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WHEAT AS A FATTENING FEED FOR CATTLE



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SUMMARY AND CONCLUSIONS

1. The results of previous investigations with wheat as a fattening feed for cattle are briefly summarized in this bulletin.

2. In addition, the results of an experiment conducted at the Kansas Agricultural Experiment Station during the winter of 1931-'32 are considered in detail. Eighty head of yearling steers were fed 180 days to get supplementary information regarding the value of coarsely ground wheat as a fattening feed. There were two series of four lots each. In Series I, ground wheat, ground shelled corn, and different mixtures of ground wheat and ground shelled corn were compared when fed in conjunction with atlas sorgo silage, cottonseed meal, and alfalfa hay. Series II differed from Series I in that no atlas sorgo silage was fed; otherwise, the comparisons were the same.

3. Ground wheat alone is less palatable than ground corn alone when fed with or without silage. Cattle will therefore eat less ground wheat than ground corn and, since both have about the same nutritive value, cattle of the same quality usually will not gain so rapidly when fed ground wheat as they will when fed ground corn.

4. A mixture of two-thirds wheat and one-third ground corn fed with or without silage is fully equal to ground corn alone. Such a mixture is more palatable than ground wheat alone and is more easily fed.

5. A mixture of one-third ground wheat and two-thirds ground corn fed with or without silage is also equal to ground corn.

6. The substitution of ground wheat for two-thirds of the ground corn resulted in carcasses similar in every respect to those from steers fed ground corn alone and superior in most respects to those from steers fed ground wheat alone.

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WHEAT AS A FATTENING FEED FOR CATTLE¹

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The problem of feeding wheat is not new. Considerable experimental work has been conducted to determine its value when fed to fattening cattle. These experiments have been spread out over a considerable period of time, with information being collected only during periods of low-priced wheat. As a consequence, rather complete information is available on some phases of the problem of feeding wheat to cattle and little or no data are available on other phases.

It was deemed advisable, therefore, to conduct at the Kansas Agricultural Experiment Station during the winter of 1931-'32, an experiment in which ground wheat and ground shelled Corn and mixtures of ground wheat and ground shelled corn were compared when fed to yearling steers. The results of that experiment are considered in detail in this bulletin. Furthermore, a number of experiments conducted at other agricultural experiment stations have been summarized in order to bring together in one publication the results and observations that have been of greatest importance in determining the value of wheat as a fattening feed for cattle.

FINDINGS OF PREVIOUS INVESTIGATORS

Coburn (4) in 1894 told Kansas farmers that with corn and wheat approximating the same price per bushel, it is neither unprofitable nor wicked to feed the wheat. His statement, however, was based upon the views of Kansas farmers as revealed in their replies to a questionnaire with reference to the value of wheat as hog feed. Numerous experiments since that time have demonstrated that ground wheat is fully equal to shelled corn for fattening hogs.

WHEAT VERSUS CORN

Experiments and experiences since 1894 have indicated rather consistently that corn should be rated somewhat higher than wheat when fed as the only grain to fattening steers. Proof for this statement may be found in Table I.

In seven of the eight experiments summarized in Table I the corn-fed lot made larger gains than the wheat-fed lot. Apparently the reason for these greater gains was that in each of these seven experiments corn was more palatable than wheat. However, the high nutritive value of wheat is indicated by the fact that in seven of the eight experiments, 1 pound of wheat produced more gain than 1 pound of corn.

In the Kentucky experiment wheat and corn were fed in equal amounts. This method of feeding, while not entirely practical, does, however, make it possible to determine whether the larger

1. Contribution No. 98 from the Department of Animal Husbandry.

TABLE I.—RESULTS OBTAINED WHERE WHEAT AND CORN WERE COMPARED AS FATTENING FEEDS FOR CATTLE.

AGRICULTURAL EXPERIMENT STATION.	Reference number.	Initial weight of steers.	Length or feeding period.	Average daily gain.		Average daily ration.	
				Corn.	Ground wheat.	Corn.	Ground wheat.
		<i>Pounds.</i>	<i>Days.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Nebraska.....	1	370	205	2.42	2.20	10.6	8.9
Oklahoma.....	2	400	184	2.20	2.01	9.6	7.1
Kansas.....	9	405	182	1.85	1.56	10.0	6.5
Missouri.....	18	510	112	2.53	2.11	13.1	9.9
Missouri.....	18	555	100	2.38	1.86	13.1	9.6
Kentucky.....	6	720	176	2.06	2.30	11.9	11.9
Kansas (a).....	8	850	152	2.22	1.77	13.1	9.5
Ohio (b).....	17	980	120	2.06	1.80	11.9	11.0

(a) Corn-and-cob meal.

(b) Both wheat and corn mixed with equal weight of bran.

gains obtained where both grains were fed according to appetite were due to the greater palatability of corn or to its higher nutritive value. The results indicate that wheat has a higher nutritive value than corn since steers gained almost 0.25 pound more per head daily on 11.9 pounds of wheat than on 11.9 pounds of corn. The nutritive value of feeds can be predicted with a fair degree of accuracy from their chemical compositions. In this connection Table II is of interest, since it gives the analyses of various grains as compiled by Henry and Morrison (10).

TABLE II.—AVERAGE PERCENTAGE COMPOSITION OF SOME FEEDS USED FOR FATTENING CATTLE.

Taken from Henry and Morrison's "Feeds and Feeding."

FEED.	Water.	Ash.	Crude protein.	Carbohydrates.		Fat.
				Fiber.	Nitrogen free extract.	
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Corn, dent, grade No. 2.....	14.8	1.4	9.6	1.9	67.6	4.8
Wheat, Minnesota, North Dakota, South Dakota, Kansas.....	10.4	1.8	13.5	2.4	69.8	2.1
Wheat bran, winter.....	10.6	6.3	15.7	8.8	54.2	4.4
Kafir grain.....	11.8	1.7	11.1	2.3	70.1	3.0
Milo grain.....	10.7	2.8	10.7	2.4	70.5	2.9
Feterita grain.....	11.1	1.5	12.5	1.7	70.1	3.1
Oats.....	9.2	3.5	12.4	10.9	59.6	4.4
Barley, common.....	9.3	2.7	11.5	4.6	69.8	2.1

Bran and oats are included in Table II to show their high fiber content which is responsible for their low value as fattening feeds. On the other hand, the composition of the grain sorghums indicates that they should be comparable to wheat and corn in feeding value. In fact it would seem that where corn is not a sure crop and the grain sorghums yield more than wheat, cattle feeders should grow more grain sorghums and less wheat.

Thus chemical analyses are useful because they indicate in a general way the nutritive values of feeds. But the practical feeder needs to know the "over-all" effect of a feed in addition to how it should compare pound for pound with other feeds in producing increases in body weight. In other words, the feeder should know whether a feed is palatable and will be consumed in sufficient amounts to produce a high degree of finish in a minimum length of time; also, whether it will have a deleterious effect either on the live animal or its carcass. Such information is not available in tables of chemical analyses.

In discussing wheat for cattle Rusk and Snapp (16) said, "Previous comparisons between wheat and corn made at a number of western stations gave evidence that wheat alone was less valuable than corn as a feed for cattle, largely because during mastication it became a sticky, pasty mass, which was more or less unpalatable to full-fed cattle. Consequently, it was not eaten in sufficiently large amounts to produce satisfactory gains."

Its unpalatability is not the only criticism that has been made of wheat when fed alone to fattening cattle. For example, in discussing the results of an experiment at the Missouri station, Moffett (14) said, "After being on full feed a short time the steers getting ground wheat went 'off feed.' They were brought back to a full feed slowly, but never consumed over 11 pounds of grain daily. Considerable difficulty was experienced in keeping them on full feed during the entire trial."

In an experiment at the Kansas station Haney and Elling (9) observed early in the feeding period that it would require more care to get steers on a full-feed of wheat than on a full-feed of corn. In this particular experiment the maximum amount of corn consumed per steer daily was 21 pounds. Similar steers scoured badly when fed over 14 pounds of wheat per head daily; hence, the total consumption of corn was much greater than the total consumption of wheat. Haney and Elling concluded that ground wheat and alfalfa hay fed together is not an economical ration for beef on account of the loosening effect of these feeds on the steers and the expensiveness of the wheat.

On the other hand, Baker (1) found that calves can be finished reasonably well on ground wheat with alfalfa hay, but like other investigators, he found that calves fed ground wheat alone ate less grain and made somewhat slower gains than calves fed shelled corn. According to Baker no digestive difficulties were experienced which

could be ascribed to the use of wheat in the ration. Neither did he have any difficulty in keeping calves on a full feed of wheat.

Why ground wheat should cause digestive disturbances in some cases and not in others is not clear. The care exercised in getting cattle on feed may be a factor. The fineness to which wheat is ground may be responsible for the differences in its effect on cattle getting all the wheat they will consume, although conclusive experimental evidence on this point is lacking. It is interesting to note that wheat was coarsely ground in practically every experiment where it gave reasonably good results. Furthermore, investigators are pretty well agreed that wheat should be ground for cattle because a high percentage of the unground grain is voided whole.

MIXTURES OF WHEAT AND CORN

In view of the amount of data indicating that corn alone is worth more than wheat alone for full-fed cattle, it is not surprising that a number of experiments have been conducted in an attempt to determine how wheat can be used most efficiently in cattle rations. Various mixtures of ground wheat and other grains have been tried. Seldom, however, has wheat comprised more than half by weight of such mixtures. The results of several trials in which a mixture of equal parts by weight of ground wheat and corn was compared with corn are given in Table III.

TABLE III.—SUMMARY OF RESULTS WHERE A MIXTURE OF GROUND WHEAT ONE-HALF AND CORN ONE-HALF WAS COMPARED WITH CORN ALONE FOR FATTENING CATTLE.

AGRICULTURAL EXPERIMENT STATION.	Reference number.	Initial weight of steers.	Length of feeding period.	Average daily gain.		Average daily ration.	
				Corn.	Corn- wheat mixture.	Corn.	Corn- wheat mixture.
Nebraska.....	1	Pounds. 370	Days. 205	Pounds. 2.42	Pounds. 2.40	Pounds. 10.6	Pounds. 10.1
Missouri.....	18	555	100	2.38	2.57	13.1	13.0
Illinois.....	15	910	94	2.32	2.42	15.8	15.8

In each experiment summarized in Table III, the mixture was consumed in approximately the same amount as corn, indicating that ground wheat is made more palatable by mixing it with corn. In two trials steers fed the mixture gained more than those fed corn, while in one trial the difference in gains was insignificant. In each trial it appeared that, from the standpoint of gains, palatability, finish of the steers at the close of the feeding period, and feed required per unit of gain, a mixture of equal parts by weight of ground wheat and corn was equal or superior to corn alone.

Gramlich and Thalman (7) found that when fed to three-year-

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old steers a mixture of one-third ground wheat and two-thirds shelled corn was consumed in greater quantities and produced larger gains at a smaller expenditure for feed than shelled corn alone.

MIXTURES OF WHEAT AND OATS

Rusk and Snapp (15) found that a grain mixture of equal parts of shelled corn, ground wheat, and ground oats proved slightly better than equal parts of corn and ground wheat and considerably better than a ration of straight shelled corn. They found, however, that equal parts of ground wheat and ground oats produced slower gains than rations composed of ground wheat and corn or ground wheat, oats, and corn. Wheat alone was not fed in the Illinois experiment, therefore, the comparative value of wheat alone and a mixture of wheat and oats was not determined.

At the Oregon station, French (5) found that the partial substitution of oats for wheat was desirable. His findings should probably be discounted somewhat because too few animals were fed and the lots were not fed the same length of time.

In a more recent test with a larger number of steers, Trowbridge and Moffett (18) found that the consumption of grain and daily gains were slightly increased when approximately one-third ground oats was substituted for ground wheat.

MIXTURES OF WHEAT AND BRAN

Burnett and Smith (3) compared a ration of bran 20 per cent and ground wheat 80 per cent with a ration of bran 20 per cent and ground corn 80 per cent. They found that the feeding value of wheat is 5 per cent greater than corn for cattle. Mixing the ground wheat with bran doubtless improved the palatability of wheat.

Thorne and Hickman (17) in reporting a steer-feeding experiment conducted in 1895, said, "We have for years followed the practice of feeding corn meal and wheat bran in equal weight in the belief that the physical condition and nutritive effect of both foods are improved by the mixture." Likewise, they were of the opinion that ground wheat was improved by mixing an equal weight of bran with it.

On the other hand, Shepard and Richard (16) found it desirable in order to reduce scouring, to feed less than one-fourth bran in a mixture of ground wheat and bran. They also found that a mixture of ground corn and bran was superior to a mixture of ground wheat and bran. It would seem that more data are needed before definite conclusions are drawn relative to the value of bran in improving the palatability of wheat.

But irrespective of the value of bran in making wheat more palatable, it should be remembered that investigators and successful feeders agree that because of its bulk and low feeding value only a small percentage of bran can profitably be included in rations for full-fed cattle.

Considerable work with wheat has been done by Vinke and Pear-

son (19) and by Linfield (12, 13) at the Montana station; also by Hickman (11) at the Idaho station. But at neither of these stations has corn been included in the comparisons; hence, the results are of more value to western feeders than to those in the corn belt.

WHEAT VERSUS BARLEY

Vinke and Pearson's work (19) indicates that ground wheat is not so palatable as ground barley, although it produces almost as large gains as ground barley. They found that less feed is required per 100 pounds gain with wheat than with barley.

A summary of several trials in which ground barley and ground wheat were compared is given in Table IV.

TABLE IV.—A COMPARISON OF GROUND BARLEY AND GROUND WHEAT AS FATTENING FEEDS FOR CATTLE.

AGRICULTURAL EXPERIMENT STATION.	Reference number.	Initial weight of steers.	Length of feeding period.	Average daily gain.		Average daily ration.	
				Ground barley.	Ground wheat.	Ground barley.	Ground wheat.
	<i>Pounds.</i>	<i>Days.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Kansas	8	405	182	1.62	1.56	8.5	6.5
Montana	19	750	140	2.25	2.16	10.1	12.7
Montana	19	765	158	2.03	2.07	11.6	10.9
Idaho	11	830	153	1.44	1.71	6.3	6.1

In the Idaho test, both wheat and barley were fed in limited amounts presumably in order to get the steers to consume large amounts of roughage. Consequently, the relative palatability of the two grains was not determined. When fed at the same level, wheat is distinctly superior to barley, as would be expected from a study of the chemical composition of the two grains.

A critical analysis of the literature on wheat feeding reveals the need for information regarding the practicability of using more than 50 per cent wheat in a mixture of wheat and corn. A detailed discussion follows of the results of a test conducted at the Kansas Agricultural Experiment Station during the winter of 1931-'32. The object of this test was to get supplementary information concerning the value of wheat as a fattening feed for cattle.

PLAN OF THE EXPERIMENT

Two series of four lots each were fed. In Series I, ground wheat, ground shelled corn, and two mixtures of ground wheat and ground shelled corn were compared when fed in conjunction with atlas sorgo silage, cottonseed meal, and alfalfa hay. Series II differed from Series I in that no atlas sorgo silage was fed; otherwise, the comparisons were the same.

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STEERS USED

For this experiment, yearling Hereford steers, in medium flesh and grading good to choice as feeders, were purchased on the Kansas City market. They were received in Manhattan November 3, and grazed on bluestem pasture until November 17, at which time they were started on atlas sorgo silage and alfalfa hay. The experiment commenced November 24, 1931, and closed May 22, 1932, at the end of 180 days.

FEEDS USED

No. 2 mixed corn, No. 2 leafy alfalfa hay, and atlas sorgo silage of excellent quality were used. The hard winter wheat and cottonseed meal fed contained 12.1 and 44.1 per cent protein, respectively. The wheat and shelled corn were coarsely ground in a burr-type mill.

SERIES I—WHEAT VERSUS CORN FOR FATTENING YEARLING STEERS FED SILAGE, COTTONSEED MEAL, AND ALFALFA HAY

The steers in this series were fed as follows:

- Lot 1—Ground shelled corn, cottonseed meal, silage, and alfalfa hay.
- Lot 2—Ground shelled corn $\frac{2}{3}$ ground wheat $\frac{1}{3}$ cottonseed meal, silage, and alfalfa hay.
- Lot 3—Ground shelled corn $\frac{1}{3}$ ground wheat $\frac{2}{3}$ cottonseed meal, silage, and alfalfa hay.
- Lot 4—Ground wheat, cottonseed meal, silage, and alfalfa hay.

METHOD OF FEEDING

Alfalfa hay was fed at the rate of 2 pounds per steer daily and silage was fed in sufficient amounts to satisfy the steers' requirements for roughage. Since each lot received only a small amount of protein-rich alfalfa and a considerable amount of silage, which is deficient in protein, it was deemed advisable to feed 2 pounds of cottonseed meal per steer daily in Series I. The grain and cottonseed meal were mixed with the silage.

The results secured in Series I are given in detail in Table V.

AVERAGE DAILY GAINS

By referring to Table V it will be seen that lot 1, fed ground corn, gained 2.34 pounds per head daily; lot 2, fed ground corn $\frac{2}{3}$ and ground wheat $\frac{1}{3}$, 2.4 pounds; lot 3 fed ground corn $\frac{1}{3}$ and ground wheat $\frac{2}{3}$, 2.42 pounds; and lot 4, fed ground wheat, 2.16 pounds. The gains made by the steers fed ground corn and mixtures of ground corn and ground wheat were not significantly different. It is interesting to note that, from the standpoint of gains, a mixture of ground wheat $\frac{2}{3}$ and ground corn $\frac{1}{3}$ was just as satisfactory as ground corn alone.

The steers in lot 4, fed ground wheat, gained 33 pounds per steer or 8 per cent less in 180 days than lot 1, fed ground corn. This difference is probably significant since it approximates the differ-

TABLE V.—EXPERIMENTAL DATA, SERIES I.

November 24, 1931, to May 22, 1932—180 days.

Lot No.	1	2	3	4
RATIONS FED.	Ground corn, cottonseed meal, silage, alfalfa hay.	Ground corn 2, ground wheat 1; cottonseed meal; silage; alfalfa hay.	Ground corn 1, ground wheat 2; cottonseed meal; silage; alfalfa hay.	Ground wheat, cottonseed meal, silage, alfalfa hay.
Number of steers per lot.....	10	10	10	10
initial weight per steer.....	Pounds. 619.58	Pounds. 613.67	Pounds. 614.00	Pounds. 612.50
Final weight per steer.....	1,040.67	1,046.00	1,049.00	1,000.83
Total gain per steer.....	421.09	432.33	435.00	388.33
Daily gain per steer.....	2.34	2.40	2.42	2.16
Daily feed consumption per steer:				
Ground corn.....	14.77	8.94	4.51	.....
Ground wheat.....	.....	4.47	9.01	11.98
Cottonseed meal.....	1.97	1.97	1.97	1.97
Silage.....	10.48	10.19	10.70	10.47
Alfalfa hay.....	2.00	2.00	2.00	2.00
Feed consumption per 100 pounds gain:				
Ground corn.....	631.27	372.35	186.47	.....
Ground wheat.....	.....	186.18	372.94	555.11
Cottonseed meal.....	84.04	81.86	81.86	91.01
Silage.....	447.89	424.21	442.76	485.51
Alfalfa hay.....	85.49	83.27	82.76	92.60

ence noted where ground corn and ground wheat were compared in trials at other agricultural experiment stations, and also agrees with the experiences of practical feeders.

AVERAGE DAILY RATIONS

Differences in gains are often explained by variations in feed consumption which, when steers receive all they will consume, is limited only by the palatability of the feeds and the ability of the steers to consume them. In lots 1, 2, 3, and 4 the average daily consumption of cottonseed meal was 2 pounds, silage, slightly in excess of 10 pounds, and alfalfa hay, 2 pounds. Since all lots consumed the same amounts of these three feeds, the measure of the palatability of the grains was in the average daily consumption of these grains, which were as follows: Lot 1, ground corn, 14.8 pounds; lot 2, ground corn, 8.9 pounds, ground wheat, 4.5 pounds, or a total of 13.4 pounds; lot 3, ground corn, 4.5 pounds, ground wheat, 9 pounds, or a total of 13.5 pounds; and lot 4, ground wheat, 12 pounds. Thus ground corn was more palatable than ground wheat, and ground wheat was made more palatable by mixing it with ground corn. Furthermore, the mixture containing two-thirds ground wheat was just as palatable as one in which ground wheat was substituted for only

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one-third of the ground corn. However, in each case less grain was consumed when ground corn and ground wheat were mixed together than when ground corn alone was fed as the grain part of the ration.

The average daily rations by 28-day periods are given in Table VI. The steers in all lots of Series I were started on 2½ pounds of grain, 1 pound of cottonseed meal, 25 pounds of silage, and 2 pounds of alfalfa hay. The grain was gradually increased at the rate of ⅓ pound per steer every three days until the steers were receiving all they would consume. Cottonseed meal was fed at the

TABLE VI.—AVERAGE DAILY RATIIONS BY 28-DAY PERIODS, SERIES I.

Lot No.....	1	2	3	4
	Pounds.	Pounds.	Pounds.	Pounds.
First 28-day period:				
Ground corn.....	6.54	4.36	2.18	.....
Ground wheat.....	.....	2.18	4.36	6.49
Cottonseed meal.....	1.78	1.78	1.78	1.78
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	24.54	23.32	24.96	24.44
Second 28-day period:				
Ground corn.....	14.08	9.03	4.43	.....
Ground wheat.....	.....	4.51	8.85	12.78
Cottonseed meal.....	2.00	2.00	2.00	2.00
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	12.61	11.96	13.61	12.68
Third 28-day period:				
Ground corn.....	17.86	10.05	5.29	.....
Ground wheat.....	.....	5.02	10.59	12.79
Cottonseed meal.....	2.00	2.00	2.00	2.00
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	8.04	8.04	8.04	8.04
Fourth 28-day period:				
Ground corn.....	17.75	10.80	5.31	.....
Ground wheat.....	.....	5.15	10.61	12.51
Cottonseed meal.....	2.00	2.00	2.00	2.00
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	7.36	7.36	7.36	7.36
Fifth 28-day period:				
Ground corn.....	16.52	9.89	4.96	.....
Ground wheat.....	.....	4.94	9.93	13.70
Cottonseed meal.....	2.00	2.00	2.00	2.00
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	6.25	6.25	6.25	6.25
Sixth 28-day period:				
Ground corn.....	16.03	9.89	4.90	.....
Ground wheat.....	.....	4.95	9.80	13.72
Cottonseed meal.....	2.00	2.00	2.00	2.00
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	6.00	6.00	6.00	6.00
Last 12 days:				
Ground corn.....	14.40	9.30	4.43	.....
Ground wheat.....	.....	4.65	8.87	11.65
Cottonseed meal.....	2.00	2.00	2.00	2.00
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	6.00	6.00	6.00	6.00
Average of all periods:				
Ground corn.....	14.77	8.94	4.51	.....
Ground wheat.....	.....	4.47	9.01	11.98
Cottonseed meal.....	1.97	1.97	1.97	1.97
Alfalfa hay.....	2.00	2.00	2.00	2.00
Silage.....	10.48	10.19	10.70	10.47

rate of 1 pound per steer per day at the start and increased $\frac{1}{10}$ pound per day until 2 pounds were being fed. Silage was gradually decreased as the grain was increased. The daily allowance of alfalfa hay remained at 2 pounds per steer throughout the experiment.

Differences in palatability of ground wheat and ground corn became evident during the second 28-day feeding period. Lot 4, fed ground wheat, was very slow to take an increase over 12 pounds of ground wheat per steer daily and at no time would they take as much grain as lot 1.

FEED REQUIRED FOR 100 POUNDS GAIN

Feed consumption and gains merely indicate in a general way that which is considerably more important; namely, the amount of feed consumed per 100 pounds of gain. On the basis of the amount of grain required to produce 100 pounds of gain, we find that ground corn was 86 per cent as efficient as ground wheat.

On this same basis ground corn was 88 per cent as efficient as a mixture of ground corn $\frac{1}{3}$ and ground wheat $\frac{2}{3}$; and 89 per cent as efficient as a mixture of ground corn $\frac{2}{3}$ and ground wheat $\frac{1}{3}$. These values based upon the results in lots 1, 2, 3, and 4 indicate definitely the high nutritive value of wheat and also explain why the steers fed mixtures of ground wheat and corn made as large gains as those fed ground corn alone, even though slightly less of each mixture was consumed.

SERIES II—WHEAT FOR FATTENING YEARLING STEERS FED COTTONSEED MEAL AND ALFALFA HAY

The steers in this series were fed as follows:

Lot 5—Ground corn, cottonseed meal, and alfalfa hay.

Lot 6—Ground corn $\frac{2}{3}$, ground wheat $\frac{1}{3}$, cottonseed meal, and alfalfa hay.

Lot 7—Ground corn $\frac{1}{3}$, ground wheat $\frac{2}{3}$, cottonseed meal, and alfalfa hay.

Lot 8—Ground wheat, cottonseed meal, and alfalfa hay.

METHOD OF FEEDING

Obviously, lots 5, 6, 7, and 8, or Series II, received considerable protein in the alfalfa; hence, only 1 pound of cottonseed meal per steer daily was fed to these groups. The grain and cottonseed meal were mixed together in the feed bunks.

The results for Series II are given in Table VII.

Considerable care was taken in increasing the grain up to all the steers would consume. This was especially necessary since a 180-day feeding period was planned and mistakes made in starting steers even on a standard ration are almost certain to result in digestive disturbances after 120 to 140 days' feeding.

AVERAGE DAILY GAINS

The average daily gains for Series II are given in Table VII. Lot 5, fed ground corn, gained 2.46 pounds per head per day; lot 6, fed ground corn $\frac{2}{3}$, ground wheat $\frac{1}{3}$, 2.51 pounds; lot 7, fed

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TABLE VII.—EXPERIMENTAL DATA, SERIES II.

November 24, 1931, to May 22, 1932—180 days.

Lot No.....	5	6	7	8
RATIONS FED.	Ground corn, cottonseed meal, alfalfa hay.	Ground corn 2, ground wheat 1; cottonseed meal; alfalfa hay.	Ground corn 1, ground wheat 2; cottonseed meal; alfalfa hay.	Ground wheat, cottonseed meal, alfalfa hay.
Number of steers per lot.....	9	10	10	10
Initial weight per steer.....	Pounds. 604.07	Pounds. 606.33	Pounds. 604.50	Pounds. 604.33
Final weight per steer.....	1,047.04	1,057.33	1,081.33	1,063.50
Total gain per steer.....	442.97	451.00	476.83	459.17
Daily gain per steer.....	2.46	2.51	2.65	2.55
Daily feed consumption per steer:				
Ground corn.....	14.05	9.63	4.69	.....
Ground wheat.....	.....	4.81	9.38	13.10
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	5.62	5.73	5.81	5.72
Feed consumption per 100 pounds of gain:				
Ground corn.....	571.00	384.24	177.08	.....
Ground wheat.....	.....	192.12	354.16	513.58
Cottonseed meal.....	40.63	39.91	37.75	39.11
Alfalfa hay.....	228.23	228.60	219.37	224.21

ground corn $\frac{1}{3}$, ground wheat $\frac{2}{3}$, 2.65 pounds; and lot 8, fed ground wheat, 2.55 pounds. It would seem that the differences in gains among these lots were too small to indicate significance.

It should be said, however, that lot 5, fed ground corn, made larger gains during the first 112 days than lot 8, fed ground wheat. The fact that the gains in lot 5 slowed up during the last 68 days was partly due to the inability of the steers in this lot to consume large amounts of grain over a long period.

The steers in lot 8 had an advantage over lot 5 in ruggedness and thrift at the close of the experiment, which was not apparent at the time they were allotted. Had it not been for the differences in individuality between lots 5 and 8, the lot fed ground corn would doubtless have gained more during the entire feeding period than the lot fed wheat.

AVERAGE DAILY RATIONS

In lots 5, 6, 7, and 8 cottonseed meal was fed at the rate of 1 pound per head daily and alfalfa hay was consumed by all lots at the rate of approximately $5\frac{2}{3}$ pounds per head daily. The relative palatability of wheat and corn and mixtures of the two are shown in the following average daily grain rations: Lot 5, ground corn, 14.05 pounds; lot 6, ground corn, 9.6 pounds and ground wheat, 4.8 pounds, or a total of 14.4 pounds; lot 7, ground corn, 4.7 pounds and

ground wheat, 9.4 pounds, or a total of 14.1 pounds; and lot 8, ground wheat, 13.1 pounds.

Ground corn was again more palatable than ground wheat. The average daily rations by 28-day periods are shown in Table VIII. Lot 5 consumed more grain than lot 8 during the second, third, and

TABLE VIII.—AVERAGE DAILY RATIONS BY 28-DAY PERIODS, SERIES II.

Lot No.	5	6	7	8
	Pounds.	Pounds.	Pounds.	Pounds.
First 28-day period:				
Ground corn.....	6.47	4.36	2.18	.....
Ground wheat.....	.....	2.18	4.36	6.47
Cottonseed meal.....	1.00	1.00	1.00	.99
Alfalfa hay.....	12.04	12.14	12.75	12.27
Second 28-day period:				
Ground corn.....	13.52	9.39	4.51	.....
Ground wheat.....	.....	4.79	9.02	12.64
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	6.46	7.07	7.00	6.89
Third 28-day period:				
Ground corn.....	17.26	11.94	5.01	.....
Ground wheat.....	.....	5.97	10.03	13.58
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	4.18	4.18	4.18	4.18
Fourth 28-day period:				
Ground corn.....	17.55	11.80	5.45	.....
Ground wheat.....	.....	5.90	10.90	15.17
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	4.00	4.00	4.00	4.00
Fifth 28-day period:				
Ground corn.....	15.30	11.00	5.56	.....
Ground wheat.....	.....	5.50	11.11	15.45
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	4.00	4.00	4.00	4.00
Sixth 28-day period:				
Ground corn.....	14.81	9.54	5.39	.....
Ground wheat.....	.....	4.77	10.78	14.93
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	4.00	4.00	4.00	4.00
Last 12 days:				
Ground corn.....	12.66	9.02	4.80	.....
Ground wheat.....	.....	4.51	9.60	13.95
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	3.33	3.33	3.33	3.33
Average of all periods:				
Ground corn.....	14.05	9.63	4.69	.....
Ground wheat.....	.....	4.81	9.38	13.10
Cottonseed meal.....	1.00	1.00	1.00	1.00
Alfalfa hay.....	5.62	5.73	5.81	5.72

fourth periods. Consequently, lot 5 had gained more than lot 8 at the end of 112 days. But during the last three periods the wheat-fed steers, lot 8, consumed more grain than the corn-fed steers. This greater grain consumption during the last 60 days by lot 8, as has been previously pointed out, was due to differences in the steers and under no circumstances should it be taken to mean that steers ordinarily eat more ground wheat than ground corn during the latter part of the feeding period. A study of the average daily rations by 28-day periods clearly reveals, therefore, the reason why the results are not entirely in agreement with the findings of pre-

vious investigators or with the results obtained in Series I of this experiment.

It should be said, however, that none of the lots was off feed at any time. Neither were there any digestive disturbances that could be attributed to wheat. As a matter of fact, the size of the gains and the amount of grain consumed by each lot are good indications that each ration was satisfactory. Each lot gained around 2.5 pounds per head daily, whereas 2.25 pounds is considered satisfactory for yearling steers fed 180 days on a good ration.

FEED REQUIRED FOR 100 POUNDS GAIN

Comparing lots 5 and 8 and basing calculations on pounds of grain required for 100 pounds gain, we find that ground corn was 90 per cent as efficient as ground wheat. Similarly, ground corn was as efficient as the mixture of $\frac{2}{3}$ ground corn and $\frac{1}{3}$ ground wheat fed in lot 6, and 93 per cent as efficient as the mixture of ground corn $\frac{1}{3}$, and ground wheat $\frac{2}{3}$ fed in lot 7. Here, as in Series I, is ample proof of the high nutritive value of ground wheat as a feed for fattening cattle.

MARKETING DATA

Because of the present interest among investigators in the possible effect of feeds on the quality of beef, shrink in transit, and dressing yields, marketing data were obtained in five lots, or 49 of the yearling Hereford steers used in this experiment. The following lots were marketed at Kansas City, Wednesday, June 8:

Lot 1—Ground corn, cottonseed meal, silage, and alfalfa hay.

Lot 3—Ground corn $\frac{1}{3}$, ground wheat $\frac{2}{3}$, cottonseed meal, silage, and alfalfa hay.

Lot 4—Ground wheat, cottonseed meal, silage, and alfalfa hay.

Lot 5—Ground corn, cottonseed meal, and alfalfa hay.

Lot 8—Ground wheat, cottonseed meal, and alfalfa hay.

All lots were continued on the experimental grain rations until they were shipped. The only change was in the case of roughage, prairie hay being fed the last week in order to prepare the steers for shipment.

Each lot was weighed Tuesday morning, June 7, immediately before being driven $2\frac{1}{2}$ miles to the station where they were loaded about 8 o'clock Tuesday evening. While at the station they had access to water and prairie hay. Each lot was weighed separately at Kansas City making it possible to calculate shrink in transit. However, the shrink was normal in each lot and the differences probably were not caused by the rations fed.

Table IX gives in detail weights and shrink of lots sold.

Carcass grades and dressing yields were obtained through the courtesy of Swift & Company. Data were obtained upon 19 steers fed ground corn (lots 1 and 5), 20 steers fed ground wheat (lots 4 and 8), and 10 steers fed ground wheat $\frac{2}{3}$, and ground corn $\frac{1}{3}$ (lot 3).

Table X gives the grades placed on the carcasses by Swift & Company.

TABLE IX.—SHRINK IN TRANSIT.

Lot No.	Average Manhattan weight.	Average Kansas City weight.	Shrink in pounds.	Shrink in per cent.
1.....	1,064	1,021	43	4.04
3.....	1,081	1,043	38	3.52
4.....	1,034	991	43	4.16
5.....	1,073	1,032	41	3.82
8.....	1,086	1,053	33	3.04

TABLE X.—CARCASS GRADES.

Lot No.	Grain ration.	Grades.		
		Choice.	Good.	Medium.
1 and 5.....	Ground corn.....	Number. 4	Number. 12	Number. 3
4 and 8.....	Ground wheat.....	1	11	8
3.....	{Ground wheat $\frac{2}{3}$ Ground corn $\frac{1}{3}$}	3	7	0

The grades of the carcasses of the wheat-fed steers, while fairly satisfactory, did not average so high as those of the corn-fed steers. It would appear, however, that the substitution of ground corn for $\frac{1}{3}$ of the ground wheat (lot 3) resulted in carcasses similar in most respects to those of steers fed corn alone (lots 1 and 5).

Table XI gives dressing yields based upon Manhattan weights and Kansas City weights.

TABLE XI.—DRESSING YIELDS.

Lot No.	Grain ration.	Yield based on:	
		Manhattan weight.	Kansas City weight.
1 and 5.....	Ground corn.....	Per cent. 61.0	Per cent. 63.5
4 and 8.....	Ground wheat.....	59.8	62.0
3.....	{Ground wheat $\frac{2}{3}$ Ground corn $\frac{1}{3}$}	60.1	62.3

Shrink in transit is responsible for the lower yields when calculations are based on home weights, but it is interesting to note that even on this basis the corn-fed steers yielded slightly higher than those fed wheat or a mixture of wheat and corn.

LITERATURE CITED

- (1) BAKER, MARVEL L.
1931. CORN, WHEAT, AND RYE FOR FATTENING CALVES. Nebr. Agr. Expt. Sta. Bul. 263: 1-11.
- (2) BLIZZARD, W. L.
1931. MIMEOGRAPHED REPORT OF STEER FEEDING EXPERIMENT CONDUCTED AT OKLA. AGR. EXPT. STA., NOV. 17, 1930, TO APRIL 30, 1931. 5 pages.
- (3) BURNETT, E. A. and SMITH, H. R.
1902. FEEDING EXPERIMENTS WITH CATTLE AND PIGS. Nebr. Agr. Expt. Sta. Bul. 75: 10-18.
- (4) COBURN, F. D.
1894. FEEDING WHEAT TO FARM ANIMALS. Report Kansas State Bd. of Agr. for Quarter Ending September 30, 1894, pp. 15-188.
- (5) FRENCH, H. T.
1895. EXPERIMENT IN FEEDING CATTLE. Oreg. Agr. Expt. Sta. Bul. 37: 78-84.
- (6) GOOD, E. S.
1931. CORN VERSUS WHEAT FOR FATTENING STEERS. Mimeographed report of steer feeding experiment conducted at Ky. Agr. Expt. Sta., Oct. 28, 1930, to April 21, 1931. 1 page.
- (7) GRAMLICH, H. J., and THALMAN, R. R.
1930. CORN VERSUS WHEAT FOR FINISHING THREE-YEAR-OLD GRASS FAT STEERS. Nebr. Agr. Expt. Sta. Cattle Cir. A, 1-6.
- (8) HANEY, J. G., and ELLING, O. H.
1904. EXPERIMENTS AT FORT HAYS BRANCH STATION, 1902-'04. Kan. Agr. Expt. Sta. Bul. 128: 304-307.
- (9) ———, and ELLING, O. H.
1906. WESTERN FEEDS FOR BEEF PRODUCTION. Kan. Agr. Expt. Sta. Bul. 132: 21-52.
- (10) HENRY, W. A., and MORRISON, F. B.
1923. FEEDS AND FEEDING. The Henry and Morrison Co., 1923.
- (11) HICKMAN, C. W., and coworkers.
1931. MIMEOGRAPHED REPORT OF STEER FEEDING EXPERIMENT CONDUCTED AT IDAHO AGR. EXPT. STA. 1 page.
- (12) LINFIELD, F. B.
1903. STEER FEEDING. Mont. Agr. Expt. Sta. Bul. 48: 154-165.
- (13) ———
1905. FATTENING CATTLE. Mont. Agr. Expt. Sta. Bul. 58: 59-67.
- (14) MOFFETT, H. C.
1930. WHEAT FOR FATTENING YEARLING STEERS. Proc. Am. Soc. An. Prod., p. 158.
- (15) RUSK, H. P., and SNAPP, R. R.
1930. UTILIZING WHEAT IN FATTENING CATTLE. Mimeographed report of steer feeding experiment conducted at Ill. Agr. Expt. Sta. Aug. 14, 1930, to Nov. 16, 1930. 3 pp.
- (16) SHEPARD, J. H., and RICHARD, W. B.
1906. FATTENING STEERS ON BARLEY AND REJECTED WHEAT. No. Dak. Agr. Expt. Sta. Bul. 73: 239-258.
- (17) THORNE, C. E., and HICKMAN, J. F.
1895. FEEDING FOR BEEF. Ohio Agr. Expt. Sta. Bul. 60: 1-12.

- (18) TROWBRIDGE, E. A., and MOFFETT, H. C.
1930. MIMEOGRAPHED REPORT OF STEER FEEDING EXPERIMENTS CONDUCTED
AT MO. AGR. EXPT. STA. 11 pp.
- (19) VINKE, LOUIS, and PEARSON, PAUL.
1931. ALFALFA HAY AND SMALL GRAINS FOR FATTENING YEARLING STEERS.
Mont. Agr. Expt. Sta. Bul. 251: 24.

PUBLICATIONS ON BEEF CATTLE AND SWINE

For further information on the recent experimental work of the Agricultural Experiment Station on beef cattle, swine, and closely related subjects, the reader is referred to the following publications:

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117. Cattle Feeding Investigations, 1923-'24. By C. W. McCampbell, B. M. Anderson, and H. W. Marston. (11 pp., 2 illus.)
128. Cattle Feeding Investigations, 1924-'25. By C. W. McCampbell, B. M. Anderson, and H. W. Marston. (14 pp., 1 illus.)
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151. Cattle Feeding Investigations, 1927-'28. By B. M. Anderson, C. W. McCampbell, and M. A. Alexander. (20 pp., 1 illus.)
152. Cattle Feeding Investigations, 1928-'29. By B. M. Anderson, C. W. McCampbell, and M. A. Alexander. (13 pp., 1 illus.)
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98. Swine Feeding Investigations, 1921-'22. By F. W. Bell, H. B. Winchester, and H. W. Marston. (11 pp., 1 illus.)
112. Swine Feeding Investigations, 1922-'23. By B. M. Anderson and H. W. Marston. (8 pp., 4 illus.)
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