	8.35	9.50	10.50	21.30	38.34	12.01
No. 49 Houston Rice Milling Co., Houston.....	7.75	11.93	10.25	18.15	40.61	11.31
No. 41 Port Arthur Rice Milling Co., Port Arthur...	7.72	10.70	13.70	8.91	42.32	16.65
Average, 1903 samples.....	8.85	11.11	11.92	15.73	41.08	11.31
Analyses by Dr. Fraenkel, November, 1902.						
No. 1 J. J. Thompson Co.....	12.47	9.92	10.02	11.27	49.78	6.54
No. 2 Eagle Lake Co*.....	11.99	4.02	4.18	27.05	33.86	18.90
No. 3 Houston Rice Milling Co.....	11.88	8.83	9.31	10.61	50.07	9.30
No. 4 Bayou City Mills, Sample A.....	11.54	10.02	11.56	15.75	42.03	9.10
No. 5 Bayou City Mills, Sample B†.....	11.23	4.53	7.37	25.07	37.02	14.78
Average Nos. 1, 3, and 4.....	11.63	9.60	10.30	12.54	47.29	8.64
Analyses at other Stations.						
No. 6 U. S. Dept. Agriculture, Report 1880.....	9.30	5.23	12.78	2.00	62.34	8.35
No. 7 North Carolina Station, Report 1882.....	8.78	8.20	10.93	17.76	41.93	12.40
No. 8 Louisiana Station, Bulletin 9.....	9.96	10.90	13.56	7.00	49.32	9.26
No. 9 " " " ".....	9.56	9.50	11.81	9.85	50.46	8.82
No. 10 " " " " 24.....	10.67	9.97	11.29	10.95	46.02	11.00
No. 11 South Carolina Station, Bulletin 59.....	10.43	17.74	13.31	8.14	44.57	8.81
No. 12 " " " " 59†.....	9.33	5.59	4.06	30.77	33.57	16.08
No. 13 California Station, Report 1895-7.....	10.55	12.80	14.96	4.85	50.20	6.64
No. 14 Wisconsin Station, Bulletin 106†.....	10.35	2.23	4.57	50.66	9.54	17.65
No. 15 " " " ".....	8.80	11.88	12.44	12.00	46.28	8.60
No. 16 Louisiana Station (Louisiana Planter).....	9.84	9.91	9.88	14.76	44.26	11.35
Average, excluding 12 and 14.....	9.76	10.35	12.33	9.70	48.38	9.48
Average all analyses except 2, 5, 12 and 14.....	9.77	10.48*	11.85	12.19	45.76	9.95
OTHER FEEDING-STUFFS.						
Corn.....	10.9	5.4	10.5	2.1	69.6	1.5
Oats.....	11.0	5.0	11.8	9.5	59.7	3.0
Cowpeas.....	14.8	1.4	20.8	4.1	55.7	3.2
Wheat bran.....	11.9	4.0	15.4	9.0	53.9	5.8

In the 1903 samples, the percentage of fat varies from 6.31 to 15.31 per cent, crude fiber from 8.91 to 21.30 per cent, and ash from 8.00 to 16.65 per cent. Protein is not subject to such a great variation. Among the 1902 samples two are clearly not pure rice bran. This is shown by the low percentage of fat and protein, and the high percentage of ash and crude fiber in samples 2 and 5. Two samples in the analyses compiled are also not pure.

† These samples are not pure rice bran.

* Rice hulls.

These samples were omitted from the average, since we are here considering pure rice bran.

Considering all the samples, we feel justified in saying that a pure rice bran should contain not less than 10 per cent protein and 6 per cent fat, and not more than 20 per cent of crude fiber. This is a conservative requirement, and allows the presence of a certain amount of hulls. The writer indeed believes that the process of separating the hulls should be so carried out that not more than 15 per cent crude fiber would be present. The machinery in use is adequate to accomplish this.

In order to obtain an idea as to the amount of rice hulls which might be in a bran under ordinary conditions of milling, the writer secured samples of rice which had been hulled and were ready to have the cuticle removed. The percentage of unhulled rice was estimated and the percentage of hulls which would occur in the bran calculated, with the following results:

	Per cent un- hulled rice.	Per cent hulls in bran.
No. 85.....	14.6	27
“ 86.....	7.6	13
“ 87†.....	.9	31
“ 89.....	.8	1.3
“ 90.....	17.7	34
“ 94.....	16.6	32

The variation in the percentage of unhulled rice is somewhat surprising. Commercial rice bran, which is pure from a mechanical standpoint, may yet contain as much as 34 per cent hulls.

COMPARISON WITH OTHER FEEDING-STUFFS.

In table III the average composition of pure rice bran is compared with the average for some other concentrated feeding-stuffs. It contains more fat than corn, oats, cowpeas or wheat bran, more protein than corn, about the same as oats, and less than cowpeas or wheat bran; less nitrogen-free extract than any of them. This deficiency in nitrogen-free extract is, however, largely counterbalanced by the excess in fat.

COMPOSITION OF COMMERCIAL BRAN.

It is necessary to make a distinction between pure rice bran and commercial rice bran, for the reason already stated; namely, that pure rice bran, rice bran mixed with rice hulls, and a mixture of rice bran, rice hulls and rice polish, are all sold under the name of rice bran. Commercial rice bran may contain as low as 4 per cent of protein, instead of 10 per cent and over in pure rice bran; 2 per cent of fat, in-

† This sample contained 4.6 per cent hulls. It was stated that a small amount of hulls was left in the rice to facilitate the work of the huller.

stead of from 6 to 15 per cent; and as high as 50 per cent crude fiber, instead of less than 20 per cent. Any addition of rice hulls decreases the feeding value of bran in proportion to the amount of hulls added. Consumers are therefore cautioned to be on their guard in regard to the mixed articles. Any mixture should be sold under its true name.*

The mixture of bran, polish and hulls sold as rice bran deserves special consideration, since those who handle this claim that since they put in their polish, worth considerably more than bran, they can also put in their hulls. This mixture would contain, on an average, 54.7 per cent hulls, 34.5 per cent bran, and 10.8 per cent polish. Taking the average composition of these substances for 1903 as a basis, the composition of the mixture would be as follows:

	Fat	Protein	Crude fiber	Nitro.-Free extract	Ash
54.7 lbs. hulls.....	.8	2.0	21.6	17.0	9.7
34.5 " bran.....	3.8	4.1	6.5	14.2	3.9
10.8 " polish.....	0.8	1.4	.1	6.7	.4
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
Total in 100 lbs.....	5.4	7.5	28.2	37.9	14.0
Average for pure bran.....	11.11	11.92	15.73	41.08	11.31

This mixture contains less than one-half as much fat, and about 63 per cent as much protein as average pure rice bran, and in addition, the protein is less valuable. With bran at \$10.00 a ton, polish at \$20.00 and the hulls at \$3.00, the cost of a ton of the mixture would be:

For the bran.....	\$3.45
For the polish.....	2.16
For the hulls.....	1.64
	<hr/>
	\$7.25

With bran at \$10.00 a ton the feeding value of the mixture would be less than \$7.00.

There is no justification in selling this mixture, or any other mixture under the name of rice bran. It is by no means equal in feeding value to rice bran, and even if it were the mixture would not be entitled to the name of rice bran. Every food, and every other article for that matter, should be sold under its true name and on its own merits.

A good name for this mixture is "rice feed."

* Since the above was written, we have received a sample of "rice bran" which contained only 6.2 per cent protein. It is undoubtedly a mixture of hulls and bran, and perhaps polish; salt was also added to make the mixture more palatable. Sale of such mixtures under the name of rice bran will inevitably damage the trade.

STANDARDS FOR RICE BRAN.

The sale of mixtures of rice bran and hulls, rice bran, rice polish and hulls, under the name of rice bran is sure to work damage to the trade in the long run. Such mixtures should be sold under their own names. The following standards are suggested.

Rice bran is the cuticle of the grain, and containing only such an amount of hulls as necessarily escape previous processes. It should contain at least 10 per cent protein, and not more than 20 per cent crude fiber.†

Rice feed is a mixture of rice bran, rice polish and rice hulls in the proportion in which they come from the mills. It should not contain less than 6.6 per cent protein, or over 30 per cent fiber.

DIGESTIBILITY OF RICE BY-PRODUCTS.

The value of any food to an animal depends upon the nourishment which the animal can extract from it—that is, on its digestibility.

Table IV gives the coefficients of digestibility for different rice products. These figures mean the proportion of each nutrient digested. That is, out of 100 parts protein fed in rice bran 63 parts are digested.

TABLE IV—COEFFICIENTS OF DIGESTIBILITY.

RICE BRAN	Total dry matter	Protein	Fat	Nitro.-Free extract	Crude fiber	Ash
Mass. (Hatch) Report 1903†.....	73.8	61.8	91.1	92.3	.....	.....
North Carolina bulletin 160*.....	64.7	62.9	88.6	78.2	29.2	2.4
Louisiana†.....	58.0	64.7	54.8	78.1	13.8	33.0
Average.....	65.5	63.1	78.2	82.9		
RICE POLISH						
Louisiana.....	82.5	65.6	73.6	92.7	22.1	31.4

† 2 steers (average)

* 2 sheep (average)

Table V shows the average amount of digestible nutrients in the different rice products, compared with other feeding stuffs

Rice bran contains 20 per cent more digestible protein than corn meal, and though it contains less nitrogen-free extract, the excess of fat almost makes up for this deficiency, so that rice bran may be considered as somewhat better than corn meal.

Compared with wheat bran, rice bran contains nearly as much digestible nitrogen-free extract, and much more fat, but only about 60

† While rice bran may contain 20 per cent crude fiber and be pure from a mechanical standpoint, yet we believe that the manufacturing process should be such that not over 15 per cent fiber would be present. A good grade of rice bran should contain 12 per cent protein.

per cent as much digestible protein. For this reason it is less valuable than wheat bran.

Rice polish contains little more digestible protein than rice bran, but much more digestible nitrogen-free extract. It is therefore worth somewhat more than rice bran for feeding, though the difference is not great.

TABLE V—AVERAGE DIGESTIBLE NUTRIENTS.
(POUNDS PER 100)

	Total dry matter	Fat	Protein	Nitro.-Free extract	Crude fiber	Ash
Pure rice bran.....	59.5	8.2	7.5	39.3	.....
Rice polish.....	73.2	7.2	7.8	57.9	.7	
Rice hulls.....						
Corn meal.....	76.0	3.4	6.2	63.0	.....
Wheat bran.....	54.9	2.5	12.0	41.0	2.0	

SUMMARY.

(1) Rice hulls have a low feeding value; their composition approximates that of wheat straw, but it has less value.

(2) Rice polish has a slightly higher feeding value than corn, and is about equal to oats or wheat.

(3) Three classes of so-called rice bran are sold in Texas; pure rice bran, consisting of cuticle of the grain mixed with a small amount of hulls incidental to the process of milling; rice bran mixed with rice hulls; rice bran, rice polish, and rice hulls mixed. This confusion will eventually damage the trade.

(4) Pure rice bran should contain not less than 10 per cent protein and 6 per cent fat, or more than 20 per cent crude fiber.

(5) Pure rice bran is slightly superior in composition to corn meal.

(6) Any addition of rice hulls lowers the feeding value of the mixture.

(7) Commercial rice bran may contain as low as 4 per cent protein, and as high as 50 per cent crude fiber.

(8) The mixture of bran, polish and hulls in the proportions in which they come from the grain will contain about 7.5 per cent protein and 28 per cent crude fiber, and has a little over half the value of pure bran.

(9) Mixtures of rice bran with rice hulls, or with hulls and polish, should be sold under their true names, and on their own merits, and not under the name and on the merits of a superior article.