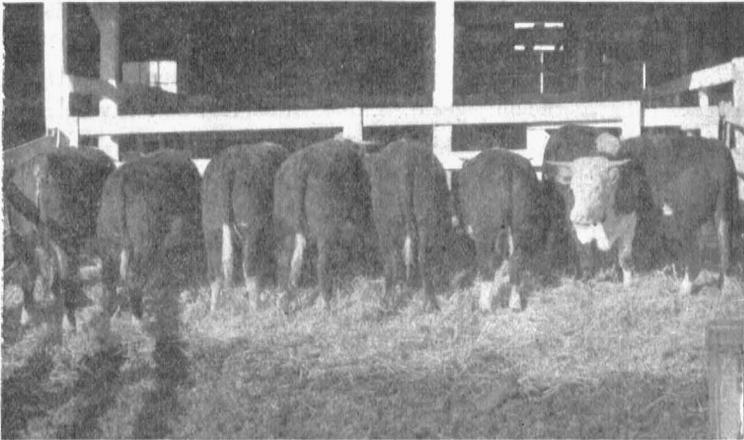


UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
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Wheat as a Cattle Feed

E. A. TROWBRIDGE and H. C. MOFFETT



These cattle were finished on equal parts of shelled corn and ground wheat.

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SUMMARY

1. Wheat can be used as a complete or partial substitute for corn or other cereals for fattening cattle.
2. Its value varies, to a considerable extent, with its preparation and the proportion used in the ration.
3. Coarsely ground wheat has greatest value—such preparation improves its value approximately 10 per cent.
4. If whole wheat is fed, cattle make less gains per bushel, but the gain on hogs following them is greater than when wheat is fed ground.
5. Ground wheat usually gives best results when composing not more than half the grain mixture fed fattening cattle. When so fed, wheat is worth 5% to 15% more than corn or other cereals.
6. Ground wheat fed to fattening cattle, as a complete substitute for corn or other grain, usually produces gain for about 10% less feed, but the cattle frequently lack finish and sell for less than corn fed cattle.
7. Cattle tend to eat less ground wheat than corn or other cereal when each is fed as the only grain. This is much less true of whole wheat or grain mixtures containing as much as 50% wheat.
8. Wheat fed as the only grain to fattening cattle usually produces less rapid gains than a mixture of wheat and corn or other cereals and frequently less than corn alone. This may be explained by the smaller consumption of ground wheat or by failure to digest completely the whole grain.
9. Wheat fed as the only grain or as a part of a grain mixture, to fattening cattle, tends to reduce the grain required per pound gain. If whole wheat is fed much passes undigested and the feed required per unit of combined beef and pork produced is higher than where either shelled corn or ground wheat is fed.
10. Cattle fed wheat should be put on feed slowly since digestive disturbances such as bloat and scouring frequently follow its extensive use in a cattle fattening ration. Unsatisfactory results in getting and keeping cattle on feed are less likely to follow if some other grain is mixed with the wheat during the early part of the feeding period. Feeding silage and a variety of other roughness seems to lessen the difficulties.

Wheat as a Cattle Feed

E. A. TROWBRIDGE and H. C. MOFFETT

Abstract.—Wheat was used as a complete and partial substitute for corn in fattening cattle rations. Cattle consumed slightly larger quantities of whole wheat than of shelled corn, but gains were not as rapid and, therefore, less economical. Grinding wheat coarsely as a feed for fattening cattle increased the value of this grain approximately 10 per cent. Ground wheat substituted for as much as half the full ration of shelled corn fed fattening cattle produced slightly more rapid and economical gains and fully as highly finished carcasses. When ground wheat was substituted for all the corn, cattle consumed less grain, gained less rapidly, produced carcasses of less finish, but the gain was more economical. Bloating, scouring, and other digestive disturbances occurred more frequently when wheat constituted the sole grain ration.

The price relationship between wheat and corn occasionally warrants the consideration of wheat in cattle fattening rations. In the summer and fall of 1930 wheat sold for less per bushel than corn. Since wheat had not been used extensively in cattle rations, little information was available as to its use. It is known to contain somewhat more protein and less fat than corn but about the same total digestible nutrients. The small hard kernels of the grain suggested grinding to increase its feeding value.

The Missouri Agricultural Experiment Station conducted two feeding experiments to determine the possibilities of feeding wheat to fattening cattle: the first, August 12 to November 20, 1930; the second, February 21 to June 12, 1931. The experiments are discussed separately.

FIRST EXPERIMENT

Objects and Plan.—The first experiment compared the feeding value of shelled corn with that of wheat (1) when wheat is ground and fed with shelled corn and cottonseed cake, (2) when wheat is ground and fed with cottonseed cake, and (3) when wheat is fed whole with cottonseed cake. Four lots of cattle were fed as follows:

- Lot I Corn 10 parts, cottonseed cake 1 part
 - Lot II Corn 5 parts, ground wheat 5 parts, cottonseed cake 1 part
 - Lot III Ground wheat 10 parts, cottonseed cake 1 part
 - Lot IV Whole wheat 10 parts, cottonseed cake 1 part
- All lots received alfalfa hay as roughage.

Cattle and Equipment.—The cattle used were grade Hereford yearling steers of good quality and in strong feeder flesh, purchased on the Kansas City market on August 5. They were shipped by rail to the Columbia stock yards from which they were trucked to the University feedlots.

The work was done at the University experimental feeding plant which consists of a series of lots each 100 feet long and 19 feet wide with an open shed 20 feet deep along the north side. Feed troughs were under the shed and water tanks in lots.

Feeds Used.—The corn was No. 2 mixed, mostly yellow, purchased from the market in car load lots. The wheat was semi-hard purchased from a local mill, and hauled to the feeding lots as needed. The alfalfa hay was "No. 2 leafy" purchased on the Kansas City market just before the test started.

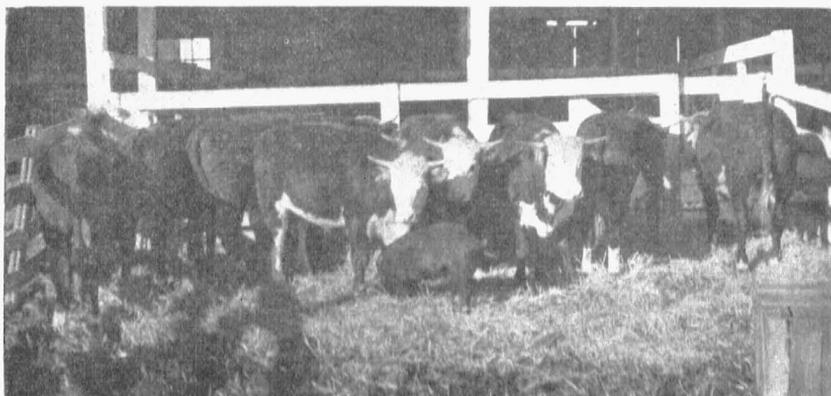


Fig. 2.—Type of Cattle Used in the First Experiment.

Methods of Feeding and Weighing, and Conditions of Experiment.—The cattle were fed mixed hay and a small allowance of oats until August 12 when they were divided and started on the experimental rations. Individual weights were taken on three consecutive mornings at the beginning and close of the test and averages were used as the initial and final weights. The cattle were fed twice daily. After they were started on feed they were given all the grain and hay they would clean up. The grain was fed first and the hay approximately an hour later. Water was before them at all times. Very warm weather and flies annoyed the cattle a great deal during the early days of the experiment; however, nearly ideal feeding conditions obtained during the last half of the period.

Pork Credit.—A sufficient number of pigs was placed with each lot to utilize the feed which passed through the cattle undigested or which was dropped from the feed troughs. No feed was given the pigs other than that picked up after the cattle.

Average Daily Feed Consumed.—All lots of cattle were started on 4 pounds of grain per head daily. The allowance was increased until the cattle were consuming approximately 10 pounds per head daily at the end of the second week. During the third week of feeding, the lot receiving ground wheat began to show signs of being on a full feed; therefore, the grain fed this lot was not increased. During the fourth week of the experiment these cattle went “off feed”, and, from this time on, considerable trouble was experienced in keeping them on a full feed of grain. Up to the fourth week, the wheat fed was finely ground, but thereafter more coarsely ground wheat was used. This was apparently a slight improvement. At no time did these cattle consume more than 13½ pounds of grain daily.

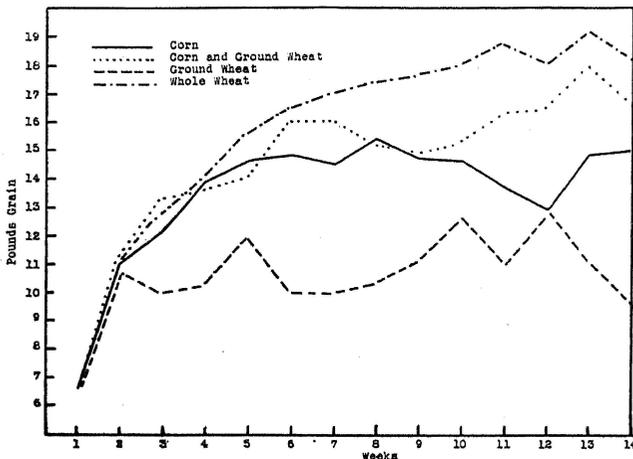


Fig. 3.—Average Grain Ration Consumed, by Weeks, in First Experiment.

The other three lots of cattle continued to steadily increase their daily grain consumption for the remainder of the test. At the close, the cattle eating shelled corn and cottonseed cake were getting 14.93 pounds per head daily, while those eating ground wheat and shelled corn with cottonseed cake were consuming 16.50 pounds of grain per head daily, and the cattle getting whole wheat with cottonseed cake were consuming 18.62 pounds per head daily.

The average daily hay consumption per head decreased from approximately 5.5 pounds per head daily during the first 28 day period to 4 pounds daily during the latter part of the test. An effort was made to maintain all lots on approximately the same hay allowance.

Average Daily Gains.—While the efficacy of the rations varied, relatively consistent gains were made by the cattle. Variations in gains

by 28-day periods, due to weather, feed consumption, etc., occurred to about the same extent as in usual feeding operations. The largest daily gain, 2.57 per head, was made by the cattle eating 5 parts corn, 5 parts ground wheat, and 1 part cottonseed meal. Where corn was fed as the grain, the daily gain was 2.38 pounds. Both these lots showed greater daily gain than the cattle eating wheat as the only grain. Where whole wheat was fed, the daily gain of 2.16 pounds was made while the cattle getting ground wheat gained 1.84 pounds daily.

TABLE 1.—WHEAT FOR FATTENING YEARLING STEERS
August 12 to November 20, 1930 (100 Days)

Lot	I Corn 10 C. S. C. 1 Alfalfa Hay	II _o Corn 5 Gr. Wheat 5 C. S. C. 1 Alfalfa Hay	III Gr. Wheat 10 C. S. C. 1 Alfalfa Hay	IV Wh. Wheat 10 C. S. C. 1 Alfalfa Hay
Initial weight August 12.....	555.9	556.7	553.7	561.7
Final weight November 20.....	793.7	813.9	737.3	777.8
Total gain.....	237.8	257.2	183.6	216.1
Average daily gain.....	2.38	2.57	1.84	2.16
Market weight.....	775.7*	790.0	721.3	772.9*
Average daily ration				
Corn.....	12.30	6.60		
Wheat.....		6.60	9.61	14.44
Cottonseed cake.....	1.23	1.32	.96	1.44
Alfalfa hay.....	4.83	5.08	4.91	5.18
Feed consumed per 100 pounds gain				
Corn.....	517.10	256.54		
Wheat.....		256.54	523.18	668.14
Cottonseed cake.....	51.7	51.31	52.32	66.81
Alfalfa hay.....	203.11	197.51	267.43	239.82
Feed cost per 100 lbs. gain (ex. pork).....	\$11.53	\$11.34	\$12.16	\$13.96
Initial cost per cwt. into expt.....	\$7.96	\$7.96	\$7.96	\$7.96
Steer cost per head into experiment.....	\$44.25	\$44.31	\$44.07	\$44.71
Total feed cost (100 days).....	\$27.42	\$29.17	\$22.33	\$30.16
Pork credit per steer (lbs.).....	15.7	13.9	4.7	45.5
Pork credit per steer at \$9.00.....	\$1.41	\$1.25	\$0.42	\$4.09
Net steer and feed cost.....	\$70.26	\$72.23	\$65.98	\$70.78
Selling price at St. Louis, Nov. 24.....	\$12.00	\$12.00	\$10.50	\$11.25
Dressing percentage (Hot weights).....	59.20	59.65	56.86	57.71
Grading data				
Feeder Cattle.....	81.17	80.27	81.67	80.35
Slaughter Cattle.....	Choice—	Choice—	Choice—	Choice—
	79.39	80.26	77.16	80.00
	Good+	Choice—	Good+	Good+
Carcasses.....	75.61	75.14	72.66	73.01
	Good	Good	Good—	Good—

Feed Prices: Corn 90c per bu.; whole wheat 90c per bu.; ground wheat 95c per bu.; 43% pea sized cottonseed cake \$46.00 per ton; Alfalfa hay \$20.00.

*Average of 7 steers. One average steer was taken from Lots I and IV to be used in an exhibit at the International Live Stock Exposition.

Feed Consumed per 100 Pounds Gain.—The feed required to produce gain is shown in Table 1. The cattle eating whole wheat required about 25 per cent more grain per hundred pounds beef produced than the other three lots, where approximately 520 pounds grain plus cottonseed cake were required. The increased pork production behind the cattle eating whole wheat indicates that a considerable amount of the whole grain was not digested by the cattle but did produce pork.

The feed requirement per unit of grain increased in all lots as the fattening period advanced. In the most efficient lots it required less than 500 pounds of concentrates to produce 100 pounds gain during the

first month, while during the last month the concentrate requirement was more than double that amount.

The hay required per unit of gain decreased slightly as the fattening period progressed, but to a much less extent than the increase in grain consumption.

Results.—At the close of the experiment the cattle were graded, tagged with individual ear tags, and turned together for a day preparatory to shipment. They were driven to the stock yards and allowed to rest approximately 3 hours before being loaded. Upon arrival at the market they were watered, divided into lots, fed, and offered for sale in the same manner as commercial cattle. When sold, they were weighed and slaughtered by lots and individual dressed weights obtained. The carcasses were ribbed and graded the following day.

The selling price is the buyer's estimate of the fatness and dressing percentage of the cattle, and the quality of meat they will yield. The lots which were fed shelled corn and equal parts of shelled corn with ground wheat sold for \$12.00 per hundredweight, although the lot fed the mixture appeared to be fatter and to show more bloom. The lot fed whole wheat was not so fat and sold for \$11.25 per hundredweight. The lot fed ground wheat was decidedly lacking in finish and general condition as compared with other lots and, therefore, sold \$1.50 per hundredweight lower than the two best lots.

The dressed beef yields of the various lots corresponded to the selling prices. These together with the data for the thin and finished cattle and the carcasses appear in Table 1. Little difference was observed among the various lots at the beginning. At the close the slaughter grades of cattle fed ground wheat were lower than the other lots. Those fed whole wheat and cottonseed meal appeared fatter on foot than the cattle which had been fed ground wheat, but the carcasses of both lots fed wheat and cottonseed meal showed less finish and somewhat darker color than the cattle getting corn in the ration.

SECOND EXPERIMENT

Better results were obtained at this and other experiment stations where wheat was fed in combination with corn than where it was fed as the sole substitute for corn. The opinion has been held that wheat fed to cattle exclusively or in large quantities may form a heavy mass in the animal's stomach and cause some digestive trouble. Since a combination of corn and wheat with a protein supplement gave better results in the previous experiment than either corn or wheat fed with a protein supplement, a combination of wheat with feeds such as oats or corn silage seemed to offer possibilities, and the second experiment was planned to cover these possibilities.

Objects and Plan.—The second experiment compared the feeding value of shelled corn with wheat (1) when wheat is ground and fed as the sole concentrate with cottonseed cake, (2) when ground wheat is fed in combination with ground oats, and (3) when ground wheat is fed with corn silage. Four lots of cattle were fed as follows:

- Lot I Shelled corn 10 parts, cottonseed cake 1 part
- Lot II Ground wheat 20 parts, cottonseed cake 1 part
- Lot III Ground wheat 9 parts, ground oats 3 parts, cottonseed cake 1 part
- Lot IV Ground wheat 20 parts, cottonseed cake 1 part, with corn silage.
(Wheat was fed on the silage).

All lots received clover hay. The amount of cottonseed cake fed was varied to supply approximately the same amount of protein in each ration.



Fig. 4.—Type of Cattle Used in the Second Experiment.

Cattle and Equipment.—The cattle used were “Medium” to “Good” grade yearling steers of mixed breeding. They were purchased on the Kansas City market February 4, 1931, and shipped by rail to the Columbia stock yards from which they were trucked to the University feeding plant. A few days after they arrived they were vaccinated for blackleg and hemorrhagic septicemia. Horns were removed after the cattle were started on feed.

Feeds Used.—The corn, wheat, and cottonseed cake were of the same grade and quality as used in the first trial. The clover hay was slightly stemmy but of good quality. The silage was made from good corn, which would yield about 40 bushels per acre, grown on the University farm.

Methods of Feeding and Weighing and Conditions of Experiment.

—The cattle were fed what clover hay they would clean up well, from February 5 to February 20. Grading, weighing, dividing the cattle, and general procedure were conducted as in the first trial.

Weather conditions were generally good. Spring rains made the lots muddy but the cattle were fed in the shed and had access to shelter and dry beds at all times.

Pork Credit.—Pigs were used to utilize the waste feed, but the muddy condition of the lots, particularly during the early part of the test, was not conducive to exceptional pork gains.

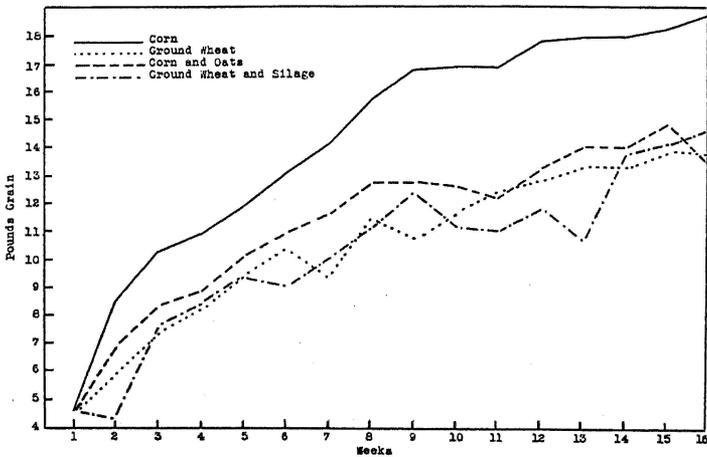


Fig. 5.—Average Grain Ration Consumed, by Weeks, in Second Experiment.

Average Daily Feed Consumed.—All lots were started on 3 pounds of grain and 4 pounds of hay per head per day. Where corn silage was fed, 4.5 pounds per head were given daily. The grain allowance was increased according to the appetites of the cattle until at the end of the second week the lot fed shelled corn was eating 10 pounds per head daily, the lot fed ground wheat was eating 7 pounds grain per head daily, the lot fed wheat and oats were eating 8 pounds per head daily, and those fed ground wheat with silage were eating 7 pounds per head daily. Considerable care was taken throughout to keep all lots on feed but those lots fed wheat scoured more than the others and showed less appetite than the lot fed shelled corn. All lots increased their daily grain consumption until the end of the experiment. During the last 28 day period the average daily grain consumption for the lot fed shelled corn was 18.29 pounds, the lot fed ground wheat consumed 13.53 pounds per head daily,

the lot fed wheat with oats consumed 14.05 pounds per head daily, and those fed ground wheat with corn silage consumed 13.73 pounds per head daily.

The roughage consumption of all lots increased somewhat during the first month the cattle were on feed, then tended to remain fairly constant for the remainder of the test.

TABLE 2.—WHEAT FOR FATTENING YEARLING CATTLE
February 20 to June 12, 1931 (112 Days)

Lot Number	I	II	III	IV
	Corn 10 C. S. C. 1 Clover Hay	Gr. Wheat 20 C. S. C. 1 Clover Hay	Gr. Wheat 9 Gr. Oats 3 C. S. C. 1 Clover Hay	Gr. Wheat 20 C. S. C. 1 Corn Silage Clover Hay
Ration Fed				
Initial weight	513.9	508.8	513.	515.4
Final weight	796.6	743.2	752.4	762.6
Total gain	282.7	234.5	239.4	247.2
Average daily gain	2.53	2.09	2.14	2.21
Market weight	780.	721.	738.	734.
Average daily ration				
Grain	13.11	9.94	10.42	9.82
Cottonseed cake	1.31	.50	.87	.49
Corn silage				3.58
Clover hay	5.86	5.81	5.81	3.72
Feeds consumed per 100 lbs. gain				
Grain	519.50	474.76	487.32	444.98
Cottonseed cake	51.95	23.76	40.61	22.25
Corn silage				162.22
Clover hay	231.94	277.61	271.93	168.69
Feed cost per 100 lbs. gain (exc. pork)	\$9.16	\$9.30	\$9.47	\$8.30
Initial cost per 100 lbs. into expt.	\$7.98	\$7.98	\$7.98	\$7.98
Steer cost per head into expt.	\$40.01	\$40.60	\$40.94	\$41.13
Total feed cost 112 days	\$25.89	\$21.81	\$22.66	\$20.52
Pork credit per steer lbs.	36.	11.1	6.	7.7
Pork credit per steer at \$6.00	\$2.16	\$0.66	\$0.36	\$0.46
Net steer and feed cost	\$64.74	\$61.75	\$63.24	\$61.19
Selling price, St. Louis	\$7.65	\$6.35	\$6.25	\$6.60
Dressing percentage (Hot weights)	57.44	56.60	55.60	56.42
Grading data				
Feeder cattle	75.46	75.33	73.39	76.16
	Good	Good	Good—	Good
Slaughter cattle	71.79	66.57	69.84	68.76
	Good—	Medium	Medium+	Medium+
Carcasses	72.45	66.13	68.57	66.94
	Good—	Medium	Medium+	Medium

Feed prices used: Shelled corn 65c; ground wheat 80c; ground oats 35c; 43% protein cottonseed cake \$40.00; corn silage \$5.00; clover hay \$18.00.

Average Daily Gain.—More rapid gains were made by cattle eating shelled corn with cottonseed cake and clover than in the other three lots where wheat was the main part of the ration. The cattle eating the shelled corn ration fed well and gained consistently during the entire feeding period. There was relatively little difference in the rate of gain produced by the rations containing wheat, although slightly more rapid gains occurred where ground wheat was fed on the corn silage. The substitution of ground oats for one-fourth of the ground wheat increased the rate of gain by only .05 pounds daily.

Feeds Consumed per 100 Pounds Gain.—All lots of cattle produced economical gains. Those lots fed wheat made more economical gains than the lot fed shelled corn although the rate of gain was less. The lot

fed ground wheat with cottonseed cake and corn silage gained slightly more economically than the others. The economy of gain varied considerably by periods and lots. The feed requirement per unit of gain increased as the fattening period progressed. Approximately 30% more concentrates were required to produce 100 pounds gain during the last half of the fattening period than were required the first half. The amount of hay required per unit of gain decreased as the fattening period progressed.

Results.—At the close of the experiment the cattle were graded, tagged, shipped to market where they were sold and slaughtered and their carcasses graded after being in the coolers approximately 24 hours. The lot fed on shelled corn with cottonseed cake and clover hay was not sold to the same packing company that purchased the other three lots, and this fact may account for a small part of the variation in price and dressing percentage. The same committee secured all the grading data. The lot fed shelled corn sold for \$7.65 per hundredweight to a small packing company in St. Louis. The other three lots appeared to have about the same degree of finish and sold for nearly the same price. Those fed ground wheat and cottonseed cake sold for \$6.35 per hundredweight, those fed ground wheat with ground oats and cottonseed cake sold for \$6.25 per hundredweight, and those fed ground wheat on corn silage sold for \$6.60 per hundredweight.

In general, the dressing percentages and grading data are in accord with the selling prices.

OTHER WORK ON FEEDING WHEAT TO CATTLE

Coburn^{7*} in 1894 concluded from replies to a questionnaire that wheat had a high value as a part of the grain ration for fattening cattle. In 1895 French¹⁹ fed wheat to cattle but got better results when oats and bran were mixed with it. In the same year Thorne²⁵ and Hickman¹⁵ secured less rapid but more economical gains when ground wheat was fed with wheat bran, gluten meal, clover hay and corn silage, than when corn was fed with these feeds. Similar results were obtained when linseed meal replaced gluten meal.

Burnett and Smith⁵ in 1901 found wheat had 5% greater feeding value than corn when each constituted 70 or 80% of the grain ration for yearling cattle on full feed. It produced greater and generally more economical gains. Less scouring and other digestive troubles occurred when the roughness fed with the wheat included alfalfa and prairie hay and wheat straw rather than alfalfa hay alone.

*Numerals refer to list of literature cited, page 18.

In 1903 and 1904 Linfield^{17, 18} fed big steers ground wheat; ground oats; ground barley; equal parts of ground wheat, oats and barley, each with clover hay as roughage. The steers fed wheat gained as rapidly and economically as those fed oats or barley. However, they seemed to tire of the ration as the feeding period progressed. The mixture was more satisfactory than either grain fed alone.

Haney and Elling¹² reported in 1904 that calves full fed ground wheat and alfalfa hay for 182 days in dry lot made 12% smaller but decidedly more economical gains than similar calves fed corn and cob meal and alfalfa hay until the last three weeks when cracked corn was substituted for corn and cob meal. The same investigators¹³ confirmed these results in 1906 with larger cattle.

Shepperd and Richards²² in 1906 found that two-year-old steers fed damaged wheat with a basal ration of bran and low quality hay gained less and required approximately twice as much grain per unit gain as similar steers fed corn meal with the basal ration. The cattle fed wheat and bran did not eat well and showed signs of digestive disturbances.

In 1924 Blizzard² reported 10.8% greater gain and about 10% greater economy when ground wheat was fed to calves instead of corn with cottonseed meal, sorghum silage and alfalfa hay. The wheat-fed calves ate less but sold at the same price.

The relatively low price of wheat which developed in the fall of 1930 stimulated considerable investigation of its feeding value.

In 1931 Blizzard³ found that ground shelled corn produced faster gains than ground wheat when each was fed with a protein supplement, prairie hay and ground limestone. Cattle fed ground wheat ate less grain but required from 12 to 15% less concentrates per unit gain. In 1932 the same investigator⁴ found that calves fed ground wheat and cottonseed meal with alfalfa hay bloated badly and therefore were changed to a ration of one-half ground shelled corn and one-half ground wheat with cottonseed meal and alfalfa hay.

Thalman and Gramlich^{23, 24} reported in 1930 and 1931 that slightly more rapid and economical gains followed the replacing of one-fourth to one-half the shelled corn with cracked wheat in a ration of corn and alfalfa hay. Where wheat constituted as much as three-fourths of the grain ration, the cattle ate less and were kept on feed with difficulty but carcasses were well finished.

Baker¹ found that calves gained more economically but less rapidly when fed ground wheat and alfalfa hay than when the grain was shelled corn or equal parts shelled corn and ground wheat. Differences resulting from the use of shelled corn and the grain mixture were slight but calves

fed the mixture sold 15c higher, dressed 0.7% higher and graded slightly higher in the carcass than those fed wheat only as the grain.

Vinke and Pearson²⁶ report that frosted or low protein wheat, not too old or hard, gave better results than barley when fed with alfalfa hay. Several trials indicated that a ration of wheat and alfalfa hay was 10 to 15% more efficient than a ration of barley and alfalfa hay. They report considerable trouble from bloat where barley or wheat was fed and suggest cattle be given a preliminary feeding period on oats or a limited amount of wheat or barley.

Dickson and Bergstedt³ fed cattle wheat in varying quantities with alfalfa hay with satisfactory results. Dickson and Vinke⁹ reported in 1932 slightly better results from feeding equal parts wheat and barley with cottonseed cake and alfalfa hay than where wheat was fed alone with alfalfa or with cottonseed cake or molasses and alfalfa hay.

Christensen⁶ found one-fourth ground wheat and three-fourths barley about equal to barley alone when fed with a basal ration of corn silage, alfalfa hay and linseed meal. Both of these rations proved more satisfactory than equal parts wheat and barley which caused scouring and decreased grain consumption.

Hickman¹⁵ compared a ration of wheat and alfalfa hay with a ration of barley and alfalfa hay. Yearling cattle receiving ground wheat and alfalfa hay made slightly larger and more economical gains than similar cattle fed barley, requiring 78 pounds less wheat and 28 pounds more alfalfa hay to produce 100 pounds gain. Substituting oats for 25% of the wheat produced essentially the same rate of gain but the gain was slightly more economical. Cattle fed on wheat showed signs of digestive disturbances during the feeding test.

Morton and Osland¹⁹ found that calves fed equal parts ground corn and cracked wheat with a basal ration of cottonseed cake, wet beet pulp, alfalfa hay, mineral and salt gained approximately 10% more rapidly and economically than similar calves fed either ground wheat, ground barley or ground corn and barley. Calves fed ground wheat took to their feed slowly, sold for less per cwt. but dressed as well as the other lots.

Potter and co-workers²⁰ got satisfactory gains on beef calves when feeding wheat, barley, or corn as the only grain ration with alfalfa hay and silage. The wheat produced slightly greater economy and rapidity of gain although the calves were not fed heavily.

Rusk and Snapp²¹ fed two-year-old cattle equal parts ground wheat, shelled corn and ground oats with a basal feed of clover hay and cottonseed meal for 94 days. This ration produced more rapid and economical gains than equal parts shelled corn and ground wheat which gave about the same results as a ration of one-half ground wheat, one-half ground

oats, but this ration was more satisfactory than shelled corn. Grinding wheat proved more satisfactory than rolling when equal parts wheat and oats were fed. Market data show that cattle fed shelled corn dressed slightly higher but sold for considerably less than cattle fed wheat.

King¹⁸ fed steers shelled corn; equal parts ground wheat and shelled corn; and equal parts ground wheat and ground oats, with a basal ration of cottonseed meal, corn silage and clover hay. Cattle fed mixtures of ground wheat with either ground oats or ground corn gained more rapidly and slightly more economically and sold higher than cattle fed shelled corn as the grain ration. Little difference in economy appeared.

Wright, Christgau and Peters²³ found that calves fed ground wheat gained more rapidly and more economically and sold higher than those fed ground barley or equal parts ground wheat and ground barley with a basal ration of linseed meal and sweet clover hay. Those fed equal parts ground wheat and ground oats gained more rapidly but less economically and sold for 15c per hundredweight less than those fed ground wheat.

Good and Harris¹¹ found that yearling cattle fed cracked wheat with a basal ration of cottonseed meal, corn silage, oat straw, ground limestone and salt gained approximately 12% more rapidly and economically than those fed shelled corn with the basal ration. At the close of the test the wheat-fed steers were better finished than those fattened on corn and therefore yielded one-half per cent more beef and sold 20c per cwt. higher.

Weber and Connell²⁷ fed yearling steers on rations of ground corn, ground wheat, and combinations of ground wheat and ground corn, with basal rations of cottonseed meal, silage and alfalfa hay. While the ground wheat ration was less palatable than the other rations, the cattle remained on feed and gained satisfactorily. A grain mixture consisting of one-third ground corn and two-thirds ground wheat was as palatable and produced practically the same rate and economy of gain as a mixture of two-thirds ground corn and one-third ground wheat and both rations produced more rapid and economical gains than the ration of ground corn. Similar steers were fed on rations of ground corn, ground wheat and combinations of ground wheat and ground corn with basal rations of cottonseed meal and alfalfa hay but with no silage. Grain rations consisting of ground wheat alone and combinations containing largest amounts of ground wheat produced most rapid and economical gains. Killing and carcass data show that wheat-fed steers dressed slightly lower and graded lower in the carcasses than either the steers fed on corn or mixtures of ground wheat and corn.

GENERAL FACTS ABOUT FEEDING WHEAT TO FATTENING CATTLE

Composition.—Wheat is essentially a fattening feed, a substitute for corn and not for high protein feeds such as cottonseed or linseed meal. This is because of the similarity of corn and wheat in composition and digestible nutrients. It carries slightly more starch and much less fat but only about 5% less total digestible carbohydrates and fat than corn. Since it carries 2% more digestible protein it requires slightly less legume hay, high protein meals, or other protein supplement to make a balanced feed. Because of this slightly higher protein and lower carbohydrate content of the wheat, it has a 1:7.7 nutritive ratio while corn has a nutritive ratio of 1:10.4, even though the two feeds are almost identical in total digestible nutrients. It contains only about one-fourth as much crude fiber as oats or barley.

PERCENTAGE COMPOSITION

	Water	Ash	Crude protein	Carbohydrates		Fat
				Fiber	N-free extract	
Corn No. 2.....	14.8	1.4	9.6	1.9	67.6	4.8
Wheat; all analyses...	10.2	1.9	12.4	2.2	71.2	2.1

DIGESTIBLE NUTRIENTS¹⁴

	Total dry matter in 100 lbs.	Digestible nutrients in 100 lbs.				Nutritive ratio	Fertilizing constituents in 1000 lbs.		
		Crude protein	Carbohydrates	Fat	Total		Nitrogen	Phosphoric acid	Potash
Corn No. 2.....	85.2	7.1	64.6	4.4	81.7	1:10.4	15.4	6.6	3.8
Wheat; all anal....	89.8	9.2	67.5	1.5	80.1	1: 7.7	19.8	8.6	5.3

Neither wheat nor corn can be relied on to supply the necessary minerals. Both are seriously deficient in calcium (lime mineral) and this element must be obtained from other sources. These cereals are also deficient in sodium and chlorine, but these elements are easily and cheaply supplied as common salt. Phosphorus is another mineral required in large amounts, and both corn and wheat carry a reasonable supply, though corn contains the least.

No cereal supplies all the vitamins that are required. Vitamin A is deficient in wheat and in white corn, but occurs in liberal amount in yellow corn. The most characteristic symptom of a severe deficiency is a disease of the eye, and of the respiratory tract, followed, of course, by death. In mild cases growth is unsatisfactory. These cereals are good sources of vitamin B. They do not contain vitamin C, but live stock does not require it. One of the most important vitamins is D, and no common feedstuff carries it in adequate amount. Sunlight is a satisfactory substitute, and if provided at reasonable intervals there will be

no difficulty due to a deficiency of vitamin D. A deficiency of this vitamin produces rickets, which can be recognized by the weakness and deformity of the bones. There are other vitamins, some of which are known to be present in both wheat and corn. Concerning the others, little useful information is available as yet, and their practical importance is unknown. It is necessary, however, to see that all the required vitamins are provided, and this can be done most certainly by supplying a good quality of forage. It is believed that green forage is most effective.

Spring wheat is slightly higher in protein and digestible nutrients than winter wheat. That climate influences the composition of wheat is shown by the fact that in the United States wheat grown on the Pacific coast carries about 2% less protein than that grown in the corn belt, which has 1% less than that grown in the northern plains area.

Preparation.—Wheat fed coarsely ground usually produces as great gains as where fed unground and less of it is required to produce a pound of gain. An appreciable portion of whole wheat passes through the cattle undigested and must be utilized by hogs. In such cases the total pork and steer gain is less than where the wheat is coarsely ground. It is suggested that finely ground wheat tends to form a heavy pasty mass in a steer's stomach and that this is the cause of their frequent scouring and the tendency to go "off feed". There is little or no evidence that cooking wheat would add to its feeding value. Hard, small kernels of unground grain may be softened by soaking but there would appear to be no advantage in so treating ground grain.

Palatability.—Cattle usually eat somewhat less of ground wheat than of corn or barley when each of these constitutes the only grain fed with a protein supplement and roughness, although occasionally this is not true. Mixing wheat with these or other good feeding grains frequently tends to increase grain consumption. Where wheat constitutes the only grain, even with a nitrogenous supplement and roughness, cattle tend to get to "full feed" slowly and frequently show tendencies to bloat and to go "off feed". Feeding silage as a part of the roughness on some occasions has seemed to lessen the difficulties from bloat and other digestive disorders. Cattle eat coarsely ground or cracked or whole wheat better than the grain finely ground. In some cases cattle eat wheat better after they have become accustomed to it and go through a feeding period with unabated appetite for this grain, while in others they show signs of tiring of it. This may be due to the quality of the grain. Like any other grain, the quality and freshness of wheat is an important factor in its palatability.

Rapidity of Gain.—The gain produced by feeding ground wheat with a protein supplement and legume hay is usually 5 to 15% less rapid than when shelled corn is fed in the same way but is equal to or

sometimes greater than that produced by ground barley so fed. Cattle usually eat less of wheat than of corn and barley has a high fibre (hull) content which facts may tend to explain these differences.

Ground wheat fed as one-fourth to one-half the grain ration with shelled corn, ground barley or oats, or mixtures of these with supplement and hay to balance the ration produces greater gain than any one of the grains fed alone. A 20% greater gain has been recorded, but this is exceptional. With wheat constituting as much as two-thirds of the grain ration occasionally greater gain is produced than by corn alone, but, as the proportion of wheat is increased beyond one-half, the difficulty of getting maximum gains seems to increase.

Economy of Gain.—Ground wheat fed with a protein supplement, legume hay and sometimes silage quite generally has produced greater gain from a given quantity of feed than has shelled corn fed in a similar ration. While the gain has usually been slower it has frequently been produced with 5 to 15% less feed per pound. Fed in the same manner ground barley has produced as much as 15% less gain per unit of feed than ground wheat.

The substitution of ground wheat for one-half or less of the corn or barley where either constitutes the grain ration usually produces a given gain with less feed. Occasionally the same result has occurred when wheat was substituted for two-thirds to three-fourths of the grain, but the greater economy appears less certain when the larger amounts of wheat are substituted. A mixture of one-third each, by weight, of ground wheat, shelled corn and oats has proven especially economical in feed requirements, in at least one experiment.

Cattle and Carcasses Produced.—The cattle produced by feeding ground wheat with legume hay and a protein supplement have usually sold for slightly less and yielded a lower percentage of dressed beef than similar cattle fed shelled corn in the place of the ground wheat, although occasionally wheat-fed steers sell for the same price and in one case they were considered to be 25c better than similar cattle fed ground corn. Cattle fed wheat as the concentrate part of the ration usually sell as well as or better than cattle fed barley as the concentrate.

Various grain mixtures containing wheat up to as much as one-half the total grain ration produced cattle which were usually fatter and, therefore, sold better than where any one of the grains were fed alone. In most cases those cattle fed a grain mixture dressed fully as high and yielded as desirable carcasses as where the grains were fed alone with roughage. The quality and grade of carcasses yielded by wheat-fed cattle seem to be dependent upon the degree of fatness and general quality and conformation of the animals.

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