

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

F. B. MUMFORD, *Director*

Rough Rice for Fattening Cattle, Sheep, and Hogs

L. A. WEAVER AND H. C. MOFFETT

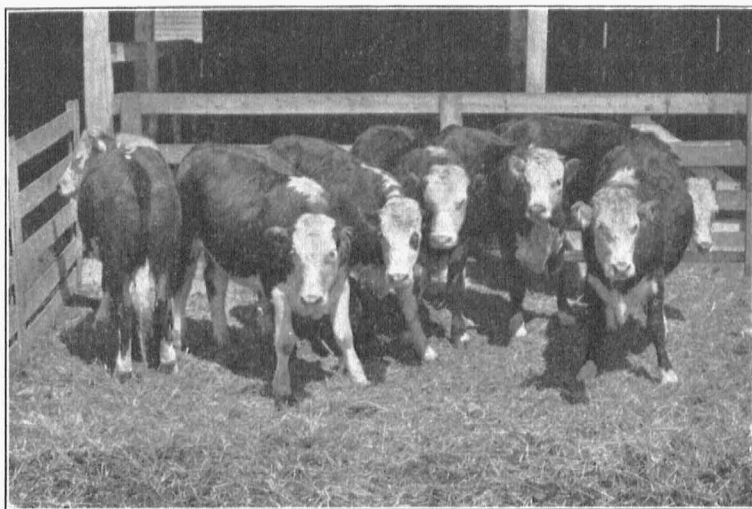


Fig. 1.—Yearling Steers Fattened on Rice, Cottonseed Cake, and Soybean Hay.

COLUMBIA, MISSOURI

What the Experiments Indicate

These experiments with fattening cattle, sheep and swine indicate that rough rice may, if price permits, be used as a substitute for corn in finishing any kind of livestock.

The rice used proved to be palatable in all cases.

While the gains made when rough rice was fed were less rapid than when corn was used, this disadvantage could be overcome by lengthening the feeding period.

Rough rice gave best results when ground before feeding cattle and swine.

Nearly twice as much protein supplement (such as cottonseed meal) is needed to balance the ration when rice is substituted for corn in the fattening ration.

Rough rice produced satisfactory beef, pork, and lamb carcasses as indicated by the "grade" of the finished animals.

In general, ground rough rice was approximately 70% as valuable pound for pound as corn when each was properly supplemented and the rice was used as a complete substitute for corn. The relative value of the rice was increased to 75 to 80% when it was used as a partial substitute for corn.

Rough Rice for Fattening Cattle, Sheep, and Hogs

L. A. WEAVER AND H. C. MOFFETT*

Rice farming in Missouri may be found a profitable means of utilizing areas of heavy, poorly drained bottomland on which the production of other staple crops is difficult. Rice requires a level topography and a tight subsoil that will hold irrigation water. On land of this character corn is at a great disadvantage from a lack of drainage in wet seasons or from the excessive effect of drought in dry seasons.

The Missouri Agricultural Experiment Station, in cooperation with the United States Department of Agriculture, has produced large yields of rice in its studies of bottomland farming, conducted on Wabash clay, the so-called "gumbo" soil, near Elsberry, in Lincoln county. Acre returns for a period of three years have reached an average of 100 bushels and under the most favorable conditions have gone as high as 150 bushels of heavy, well matured grain. Corn on the same land, in the same period, has averaged 41 bushels.

There has not yet been found any serious natural hazard to the rice crop in Missouri. Drought, which so frequently reduces our corn crop, needs not affect rice. Uncontrollable insects and diseases have not appeared. Rice may, therefore, be considered a safe crop to produce in some sections of the state. Moreover it can be grown on land suited to the plant, at a much lower cost than corn. And so withal there is a sound prospect that rice may become an extensive and important crop on such bottomland soils as the Waverly silt loam in Southeast Missouri, and the Wabash clay along the Mississippi, the Grand, and the Chariton rivers.

The disposal of the rice crop is through the ordinary commercial markets and the feed lot. As a feed grain, however, it is not well established, mainly because the old centers of rice production are not particularly livestock centers, and the commercial market has, therefore, absorbed the crop and directed it towards its customary use as human food. But there is good reason for believing that in Missouri, where the demand for feed grain is so great that the State usually consumes more corn than it produces, the rice

*Facts regarding the possibilities of rice production in Missouri were furnished by Dr. W. C. Etheridge of the Department of Field Crops. The sheep feeding experiment was supervised by Raymond S. Glasscock.

crop can be used as a feed to at least partially augment the shortage of corn. According to Henry and Morrison* rough rice and corn contain the following amounts of digestible nutrients.

DIGESTIBLE NUTRIENTS IN 100 POUNDS

	Crude Protein (lbs.)	Carbo- hydrates (lbs.)	Fat (lbs.)	Total Lbs.
Corn, Dent Grade, No. 2----	7.1	64.6	4.4	81.7
Rice, Rough.....	4.7	64.6	1.7	73.1

Like corn, rice would, therefore, be classified as a carbonaceous concentrate but because of the large amount of fiber in the hull it contains less total digestible nutrients. On the basis of digestible nutrients alone, rough rice would be worth approximately 90 per cent as much as corn pound for pound. However, rice contains a smaller amount of protein than corn and because of its more bulky nature actual feeding tests are the best criterion of the relative feeding value of these two feeds.

EXPERIMENTS IN OTHER STATES

A large amount of data has been secured at a number of agricultural experiment stations, notably Louisiana, Texas, and California, showing the value of the various rice by-products as livestock feeds but relatively few experiments have been conducted with rough rice.

At the Louisiana Station (1)† experiments conducted have shown that rough rice can be fed to livestock without injurious results. Experiments with hogs and dairy cows are reported. Shotes having an initial weight of 140 pounds fed a ration of ground rough rice 86% and tankage 14% made an average daily gain of 1.86 pounds for 42 days. Similar hogs fed equal parts of ground rough rice and corn meal supplemented with tankage gained 2.19 pounds while those fed corn meal and tankage as a check gained 2.04 pounds daily. For dairy cows a ration of ground rough rice and cottonseed meal was apparently not so palatable and produced slightly less milk yield than a ration of corn meal, bran, and cottonseed meal, but no injurious effects resulted from the use of the rough rice although it made up 80% of the grain mixture.

At the Texas Station (2) John A. Craig and F. R. Marshall compared a ration of ground rough rice, too seriously discolored for marketing, with cottonseed meal, and reported that when cot-

*Feeds and Feeding, Appendix I, Table III.

†Numerical references are to "Literature Cited," Page 15.

tonseed hulls were used for roughage, 2.3 pounds of rough rice were equal to 1 pound of cottonseed meal when fed to yearling steers for 70 days.

Cruse of the Texas Station (3) studied the value of rough red rice in rations for fattening steers and found that steers fed whole rough rice with cottonseed meal and Johnson grass hay tended to bloat and scour badly and much of the rice passed through the steers undigested. When the ration was changed to ground rough rice the ration was more palatable and the steers immediately stopped scouring and bloating. In these experiments, rough red rice in a mixed ration of cottonseed meal and hulls produced more rapid gains than a straight meal and hull ration, indicating that the rough rice can, in combination with other feeds, be fed to fattening steers. In hog feeding trials reported Cruse found ground rough rice fed with cottonseed meal to be an economical ration for fattening hogs, although the hogs gained less rapidly than when the ration was corn chops and cottonseed meal.

Hughes of the California Station (4) found that fattening hogs fed whole rice and tankage made slow gains and required a large amount of feed to produce 100 pounds gain. Cooking the rice did not prove a satisfactory method of preparation. Grinding the rough rice finely gave better results than grinding coarsely. Finely ground rough rice and tankage produced gains more slowly and more feed was required per unit of gain than when rolled barley and tankage were fed. Pigs fed rough rice consumed more tankage than did those fed barley. Hogs fed a mixture of rolled barley, rough rice and tankage gained more rapidly on less feed than those fed barley and tankage. The amount of tankage consumed was not very different from that consumed by the hogs fed barley and the addition of rough rice to the ration, although comparatively small quantities were consumed, seemed to reduce the amount of feed required per 100 pounds of gain.

At the Arkansas Station (5) pigs self-fed whole rough rice with tankage and minerals gained at the rate of 1.42 pounds per day and required 508 pounds of feed for 100 pounds gain. The pigs consumed an excessive amount of tankage indicating a lack of palatability for the whole rough rice.

Ground rough rice self-fed with tankage was consumed somewhat better than the whole rough rice and the pigs fed the cereal ground gained more rapidly and required less feed per unit gain.

Similar pigs self-fed brewer's rice 50, rice polish 40, and tank-age 10, gained 2.10 pounds per head daily and required 350.3 pounds of feed for 100 pounds gain.

To supplement the data reviewed above, the Missouri Experiment Station has made studies to determine to what extent, in what way, and how efficiently rough rice (the threshed, unmilled grain—sometimes called paddy) may be used instead of corn in rations for fattening cattle, sheep, and hogs.

MISSOURI EXPERIMENTS

Approximately nine-tenths of the rice used in these feeding experiments was Lady Wright, a long grain variety known to be well adapted to local conditions. The remainder was a mixture of Colusa 1600, Caloro, Early 1600, and other similar short grain rice. The entire lot was of excellent quality, practically free of foreign material and showed a test weight of 45 pounds to the bushel. It was produced by the Missouri Agricultural Experiment Station, Department of Field Crops, in cooperation with the United States Department of Agriculture, on river bottom land near Elsberry, Missouri.

The average chemical analysis of two samples of this rice, made by the Department of Agricultural Chemistry of the Missouri Station, along with the composition of No. 2 dent corn (for comparison) follows:

	Dry Matter %	Protein	Fat	Fiber	N. free Extract	Mineral Matter
Rough rice----	90.2	6.0	1.6	9.4	67.7	5.3
No. 2 Dent corn	85.2	9.2	3.8	2.2	67.0	1.3

GROUND ROUGH RICE FOR FATTENING YEARLING STEERS

To determine the palatability and feeding value of ground rough rice when used as a sole substitute for corn in fattening cattle rations, two lots of 8 yearling steer cattle each were fed as follows:

Lot I Shelled corn 10 parts, pea sized cottonseed cake 1 part, with soybean hay.

Lot II Ground rough rice 7 parts, pea sized cottonseed cake 1 part, with soybean hay.

The corn used was No. 2 mixed, mostly yellow. The rough rice was principally a long grain variety, fed ground since experience with feeding small hard grains to cattle had demonstrated

the advisability of grinding. The cottonseed cake was pea sized, of prime grade, and guaranteed 43% protein. The soybean hay was grown on upland near Columbia and was of average quality. Since rice contains only 4.7% digestible protein as compared to 7.1% contained in No. 2 dent corn, the amount of protein supplement was adjusted so that the nutritive ratio of the concentrate mixture of the two lots was nearly the same. During the experiment they were fed twice daily all the grain and hay they would clean up reasonably well. Any coarse hay or dirty grain was weighed back. Water was before them at all times.

Animals Used.—The cattle used were grade Hereford yearling steers of "Good" quality and in thin flesh. They were purchased on the Kansas City market and shipped by rail to the University feed lots where they were maintained on dry feed for three weeks before the test started. At the beginning and close of the test they were weighed on three consecutive mornings and averages of these weights were taken as the beginning and final weights.

TABLE 1.—RICE IN RATIONS FOR YEARLING STEERS
DECEMBER 11 TO APRIL 30—140 DAYS

Lot Number	I	II
Rations Fed	Corn-----10 C. S. C.-----1 Soybean Hay--	Rough Rice---7 C. S. C.-----1 Soybean Hay--
Average initial weight (lbs.)-----	604.7	609.3
Average final weight (lbs.)-----	900.8	859.2
Total gain (lbs.)-----	296.1	249.9
Average daily gain (lbs.)-----	2.12	1.79
Average daily ration (lbs):		
Corn-----	13.33	-----
Rice-----	-----	13.18
Cottonseed Cake-----	1.33	1.89
Soybean hay-----	3.29	3.67
Feeds consumed per 100 lbs. gain (lbs.)		
Corn-----	628.7	-----
Rice-----	-----	738.3
Cottonseed cake-----	62.9	105.6
Soybean hay-----	155.4	205.3

The cattle were started on 4 pounds of concentrate and 10 pounds of soybean hay daily. The grain was increased until they were eating 10 pounds of grain per head at the end of the second week, and 13 pounds at the end of the fourth week. The average grain consumption for the entire feeding period was 14.66 pounds per head daily. Both lots were fed the same amounts of concentrates, the amount offered being governed by the lot that consumed the least. After the cattle were on full feed the lot fed ground rough

rice cleaned up their feed boxes somewhat more readily and otherwise exhibited stronger appetites than those fed on the shelled corn. The rice fed cattle would have taken somewhat more feed than was offered them.

The amount of hay consumed by the cattle decreased from an average daily consumption of 10 pounds per head at the beginning of the test to approximately 4 pounds per head daily at the close of the test.

Both lots fed well and gained consistently throughout the period. The cattle fed shelled corn gained .33 pound or 18% per head daily more than those fed on ground rough rice.

The cattle fed ground rough rice required 151 pounds more concentrates and 50 pounds more soybean hay to produce 100 pounds gain than those fed on shelled corn.

The cattle fed on shelled corn were somewhat better finished at the close of the test and sold to the packers for 31c per cwt. more than the lot fed on rough rice. Both lots graded "Good" as slaughter cattle but the lot fed shelled corn graded approximately one-third of a grade higher in the carcass than those fed the ground rough rice, grading "Good" and "Low Good" respectively.

Summary .

(1) Ground rough rice proved to be highly palatable to yearling steer cattle.

(2) A ration of shelled corn and cottonseed cake produced 18 per cent more rapid gains than a ration of ground rough rice and cottonseed cake.

(3) Cattle fed ground rough rice required 22% more concentrates and 32% more hay for the production of a unit gain than where shelled corn was fed.

(4) In this test ground rough rice was worth 76.31% as much as shelled corn if it is considered that 1 pound of cottonseed cake used to balance the ration is equivalent to 2 pounds of ground rough rice.

(5) Shelled corn produced noticeably more finish on cattle in 140 days feeding than rough rice.

(6) Grading data on both lots showed that the cattle fed shelled corn graded approximately one-third of a grade higher in the carcass than those fed ground rough rice.

(7) There was no noticeable difference in general quality of meat yielded from the two lots.

ROUGH RICE FOR FATTENING LAMBS

To determine the feeding value of rough rice in fattening lamb rations (1) when used as the sole substitute for corn and (2) when used to replace one-half the corn, three lots of lambs were hand fed the following rations:

- Lot I Shelled corn 20 parts, cottonseed cake 1 part, alfalfa hay.
- Lot II Rough rice 10 parts, shelled corn 10 parts, cottonseed cake 1.5 parts, alfalfa hay.
- Lot III Rough rice 10 parts, cottonseed cake 1 part, alfalfa hay.



Fig. 2.—Lambs Fattened on Rice, Cottonseed Cake, and Alfalfa Hay.

The corn used was No. 2 mixed, mostly yellow. The rough rice was principally a long grain variety, fed whole. The cottonseed cake was pea sized, of prime grade, and guaranteed 43% protein. The alfalfa hay was grown locally on bottom land and would have graded No. 1 leafy. Since rice contains less protein than corn, the amount of protein was adjusted so that the nutritive ratio of the concentrate mixture of all lots was approximately the same. During the experiment the lambs were fed twice daily what grain and hay they would clean up reasonably well. Any coarse hay or dirty grain was weighed back. Water and salt were available at all times.

Animals Used.—Thirty-six head of "Good" quality western feeder lambs weighing 62 pounds per head were used. They were purchased on the Kansas City market in early November and fed a light grain ration and alfalfa hay for 2 weeks prior to November 24 when they were weighed and started on the feeding test. The test was conducted in a series of feeding pens constructed under a shed open to the east.

TABLE 2.—ROUGH RICE FOR FATTENING LAMBS
NOVEMBER 24 TO FEBRUARY 3—71 DAYS

Lot Number	I	II	III
		Sh. Corn...20 C. S. C.....1 Alfalfa Hay..	Rough Rice..10 Sh. Corn....10 C. S. C.....1.5 Alfalfa Hay..
Rations Fed			
Avg. initial wt. (lbs.).....	64.60	64.60	64.75
Avg. final wt. (lbs.).....	91.40	90.55	85.77
Total gain (lbs.).....	26.80	25.95	21.02
Avg. daily gain (lbs.).....	.38	.37	.30
Avg. daily ration (lbs.)			
Shelled corn.....	1.40	.76	----
Cottonseed cake.....	.07	.11	.15
Rough rice.....	----	.76	1.51
Alfalfa hay.....	1.00	.99	.94
Feeds consumed per 100 lbs. gain (lbs.)			
Shelled corn.....	372.75	208.03	----
Rough rice.....	----	208.03	509.97
Cottonseed cake.....	18.65	31.20	50.99
Alfalfa hay.....	265.58	272.32	317.63

The lambs fed on rough rice went on feed more quickly than lambs fed on shelled corn or a mixture of shelled corn and rough rice, although all lots of lambs fed satisfactorily. The daily concentrate consumption including cottonseed cake was largest for the lot fed rough rice, with the lot receiving a mixture consisting of equal parts rough rice and shelled corn ranking second. The daily consumption of hay for the lots varied from 1 pound per head daily for the lot fed on shelled corn to .94 pound per head daily for the lot fed rough rice. The lot fed on shelled corn gained more rapidly than the lot fed rough rice or the one fed equal parts of shelled corn and rough rice. During the early part of the period the lambs fed on the rough rice gained as rapidly as the lambs being fed on shelled corn, but as the feeding period progressed their rate of gain decreased as compared to other lots. Most economical gains were produced by the lambs fed shelled corn, while those

fed rough rice produced their gains the least economically of the three lots.

The selling price, slaughter and grading data taken at the close of the test indicate that there was little difference in the finish of the three lots of lambs. The lambs fed on shelled corn looked to be slightly fatter than either of the other lots. They yielded 50.3% hot dressed weight and their carcasses graded 2 "Choice," 9 "Good," and 1 "Heavy" lamb. Lambs fed on a mixture of equal parts of rough rice and shelled corn yielded 49.6% hot dressed weight and their carcasses graded 5 "Choice," 4 "Good," 2 "Medium," and 1 "Heavy." The third lot of lambs fed on rough rice yielded 49.3% hot dressed weight and their carcasses graded 3 "Choice," 6 "Good," and 3 "Medium."

Summary

(1) Rough rice fed whole was a highly palatable feed for lambs.

(2) A ration of 20 parts shelled corn, 1 part cottonseed cake, with a basal ration of alfalfa hay, produced 27.50% more rapid gain than a ration of 10 parts rough rice and 1 part cottonseed cake, and 4.05% more rapid gains than a ration of 10 parts each of rough rice and shelled corn with 1.5 parts cottonseed cake.

(3) Lambs fed rough rice consumed slightly more concentrates per head daily than was consumed by lambs fed on equal parts of rough rice and shelled corn or shelled corn alone. The largest daily consumption of roughage occurred in the lot fed shelled corn with the smallest amount of roughage being consumed by the lot fed on rough rice.

(4) Lambs fed ground rough rice required 42.30% more concentrates and 19.60% more hay for the production of a unit of gain than was required by lambs fed on shelled corn. Where rough rice was substituted for one-half the grain ration 14.27% more concentrate and 2.54% more hay was required for the production of a unit of gain than was required by similar lambs fed on shelled corn.

(5) Shelled corn produced slightly more finish on lambs, but all lots of lambs sold for the same price per cwt.

(6) Lambs fed on shelled corn yielded a slightly higher percentage of carcass weight than lambs fed on a mixture of rough rice and shelled corn or rough rice alone.

(7) Lambs fed on shelled corn graded slightly higher in the carcass than those fed on equal parts of shelled corn and rough rice or those fed on rough rice.

(8) If it is assumed that each pound of cottonseed cake used to balance the ration is equivalent to or will replace 2 pounds of cereal in the production of a unit of gain, whole rough rice was worth 64.86% as much pound for pound as corn when used to replace all the corn in the ration and 70.66% when used to make up one-half of the grain ration fed.

RICE VERSUS CORN IN RATIONS FOR FATTENING HOGS

Investigations were made to (1) determine the relative value of rough rice and corn in rations for fattening swine; and (2) To study cooking and grinding as methods of preparing rough rice for swine feeding.

Rations Fed.—All lots were self fed cereal and mixed supplement, free choice, in dry lot. The protein supplement was the same for all lots and consisted of tankage 3 parts, linseed oil meal 1 part, and alfalfa meal 1 part, by weight. All lots were self fed a simple mineral mixture (equal parts ground limestone, bone meal and salt) to insure an adequate supply of calcium, phosphorus, and salt. The cereal fed the various lots was as follows: Lot I shelled corn; Lot II ground corn and ground rough rice, equal parts; Lot III ground rough rice; Lot IV ground rough rice; and Lot V cooked rough rice.

Animals Used.—The 30 hogs fed in Lots I, II, and III were thrifty, good grade Hampshires purchased locally and averaged approximately 90 pounds in weight at the beginning of the trial. The hogs used in Lots IV and V were raised in the College herd. In each of these lots (IV and V) there were 2 crossbred Duroc-Polands and 4 purebred Durocs. They were fall farrowed and averaged approximately 60 pounds in weight at the beginning of the experiment. Lots I, II, and III were used to compare the relative value of corn and rice (Object 1) while Lots IV and V were used to study methods of preparing rice for feeding (Object 2).

Quarters.—All lots were fed at the University swine barn, the floor of which is concrete. Each feeding pen in the barn connects with a small concrete paved lot outside of barn to which the pigs also had access.

The results secured are tabulated in Table 3.

The hogs fed corn (Lot I) made more rapid gains, 2.10 pounds daily per head, compared with a gain of 1.83 pounds made by the hogs fed ground rough rice (Lot III), while the hogs fed corn and rice, equal parts, ranked in between with an average daily gain of 2.01 pounds per head. These three lots ranked in the same order

as to amount of feed consumed per 100 pounds gain, requiring 352, 386, and 415 pounds respectively. Less protein supplement was consumed per unit of gain by the hogs fed corn, namely 1 pound of supplement for each 9.59 pounds of corn as compared with 1 pound of supplement for each 5.94 pounds of rice. Again the lot fed corn and rice, equal parts, ranked between the other two lots in proportions of supplement to cereal consumed, although there was not much difference in this respect between the lots fed corn and rice and the lot fed corn.

TABLE 3.—RICE VS. CORN IN RATIONS FOR FATTENING SWINE
DECEMBER 23 TO FEBRUARY 24—63 DAYS

Lot Number	I	II	III	IV	V
Number Hogs	10	10	10	6	6
Ration	Corn Protein Supple- ment	Corn 1 Rice 1 Protein Supple- ment	Rice Protein Supple- ment	Rice Protein Supple- ment	Rice Protein Supple- ment
Avg. initial wt. (lbs.)-----	89.50	90.03	88.83	58.83	59.66
Avg. final wt. (lbs.)-----	221.6	216.6	204.3	160.56	134.33
Avg. daily gain per head (lbs.)-----	2.10	2.01	1.83	1.61	1.18
Avg. daily feed per head (lbs.)-----	7.40	7.75	7.62	5.99	5.22
Feeds per 100lbs.gain (lbs.)					
Cereal-----	319.37	353.17	355.84	305.33	360.27
Supplement-----	33.29	33.42	59.91	65.62	80.47
Total-----	352.66	386.59	415.75	370.95	440.74

Comparing Lot IV fed ground rough rice with Lot V fed whole rough rice cooked it is seen that grinding proved to be the best method of preparation as measured by both rate and economy of gains—Lot IV gaining 1.6 pounds per head daily and requiring 370 pounds of feed per 100 pounds gain while Lot V gained 1.18 pounds per head daily and consumed 440 pounds of feed per 100 pounds gain. There was little difference in the proportion of supplement to cereal consumed by these lots—1 pound of the protein mixture being eaten with a little less than 5 pounds of rice in each case.

Summary

1. When ground rough rice was used as a complete substitute for corn, hogs fed rice (Lot III) required 18% more feed per unit gain than similar hogs fed corn (Lot I).

2. Seventy-five per cent more protein supplement was used for each 100 pounds gain when rice was fed than when corn was the carbonaceous concentrate used.

3. Approximately 10% more feed was required for each 100 pounds gain when the cereal was rice and corn equal parts (Lot II) than when it was corn (Lot I).

4. There was not such difference in the proportion of supplement to cereal consumed whether the carbonaceous concentrate was corn or a mixture of corn and rice equal parts.

5. Hogs fed corn and a protein supplement gained 15% faster than those fed rice and a protein supplement.

6. Hogs fed corn and a nitrogenous concentrate gained 5% more rapidly than similar hogs fed a ration of corn and rice equal parts supplemented with nitrogenous concentrate.

7. Hogs fed cooked rough rice required 18% more feed per 100 pounds gain than when the rice was fed ground.

8. When ground rice was fed, hogs gained 36% more rapidly than when the whole rough rice was cooked before feeding.

9. The method of preparation had no effect upon the amount of protein supplement consumed per unit of rough rice fed.

10. If it is assumed that each pound of protein supplement fed will replace or save 3 pounds of cereal, then ground rough rice was worth 73% as much pound for pound as corn when used as a complete substitute for corn and 82% as much when used to make up one-half of the carbonaceous concentrate fed.

CONCLUSIONS

These experiments with fattening cattle, sheep and swine indicate that rough rice may, if price permits, be used as a substitute for corn in finishing any kind of livestock.

The rice used proved to be palatable in all cases.

While the gains made when rough rice was fed were less rapid than when corn was used, this disadvantage could be overcome by lengthening the feeding period.

Rough rice gave best results when ground before feeding cattle and swine.

Nearly twice as much protein supplement (such as cottonseed meal) is needed to balance the ration when rice is substituted for corn in the fattening ration.

Rough rice produced satisfactory beef, pork, and lamb carcasses as indicated by the "grade" of the finished animals.

In general, ground rough rice was approximately 70% as valuable pound for pound as corn when each was properly supplemented and the rice was used as a complete substitute for corn. The relative value of the rice was increased to 75 to 80% when it was used as a partial substitute for corn.

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