THE EFFECT OF LEVEL AND SOURCE OF FIBER ON FEED-LOT PERFORMANCE, CARCASS CHARACTERISTICS, AND GASTRO-INTESTINAL TRACT OF SWINE

By

Laysel N. Hochstetler

AN ABSTRACT

Submitted to the School of Graduate Studies of
Michigan State University of Agriculture and Applied Science
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Animal Husbandry

1959

Approved J. A. Hoefer

ABSTRACT

Laysel N. Hochstetler

A total of 108 pigs were used in four trials designed to study the effect of replacing part of a basal ration with different fibrous feeds. Data were obtained on feed-lot performance, carcass characteristics, and gastro-intestinal tract. In the first trial, oats replaced 20 and 40% of the basal ration. There were no significant differences between treatments. In the second trial, wheat bran replaced 20 and 40% of the basal ration. There was a highly significant ($P < .01$) decrease in daily gain and a significant ($P < .05$) increase in feed required to produce a pound of gain between the pigs receiving 40% wheat bran and those receiving the basal ration.

In the third trial, alfalfa replaced 10 and 20% of the basal ration. There were no significant differences between treatments. In the fourth trial, wheat bran replaced 20 and 40% of the basal ration. In this trial, there was a significant ($P < .05$) decrease in rate of gain, backfat thickness, dressing percentage, and a highly significant ($P < .01$) decrease in percent fat trim and increase in feed per pound of gain between pigs receiving the 40% wheat bran and those receiving the basal ration.

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The carcasses from the 40% lot exhibited a significant ($P < .05$) increase in both the percent of lean cuts and primal cuts (carcass basis) over both the basal and 20% wheat bran lots. The large intestines of pigs fed 40% wheat bran (trial II and IV) contained significantly ($P < .05$) more fecal material than the large intestines of pigs fed the basal ration. Carcass length and area of the longissimus dorsi were not measurably affected by any of the rations fed.

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ACKNOWLEDGEMENTS

The author wishes to express his sincere thanks to Dr. J. A. Hoefer for his constant personal interest and continual guidance. Thanks are due Dr. C. A. Hoppert, Dr. R. W. Luecke, and Dr. E. P. Reineke for their valuable suggestions and encouragement.

The writer is greatly indebted to Dr. A. M. Pearson for his valuable assistance with the carcass study, and to Dr. D. E. Ullrey for his assistance in the histological study. The author greatly appreciates the interpretation of the slides by Dr. R. K. Ringer and Dr. D. A. Schmidt and expresses his gratitude to Mr. Neal First for his assistance in the preparation of the histological slides. The writer is also indebted to Dr. W. D. Baten for his assistance with the statistical analysis.

The privilege to have worked with the entire guidance committee and to have known them as a scientist, scholar, teacher, and friend will always be cherished.

The author wishes to express deep appreciation for the financial support of Michigan State University in the form of an instructorship and to the Animal Husbandry Department for providing laboratory facilities.

Thanks are due Mrs. Donald Hillman for her aid in the preparation of this thesis. The writer wishes especially to acknowledge his gratitude and indebtedness to his wife, Catherine, and to his sons, Douglas and Franklin, whose sacrifices and encouragement made this study possible.

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INTRODUCTION

Much research has been directed toward ways and means of producing leaner pork carcasses. In 1931, Ellis and Zeller were conducting some experiments on the utilization of feed by swine as affected by the level of intake and discovered when the energy intake was restricted to hogs they produced leaner carcasses. Other workers followed up the study of relative efficiency of limited and full-feeding for fattening pigs (St. Pierre *et al*. 1934, Burroughs and Carroll, 1939). Although there was some disagreement on the relative efficiency of gain, all agreed that restricting the energy intake produced hogs with less fat.

Hand feeding swine in the United States is rather impractical and expensive. The logical approach to such a problem would be to self-feed a low energy ration. Crampton *et al*. (1954) were able to produce leaner pork carcasses by diluting part of a high energy, self-fed ration with such high fiber feeds as alfalfa, wheat bran, and wild oats. On the other hand, Teague and Hanson (1954) fed a purified ration in which they increased the fiber content by adding Ruffex and found that carcass characteristics could not be correlated with the level of fibrous material fed.

The effect on swine of diluting the energy of a ration with high fibrous feeds is not clear as was indicated by the conflicting reports in the literature. The purpose of the investigation reported here was to study this problem. The objectives were as follows:

1. To study the effect of increasing the fiber content of rations on rate and efficiency of gain.

2. To study the effect of fiber on carcass characteristics.

3. To study the effect of using different high fiber feeds.

REVIEW OF LITERATURE

Effect of Limited Feeding on Carcass Characteristics

Ellis and Zeller (1931) hand-fed pigs at three levels: full feed, three-fourths full feed, and one-half full feed. They reported the three-fourths ration resulted in a small decrease in the amount of fat, but the one-half ration decreased the fat by 20%. Mansfield and Trehane (1935) reported on an experiment in which one-half of the pigs were full-fed and the other half were fed on a restricted diet. The pigs on the restricted diet consumed less feed per unit of gain and yielded a higher percentage of carcasses that graded A and B under the British grading system.

McMeekan (1940) found that for the first sixteen weeks the skeleton and muscle increased at a higher rate than fat. At about sixteen weeks, the rate of fat increase was equal to the rate of muscle increase. After that time, the fat increased at a faster rate than the muscle. McMeekan then conducted an experiment with high and low planes of nutrition, and found that in the high plane pigs the skeleton was 221%; muscle, 291%; and fat, 1007% of the weight of these tissues in the low plane animals.

McMeekan and Hammond (1939) planned an experiment in which they fed pigs to gain at four different rates. The first rate was to get a pig to 200 pounds as rapidly as possible, called the H-H; the next was to have the pig gain rapidly for sixteen weeks, then slow down the rate of growth, called the H-L. The other two rates were to have the pigs gain slow for the first sixteen weeks, then feed one-half of them for rapid gains from sixteen weeks to 200 pounds, called the L-H; the remaining half was grown slow from birth to 200 pounds called the L-L. According to the grading standards, the H-H pigs were too fat; the H-L pigs were nearer correct in the amount of fat; the L-H pigs were much too fat; and the L-L pigs had the least fat but had a larger proportion of bone to muscle.

Winters *et al*. (1949) reported on an experiment designed like that of McMeekan and Hammond and found the animals fed the restricted diet throughout produced the leanest carcasses. On the other hand, Shorrock (1940) reported that restriction of feeding made little difference in carcass quality, but what slight advantage there was, was on the side of the most restricted ration. However, the lowest feeding scale was above 70% of the full-fed ration until the pigs reached 165 pounds. On the other hand, Brugman (1950) reported that carcass qualities of swine can be changed by limiting the feed intake to 70% of full feed up to 150 pounds, and full feeding from then until the animal reaches approximately 220 pounds live weight. This method of feeding brought about a significantly higher percentage of primal cuts and lower percentage of lard as compared to full feeding throughout the growing-fattening period.

The Effect of Adding Fibrous Feeds to Self-fed Rations

If restricting the energy intake to pigs by hand-feeding will produce leaner carcasses, it seems logical to expect that self feeding a low energy ration would produce similar results. Vestal (1921) reported that when fibrous feed was added to a basal ration of corn and tankage the rate of gain decreased, and the feed required to produce the gain increased as the fiber in the ration was increased. Robison (1930) reported that when the fiber content of a basal ration containing less than one percent was brought up to 3, 6, 9, and 12% with peanut hulls and oat hulls the rate of growth decreased with each increase in fiber with the exception of 9 to 12%. He stated, "With few exceptions an increase in the fiber content of the ration increased the feed required per unit of gain, even with the feed calculated on a fiber free basis." Robison also commented that pigs fed a relatively bulky ration tend to grow rather than fatten.

Fargo _et al_. (1941) found that it made relatively little difference in the rate of gain whether 5, 10, or 15% of ground alfalfa hay was mixed in the ration or whether 8 or 16% of oat hulls or oat feed was fed in addition to a ration containing 5% alfalfa hay if the fiber or roughage was finely ground.

Whatley _et al_. (1951) reported on an experiment in which they fed all pigs alike up to 140 pounds and then self-fed one-half of them a high energy ration to 225 pounds. The other one-half were self-fed a low energy ration to the same weight. Restricting the energy intake by substituting ground hay for part of the corn in the ration reduced the rate of gain and increased the feed cost. It also resulted in a leaner carcass with a higher yield of lean cuts; but because of the lower dressing percentage, the carcass value per cwt. of live hog was not increased.

Bohman _et_ _al_. (1953) found little difference in rate of gain of pigs fed rations containing from 10 to 30% alfalfa. They reported fair gains were observed in animals fed 50% alfalfa compared with those fed the 10% alfalfa level, and a pelleted 50% alfalfa-grain mixture increased the rate of gain as compared with the ground mixture. Carcasses of pigs grown on rations containing 30 to 50% alfalfa were graded medium with a small proportion of Choice No. 1.

Axelsson and Eriksson (1953) used wheat straw meal to raise the fiber content from a low of 4.8% to a high of 9.3% of the dry matter in the ration. They reported the daily feed consumption increased a small amount as the crude fiber content increased. However, this increase was too small to keep the amount of daily metabolizable energy from decreasing. They found that a crude fiber content of 6.57% of the dry matter was optimum for growth, and a content of 7.26% for feed efficiency. The higher fiber tended to produce carcasses with less fat.

Coey and Robinson (1954) reported on an experiment in which they fed rations containing 3.5 to 11.5% crude fiber. They equalized the intake of digestible nutrients by adjusting the feed intake according to the amount of fiber in the ration. Their results showed that a rise in the level of dietary crude fiber was accompanied by a fall in the dressing percentage and hence, lower carcass weights. This effect was produced even by comparatively small changes, such as a rise from 3.5 to 5% crude fiber. Carcass weight was positively correlated with back fat thickness. Consequently the high fiber pigs had thinner backfats and tended to grade higher.

Crampton _et al_. (1954) reported that they were able to produce bacon carcasses with less shoulder and loin fat and a higher percentage of lean in the bacon rasher by "diluting" relatively high digestible rations with fibrous feed during the finishing period. Bacon carcass improvement was accompanied by a decrease in rate of gain when one-half of a high energy basal ration was replaced by either alfalfa or wheat bran or when the basal portion of the ration consisted entirely of oats. Increases in the percentage of Grade A carcasses were also obtained when wheat bran or wild oats replaced 25% of a high energy basal ration. In these cases, the improvement was not associated with any change in rate of gain. On the other hand, Teague and Hanson (1954) studied the effect of replacing corn starch in a purified basal ration with Ruffex at 5, 10, 15, and 20% levels. They found that carcass characteristics could not be correlated with the level of fibrous material fed. They reported that growth rate and feed utilization appeared to be adversely affected by the higher levels of Ruffex ingested.

Gard *et al*. (1954) found that 10% dehydrated alfalfa meal depressed growth, but equivalent woodflock crude fiber failed to influence gains. Hanson *et al*. (1955) found when 15 to 30% alfalfa meal was added to a self-fed ration (replacing the corn in a corn-soy bean oil meal ration) a significant depression of rate and efficiency of gains was evident. However, when the pigs were equally fed, the depression in rate of gain was not as severe. The addition of corn oil completely overcame the depression produced by the 30% alfalfa level when equally fed. However, under ad libitum conditions, corn oil did not appreciably improve rate of gain but increased feed efficiency. They stated that the growth-depressing property of alfalfa meal in the ration appears to be due to a lowered TDN content of the ration and to a lowered feed intake of the pigs. Sheffy et al. (1955) reported that increases in roughage content over 12.5% resulted in slower growth even when the energy content of the ration was kept constant by addition of fat.

Bohman et al. (1955) fed rations containing 0, 10, 30, and 50% alfalfa. They found as the level of alfalfa in the ration increased, the rate of gain, dressing percentage, depth of back fat, and percent of bacon belly decreased while the percent of shoulder, ham, and loin increased. They also found the weight of the stomach and large intestines increased as the alfalfa level increased. They concluded that swine apparently adjust to a high level of alfalfa intake by enlarging the size of their digestive tracts where limited transitory feed storage takes place as indicated by the increased weights of the stomach and large intestines.

Merkel et al. (1958) found that restricting the TDN level by incorporating fibrous feeds into swine rations decreased daily gains and increased the feed required to produce the gains. However, the TDN consumed per 100 pounds of gain was essentially equal except when the ration contained approximately 52% "poor quality" alfalfa hay. They found no significant differences when the crude fiber content was less than 10%. In another article, Merkel _et al_. (1958) reported the incorporation of the fibrous feeds, corn cobs, or alfalfa hay into swine rations decreased dressing percentages, carcass fatback thickness, and leaf fat weights.

The Digestibility and Utilization of Crude Fiber by Swine

The capacity of pigs to digest fiber is usually regarded as very limited. However, Fingerling _et al_. (1913) reported the results of a series of digestion trials with 2 wethers and 2 pigs, using an alkali-digested straw pulp, immature grass and wheat chaff as sources of cellulose. The average digestibility of crude fiber in the straw pulp in the case of the pigs was almost 95 percent and was appreciably higher than the coefficients obtained in the trials with the sheep. However, the crude fiber of the other feeds was digested much better by the wethers than by the pigs. Woodman et al. (1929) reported an average crude fiber digestion coefficient of 90% for sugar beets and 84% for sugar beet pulp. On the other hand, Mitchell and

Hamilton (1933) reported crude fiber digestion coefficients of 2% for oat hulls and 1.8% for alfalfa.

Mitchell and Hamilton comment that the alkali treatment of the straw pulp may have initiated hydrolytic changes in the cellulose that would make it more amenable both to bacterial fermentation and to further hydrolytic changes in the intestinal tract of the pig so that it would, in a large part, pass from the crude-fiber constituents of the feed to the nitrogen-free extract of the feces.

Bohstedt and Fargo (1933) studied the relative effect of adding ground peanut shells, ground cottonseed hulls, oat feed, ground oat hulls, and timothy hay to swine rations. When they compared a unit increment of fiber of the above feeds with the check ration, peanut shells and cottonseed hulls caused a smaller increase in feed required for 100 pounds gain than either oat feed, oat hulls, or timothy hay. Timothy hay, although ground to the same degree of fineness and having approximately the same chemical composition as oat feed, was less efficient than oat feed. They reported that the heat treatment of oat hulls produced as a by-product in oat meal manufacture has a favorable effect on the nutritive value as compared to "green" oat hulls. Crampton and Bell (1944) reported that the fineness to which oats was ground made a difference in rate of gain of young pigs. They found that 50 pound pigs fed coarse, medium, and finely ground oats for 60 days gained 71, 82, and 105 pounds, respectively. However the degree of fineness of the oats did not affect the digestibility of the dry matter.

Teague and Hanson (1954) reported crude fiber, supplied by Ruffex, was poorly digested at all levels, and its inclusion depressed the apparent digestibility of the protein and nitrogen-free extract portions of the diet. Forbes and Hamilton (1955) studied the utilization by swine of such cellulosic materials as woodflock, ruffex, wheat straw, wheat straw pulp, and oat hulls. They found the digestibility of cellulose in rations containing about 50% of their cellulose from woodflock, ruffex, or wheat straw pulp averaged 41, 46, and 68 percent, respectively. Comparisons of varied fiber sources with woodflock showed the following decreasing order of cellulose digestibility: alfalfa meal, woodflock, wheat straw, and oat hulls. Forbes and Hamilton (1955) also reported that metabolizable energy values, expressed as a percent of the digestibility energy, show that the organic acids produced in the digestion of cellulose are highly utilizable by the animal.

EXPERIMENTAL PROCEDURE

Four feeding trials were conducted involving a total of 108 pigs. The breeds represented were Berkshire, Chester White, Duroc, and Chester White-Duroc crossbreeds from the University herd. The pigs were started on trial after they were weaned and wormed. Twenty-seven pigs were used in each trial. Fifteen of the 27 head were divided into 3 groups of 5 each and self-fed, and the remaining 12 pigs were self-fed in individual pens. There were three ration treatments with 9 pigs per treatment, (five fed in a group and 4 fed individually), in each trial. They were weighed at 14-day intervals and feed consumption recorded. Daily gain and feed efficiency were calculated.

All rations were analyzed chemically, using official A.O.A.C. methods. The percentage of protein, crude fiber, and estimated TDN are presented in table 1.

All pigs were slaughtered at the University Meats Laboratory when they reached approximately 210 pounds.

Table 1

Percent of Protein, Crude Fiber, and TDN in Rations

Trial I Oat Rations	Under 100 lbs. Basal	20%	40%	100 lbs. to Slaughter Basal	20%	40%
Protein	14.9	15.2	15.2	12.9	12.8	12.6
Crude Fiber	3.1	4.5	6.5	2.9	5.0	6.3
TDN*	74.47	72.23	69.98	75.55	73.42	71.24
Trial II Wheat Bran	**Basal**	**20%**	**40%**	**Basal**	**20%**	**40%**
Protein	14.6	14.6	14.6	13.0	13.2	13.4
Crude Fiber	3.1	4.4	5.8	2.6	3.9	5.2
TDN*	74.72	70.88	66.95	75.35	71.51	67.68
Trial III Alfalfa Meal	**Basal**	**10%**	**20%**	**Basal**	**10%**	**20%**
Protein	15.0	14.9	15.0	13.1	12.7	13.0
Crude Fiber	2.8	5.5	8.2	2.5	5.2	8.1
TDN*	74.81	70.92	66.68	75.26	71.32	67.10
Trial IV Wheat Bran	**Basal**	**20%**	**40%**	**Basal**	**20%**	**40%**
Protein	17.8	18.7	18.0	13.2	14.5	14.2
Crude Fiber	3.5	5.2	6.3	2.8	4.2	5.3
TDN*	74.62	70.70	66.75	75.40	71.48	68.48

*TDN calculated using National Research Council tables.

The following measurements were made on the chilled carcasses: dressing percentage, backfat thickness, carcass length, lean cuts (both live and carcass basis), primal cuts (both live and carcass basis), area of *longissimus dorsi* at the 10th and last rib, and percent of fat trim. All data were analyzed by an analysis of variance (Snedecor, 1946) and multiple range and multiple F tests (Duncan, 1955).

Trial 1

The first trial was started in June 1955, using oats to replace 20 and 40% of the basal ration. The constituents of the rations are given in table 2. Seven Duroc, 3 Chester White, and 5 Chester White-Duroc crossbred pigs were lotted as uniformly as possible according to litter, sex, and size into three groups of five pigs each. These pigs were group fed on a concrete slab with a house at one end. Water and feed were available at all times. An additional 6 Chester White and 6 Chester White-Duroc crossbred pigs were assigned to lots on the basis of litter, sex, and size. The pigs were taken from these lots and placed in an (8' x 3') individual pen where they spent the rest of their lives except for weighing every two weeks.

Table 2

Percentage Composition of Rations Used in Trial I

Ingredients	Initial to 100 lbs.			100 lbs. to Slaughter		
	Basal	20%	40%	Basal	20%	40%
Ground corn	80	62	44	87	69	51
Protein supplement[a]	17.8	16	14.2	11.56	9.8	8.0
Ground oats	0	20	40	0	20	40
Dicalcium phosphate + zinc[b]	0.69	.63	.56	.44	.38	.31
Trace mineral + salt	0.67	.61	.54	.44	.37	.30
Limestone	.69	.63	.56	.44	.38	.31
Aurofac #10	.05	.05	.05	.04	.03	.03
Merck Vitamin Mix #58C	.07	.07	.06	.05	.04	.04
Vitamin A and D[c]	.04	.03	.03	.03	.02	.02

[a] Supplement: soybean oil meal 65%, meat and bone scrap 15%, fish meal 5%, and dehydrated alfalfa meal 15%.

[b] Contains 10 grams of zinc carbonate per pound of dicalcium phosphate.

[c] Contains 10,000 USP units of vitamin A and 3,000 USP units of vitamin D per gram.

Each pen was equipped with an automatic waterer at one end and a self-feeder at the other.

The pigs were removed for slaughter at a minimum weight of 204 pounds. All pigs were in excellent health throughout the experiment.

Trial II

Wheat bran replaced 20 and 40% of the basal ration in the second trial (Fall and Winter 1955 and 1956). The constituents of the rations are presented in table 3. Twenty-four Duroc and 3 Chester White pigs were used in this trial. They were lotted according to litter, sex, and size in the same manner as in the first trial.

Bohman _et al_. (1955) suggested that increasing the fiber in swine rations caused an increase in the weight of the stomach and large intestine. Consequently, weights were taken of the stomach (both full and empty), small intestine, and large intestine (both full and empty). In addition, the volume of the stomach was estimated by filling it with water. Histological samples were taken from the fundus portion of the stomach, anterior portion of the duodenum, and center portion of the colon. Special care was taken

Table 3

Percentage Composition of Rations Used in Trial II

Ingredients	Initial to 100 lbs.			100 lbs. to Slaughter		
	Basal	20%	40%	Basal	20%	40%
Ground corn	79.0	63.0	46.0	86.0	70.0	54.0
Protein supplement[a]	19.0	15.0	12.0	12.0	8.0	4.0
Wheat bran	0	20.0	40.0	0	20.0	40.0
Dicalcium phosphate + zinc[b]	.4	.4	.4	.4	.4	.4
Dicalcium phosphate	.4	.4	.4	.4	.4	.4
Trace mineralized salt	.6	.6	.6	.6	.6	.6
Limestone	.4	.4	.4	.4	.4	.4
Aurofac #10	.05	.05	.05	.05	.05	.05
Merck vitamin Mix #58C	.05	.05	.05	.05	.05	.05
Vitamin A and D[c]	.025	.025	.025	.025	.025	.025

[a] Supplement: soybean oil meal 65%, meat and bone scrap 15%, fish meal 5%, and alfalfa meal 15%.

[b] Contains 10 grams of zinc carbonate per pound of dicalcium phosphate.

[c] Contains 10,000 USP units of vitamin A and 3,000 USP units of vitamin D per gram.

to remove as much fat as possible from the visceral organs before weighing. After the histological sample was taken the contents of the large intestines were washed out with water and the intestines allowed to drip dry before taking the empty weight.

Trial III

Alfalfa meal replaced 10 and 20% of the basal ration in the third trial (Summer 1956). The constituents of rations are given in table 4. Nine Berkshire and 18 Chester White pigs were used in this experiment. The experimental procedure was carried out in the same manner as trial II.

Trial IV

In this trial wheat bran was used as the fibrous feed in the same proportions as the second trial (see table 5). Eighteen Duroc and 9 Chester White-Duroc crossbred pigs were used in this trial. They were lotted according to litter, sex, and size. The group fed pigs were managed in the same manner as the other trials. However, excessive feed wastage was encountered in the individually fed lots. In order to better control this feed wastage, the feeders were placed

Table 4

Percentage Composition of Rations Used in Trial III

Ingredients	Initial to 100 lbs.			100 lbs. to Slaughter		
	Basal	10%	20%	Basal	10%	20%
Ground corn	78.1	71.4	64	85.1	78.4	70.9
Protein supplement[a]	20.5	17.5	14.9	13.7	10.5	8
Alfalfa meal[b]	0	10	20	0	10	20
Dicalcium phosphate + zinc[c]	.5	.5	.5	.5	.5	.5
Trace mineral + salt	.5	.5	.5	.5	.5	.5
Limestone	.3	0	0	.3	0	0
Aurofac #10	.05	.05	.05	.05	.05	.05
Merck vitamin Mix #58C	.05	.05	.05	.05	.05	.05
Vitamin A and D[d]	.025	.025	.025	.025	.025	.025

[a] Supplement: soybean oil meal 55%, meat and bone scraps 20%, alfalfa meal 15%, and wheat middlings 10%.

[b] Alfalfa meal 17% protein.

[c] Contains 10 grams of zinc carbonate per pound of dicalcium phosphate.

[d] Contains 10,000 USP units of vitamin A and 3,000 USP units of vitamin D per gram.

Table 5

Percentage Composition of Rations Used in Trial IV

Ingredient	Initial to 100 lbs.			100 lbs. to Slaughter		
	Basal	20%	40%	Basal	20%	40%
Ground corn	76.3	59.0	41.5	86.2	67.8	52.0
Protein supplement[a]	22.3	19.6	17.1	13.4	10.8	7.6
Wheat bran	0	20.0	40.0	0	20.0	40.0
Dicalcium phosphate + zinc[b]	.5	.5	.5	.5	.5	.5
Trace mineral salt	.5	.5	.5	.5	.5	.5
Limestone	.3	.3	.3	.3	.3	.3
Aurofac #10	.05	.05	.05	.05	.05	.05
Merck vitamin Mix #58C	.05	.05	.05	.05	.05	.05
Vitamin A and D[c]	.025	.025	.025	.025	.025	.025

[a] Supplement: soybean oil meal 55%, meat and bone scrap 20%, alfalfa meal 15%, and wheat middlings 10%.

[b] Contains 10 grams of zinc carbonate per pound of dicalcium phosphate.

[c] Contains 10,000 USP units of vitamin A and 3,000 USP units of vitamin D per gram.

in the pens for only 3 one-hour periods per day (morning, noon, and night).

RESULTS AND DISCUSSION

The Effect of Rations Containing 0, 20, and 40% Oats Upon Growth and Carcass Characteristics

Trial 1

The means and standard deviations of daily gains and feed efficiency are given in table 6. Those of the carcass characteristics are presented in table 7 and 7a.

Pigs on the basal ration gained 1.67 pounds per day and consumed 3.59 pounds of feed per pound of gain, while the pigs fed 40% oats gained 1.59 pounds per day and required 3.75 pounds of feed per pound of gain. However, the differences were too small to be significant. The average backfat of carcasses from the basal lot pigs was .1 inch thicker than carcasses from the 40% oat lot. Again, the difference was not significant. Mention is made of these non-significant differences because they fit into the general trend when all trials are compared (Figure 1). Other carcass traits were not affected regardless of the level of oats in the ration.

Table 6

Means and Standard Deviations of Feedlot Performance for Trial I

Ration	No. Pigs	Initial Weight (lbs.)	Average Daily Gains (lbs.)	Feed per Pound of Gain (lbs.)	Final Feedlot Wt. (lbs.)
I. Group Fed Pigs					
Basal	5	37.0	1.63 ± .15	3.53	210.4
+ 20% oats	5	37.0	1.64 ± .08	3.48	207.1
+ 40% oats	5	36.4	1.59 ± .05	3.74	210.6
II. Individually fed pigs					
Basal	4	46.2	1.73 ± .08	3.67 ± .18	207.2
+ 20% oats	4	45.0	1.63 ± .13	3.63 ± .11	211.1
+ 40% oats	4	45.0	1.58 ± .08	3.76 ± .11	205.7
III. Combined--group and individually fed pigs					
Basal	9	41.1	1.67 ± .05	3.59	209.0
+ 20% oats	9	40.6	1.64 ± .04	3.54	208.9
+ 40% oats	9	40.2	1.59 ± .03	3.75	208.5

Table 7

Means and Standard Deviations of Carcass Traits for Trial I

Ration	Av. Slaughter Weight (Lbs.)	Backfat[a] Thickness (In.)	Carcass[b] Length (In.)	Dressing Percentage	Percent Fat Trim
Group Fed Pigs					
Basal	200.5	1.98 ± .28	28.9 ± .70	76.0 ± 1.07	27.2 ± 2.10
20% oats	195.4	1.83 ± .05	28.9 ± .37	75.4 ± .95	26.8 ± 1.38
40% oats	199.5	1.90 ± .11	28.0 ± .72	75.0 ± 1.25	27.1 ± 3.22
Individually Fed Pigs					
Basal	195.6	1.94 ± .20	28.4 ± .78	75.5 ± 1.67	25.2 ± 2.89
20% oats	200.6	1.99 ± .06	28.6 ± .74	75.1 ± .97	26.6 ± 1.13
40% oats	196.0	1.82 ± .21	28.1 ± 1.62	77.1 ± 2.00	25.3 ± 3.41
Combined--Group and Individually Fed Pigs					
Basal	198.3	1.96 ± .08	28.8 ± .26	75.8 ± .46	26.3 ± .89
20% oats	197.7	1.90 ± .03	28.8 ± .19	75.3 ± .32	26.7 ± .42
40% oats	197.9	1.86 ± .06	28.1 ± .39	75.9 ± .66	26.3 ± 1.14

[a]Average thickness measured at first, seventh, and last rib and last lumbar.

[b]Measured from the anterior edge of aitchbone to the anterior edge of the first rib.

Table 7A

Means and Standard Deviations of Carcass Traits for Trial I (Continued)

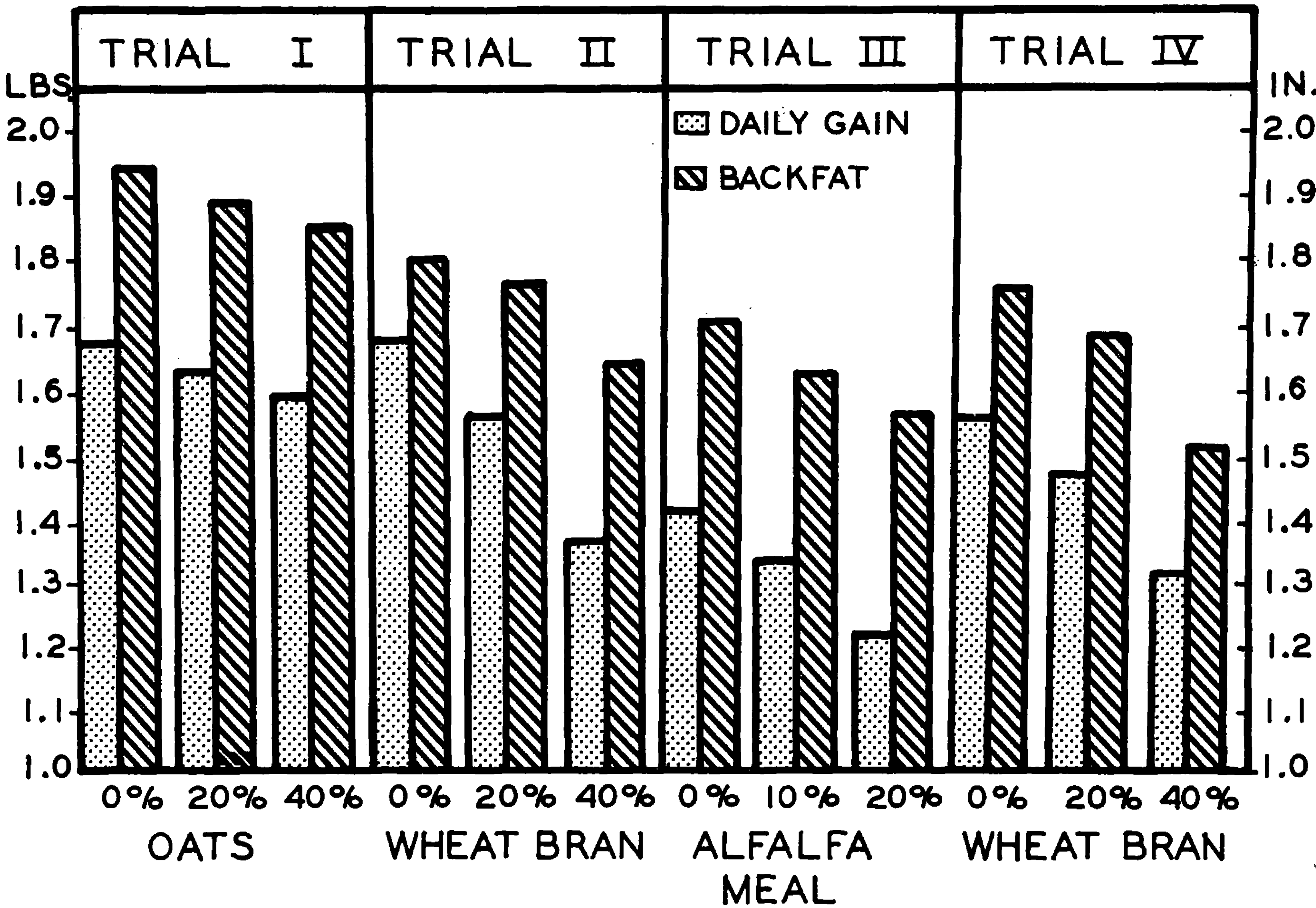
Ration	Lean Cuts[a] Live Basis Percent	Lean Cuts[a] Carcass Basis Percent	Primal Cuts[b] Live Basis Percent	Primal Cuts[b] Carcass Basis Percent	Area Longissimus Dorsi Tenth Rib Sq. In.	Area Longissimus Dorsi Last Rib Sq. In.
Group Fed Pigs						
Basal	35.0 ± .77	46.1 ± 1.36	46.0 ± .67	60.6 ± 1.21	3.1 ± .56	3.3 ± .49
20% oats	35.2 ± 1.98	46.6 ± 2.18	46.4 ± 1.48	61.5 ± 1.52	3.0 ± .44	3.1 ± .39
40% oats	35.2 ± 2.36	46.9 ± 3.39	46.1 ± 2.21	61.5 ± 3.38	2.9 ± .43	3.3 ± .54
Individually Fed Pigs						
Basal	36.2 ± 2.53	47.9 ± 2.34	46.7 ± 2.46	61.8 ± 2.07	3.4 ± .36	3.8 ± .72
20% oats	35.0 ± 1.28	46.6 ± 1.77	46.0 ± 1.31	61.2 ± 1.66	3.3 ± .34	3.5 ± .43
40% oats	36.3 ± .79	47.1 ± 1.63	47.1 ± 1.19	61.2 ± 2.38	3.5 ± .13	3.5 ± .14
Combined--Group and Individually Fed Pigs						
Basal	35.5 ± .62	46.9 ± .70	46.4 ± .57	61.1 ± .59	3.2 ± .17	3.5 ± .22
20% oats	35.1 ± .57	46.6 ± .67	46.2 ± .47	61.4 ± .53	3.1 ± .14	3.3 ± .14
40% oats	35.7 ± .65	46.9 ± .92	46.6 ± .64	61.4 ± 1.01	3.2 ± .16	3.4 ± .14

[a]Includes New York shoulder, loin, and ham.

[b]Includes New York shoulder, loin, ham, and belly.

FIGURE I

EFFECT OF FIBER ON DAILY GAIN AND BACKFAT



The Effect of Rations Containing 0, 20, and 40% Wheat Bran Upon Growth and Carcass Characteristics

Trial II

Means and standard deviations of daily gains and feed efficiency are presented in table 8, while those for the carcass traits are given in table 9 and 9a.

In the second trial, one pig in the group fed 20% bran lot had to be removed from the experiment because of extremely poor growth. The data were treated for missing values as outlined by Goulden (1952).

Pigs fed the 40% wheat bran ration grew at a significantly lower rate ($P < 0.01$) than those fed the basal ration. Pigs receiving the basal ration required significantly less ($P < 0.05$) feed per pound of gain than either those receiving the 20% or 40% bran rations (table 8). The 40% wheat bran pigs tended to yield leaner carcasses than those from the basal lot as indicated by backfat thickness and percent fat trim (table 9). However this trend was not significant. There was a trend for the percentage of primal cuts (carcass basis) to increase as the bran was increased in the ration, but at a non-significant rate. Carcass length and dressing percentage were not measurably affected by the different levels of bran in the ration.

Table 8

Means and Standard Deviations of Feedlot Performance for Trial II

Ration	No. Pigs	Initial Weight (Lbs.)	Average Daily Gains (Lbs.)	Feed per Pound of Gain (Lbs.)	Final Feedlot Wt. (Lbs.)
I. Group Fed Pigs					
Basal	5	27.8	1.57 ± .17	3.50	208.3
+ 20% Wheat Bran	5	27.3	1.45 ± .11	3.56	206.0
+ 40% Wheat Bran	5	27.8	1.35 ± .04*	4.02	208.6
II. Individually Fed Pigs					
Basal	5	52.3	1.79 ± .09	3.80 ± .11	209.5
+ 20% Wheat Bran	5	52.5	1.70 ± .16	4.50 ± .34	207.8
+ 40% Wheat Bran	5	52.7	1.41 ± .08**	4.66 ± .17*	205.6
III. Combined--Group and Individually Fed Pigs					
Basal	9	38.7	1.67 ± .06	3.63	208.8
+ 20% Wheat Bran	9	39.8	1.57 ± .08	4.08	206.9
+ 40% Wheat Bran	9	38.9	1.37 ± .02**	4.30	207.3

* (P .05)
** (P .01)

Table 9

Means and Standard Deviations of Carcass Traits for Trial II

Ration	Av. Slaughter Weight (Lbs.)	Backfat[a] Thickness (In.)	Carcass[b] Length (In.)	Dressing Percentage	Percent Fat Trim
Group Fed Pigs					
Basal	200.3	1.85 ± .12	28.1 ± .92	75.1 ± .97	28.9 ± 1.97
20% Wheat Bran	195.0	1.80 ± .28	27.5 ± .77	74.7 ± 2.62	27.6 ± 3.76
40% Wheat Bran	198.6	1.62 ± .05	28.3 ± .41	73.4 ± 1.39	26.3 ± 1.81
Individually Fed Pigs					
Basal	200.0	1.77 ± .18	28.3 ± .44	74.9 ± 1.54	27.1 ± 1.90
20% Wheat Bran	197.0	1.74 ± .12	27.8 ± .10	75.0 ± 1.11	25.8 ± 1.30
40% Wheat Bran	194.9	1.70 ± .19	27.9 ± .43	75.2 ± .36	25.7 ± 3.75
Combined--Group and Individually Fed Pigs					
Basal	200.2	1.81 ± .05	28.2 ± .25	75.0 ± .42	28.1 ± .72
20% Wheat Bran	196	1.77 ± .07	27.7 ± .22	74.7 ± .75	26.7 ± .99
40% Wheat Bran	196.9	1.65 ± .04	28.1 ± .15	74.2 ± .54	25.9 ± .93

[a]Average thickness measured at the first, seventh, and last rib and last lumbar.

[b]Measured from the anterior edge of aitchbone to the anterior edge of the first rib.

Table 9A

Means and Standard Deviations of Carcass Traits for Trial II (Continued)

Ration	Lean Cuts[a]		Primal Cuts[b]		Area Longissimus Dorsi	
	Live Basis Percent	Carcass Basis Percent	Live Basis Percent	Carcass Basis Percent	Tenth Rib Sq. In.	Last Rib Sq. In.
Group Fed Pigs						
Basal	36.4 ± .86	48.4 ± 1.39	46.2 ± 1.31	61.6 ± 1.45	3.4 ± .59	3.4 ± .62
20% Bran	35.3 ± 1.81	47.1 ± 2.99	46.0 ± 1.41	61.5 ± 2.30	3.4 ± .63	3.4 ± .58
40% Bran	35.9 ± 1.64	49.3 ± 1.47	46.6 ± 2.77	64.0 ± 2.81	3.3 ± .45	3.5 ± .56
Individually Fed Pigs						
Basal	35.8 ± 1.56	47.8 ± 1.93	46.9 ± 1.43	62.5 ± 2.58	3.1 ± .23	3.2 ± .42
20% Bran	36.6 ± 1.35	48.9 ± 1.28	48.1 ± 1.18	64.1 ± .67	3.2 ± .21	3.3 ± .24
40% Bran	36.9 ± 1.42	49.1 ± 1.69	48.8 ± 1.23	64.8 ± 1.43	3.4 ± .43	3.5 ± .67
Combined--Group and Individually Fed Pigs						
Basal	36.1 ± 1.17	48.1 ± .55	46.6 ± 1.33	61.9 ± .69	3.3 ± .48	3.3 ± .53
20% Bran	35.9 ± 1.81	48.0 ± .81	47.1 ± 1.72	62.8 ± .69	3.3 ± .50	3.4 ± .43
40% Bran	36.4 ± 2.62	49.2 ± .52	47.6 ± 2.38	64.3 ± .78	3.4 ± .41	3.5 ± .57

[a]Includes the New York shoulder, loin, and ham.

[b]Includes the New York shoulder, loin, ham, and belly.

The full large intestine was significantly heavier ($P < 0.05$) in pigs fed the 40% bran ration than those on the basal ration; however, there was no significant difference in the weight of the empty large intestines. Neither the weight of the stomach both full and empty, nor the volume of the stomach (as measured by the amount of water required to fill it) were significantly affected by the various levels of bran in the ration (table 10).

Trial IV

Table 11 shows the means and standard deviations for daily gains and feed efficiency. Tables 12 and 12A show the means and standard deviations for the carcass characteristics.

In the fourth trial pigs receiving the 40% bran ration gained at a significantly slower rate ($P < 0.05$) and consumed more feed per pound of gain ($P < 0.01$) than those receiving the basal ration. Carcasses from the 40% bran lot had significantly less ($P < 0.01$) backfat thickness than those from the basal of 20% bran lots. This was accompanied by a lower percent fat trim ($P < 0.01$) in carcasses from the 40% bran lot as compared with those from the basal lot. The percentage of lean and primal cuts (carcass basis) was

Table 10

Mean Weight and Standard Deviation of Stomach, Intestines, and Contents

	Trial II			Trial III			Trial IV		
	Basal lbs.	20% Bran lbs.	40% Bran lbs.	Basal lbs.	10% Alfalfa lbs.	20% Alfalfa lbs.	Basal lbs.	20% Bran lbs.	40% Bran lbs.
Wt. of full stomach	1.6± .13	1.7±.37	1.9± .37	1.5±.22	1.6± .26	1.7±.28	1.8± .38	1.8± .21	2.1± .11
Wt. of empty stomach	1.3± .11	1.5±.19	1.6± .19	1.2±.15	1.3± .12	1.2±.12	1.3± .11	1.5± .17	1.7± .19
Wt. of small intestine	4.0± .23	3.6±.39	3.7± .84	3.8±.50	4.3±1.27	4.3±.72	4.1± .66	4.1± .51	4.2± .65
Wt. of full large intestine	8.2±1.34	8.7±.76	9.6±1.14*	6.2±.77	7.1±1.88	7.2±.98	7.2±1.01	8.7±1.32	9.7±2.51*
Wt. of empty large intestine	5.5±1.02	5.1±.69	5.4± .95	4.1±.98	4.0± .50	4.3±.60	4.2± .91	4.7± .44	4.8± .73
Fill in large intestine	2.7±1.06	3.6±.83	4.2± .75*	2.1±.65	3.1±1.57	2.9±.69	3.0±1.04	4.0±1.12	4.9±1.91*

*Significant at the 5% level.

Table 11

Means and Standard Deviations of Feedlot Performance for Trial IV

Ration	No. Pigs	Initial Weight (lbs.)	Average Daily Gains (lbs.)	Feed per Pound of Gain (lbs.)	Final Feedlot Wt. (lbs.)
I. Group Fed Pigs					
Basal	5	34.8	1.60 ± .13	3.43	214.4
+ 20% Wheat Bran	5	34.6	1.56 ± .15	3.62	209.8
+ 40% Wheat Bran	5	34.6	1.38 ± .06*	3.95	208.4
II. Individually Fed Pigs					
Basal	4	28.7	1.52 ± .08	3.55 ± .06	215.7
+ 20% Wheat Bran	4	30.0	1.38 ± .15	4.00 ± .21	214.0
+ 40% Wheat Bran	4	29.7	1.26 ± .31	4.65 ± .05**	210.7
III. Combined--Group and Individually Fed Pigs					
Basal	9	32.0	1.56 ± .04	3.48	215.0
+ 20% Wheat Bran	9	32.5	1.48 ± .06	3.79	211.6
+ 40% Wheat Bran	9	32.4	1.33 ± .07*	4.26	209.4

* $P < .05$
** $P < .01$

Table 12

Means and Standard Deviations of Carcass Traits for Trial IV

Ration	Av. Slaughter Wt. (Lbs.)	Backfat[a] Thickness (In.)	Carcass[b] Length (In.)	Dressing Percentage	Percent Fat Trim
Group Fed Pigs					
Basal	203.2	1.80 ± .16	29.0 ± .43	74.0 ± .95	27.5 ± 2.23
20% Wheat Bran	197.1	1.70 ± .12	29.3 ± .69	72.4 ± 1.34	26.9 ± 2.08
40% Wheat Bran	194.1	1.54 ± .12	29.6 ± .44	71.4 ± 1.56	23.9 ± 2.19
Individually Fed Pigs					
Basal	204.5	1.73 ± .11	29.3 ± .61	74.3 ± 1.71	27.3 ± 1.63
20% Wheat Bran	201.7	1.70 ± .07	29.9 ± .21	73.7 ± .61	23.8 ± .70
40% Wheat Bran	197.0	1.49 ± .04	30.1 ± .96	72.9 ± 1.58	21.9 ± 1.68
Combined--Group and Individually Fed Pigs					
Basal	203.8	1.77 ± .05	29.1 ± .18	74.1 ± .44	27.4 ± .66
20% Wheat Bran	199.2	1.70 ± .05	29.6 ± .21	73.0 ± .44	25.5 ± .80
40% Wheat Bran	195.4	1.52 ± .03***	29.8 ± .25	72.0 ± .62*	23.1 ± .75**

*($P < 0.05$)
**($P < 0.01$)
***($P < 0.01$) from both basal and 20% lots.
[a]Average thickness measured at the first, seventh, and last rib and last lumbar.
[b]Measured from the anterior edge of aitchbone to the anterior edge of the first rib.

Table 12A

Means and Standard Deviations of Carcass Traits for Trial IV (Continued)

Ration	Lean Cuts[a]		Primal Cuts[b]		Area Longissimus Dorsi	
	Live Basis Percent	Carcass Basis Percent	Live Basis Percent	Carcass Basis Percent	Tenth Rib Sq. In.	Last Rib Sq. In.
Group Fed Pigs						
Basal	36.1 ± 1.85	48.8 ± 2.46	46.4 ± 1.74	62.7 ± 2.25	3.3 ± .32	3.1 ± .29
20% Bran	34.8 ± 1.78	48.2 ± 2.74	45.3 ± 1.62	62.5 ± 2.74	3.1 ± .36	3.2 ± .29
40% Bran	36.6 ± 1.56	51.4 ± 1.88	46.5 ± 1.81	65.3 ± 1.18	3.3 ± .36	3.2 ± .33
Individually Fed Pigs						
Basal	36.5 ± .91	49.0 ± .82	46.6 ± 1.03	62.7 ± 1.07	3.1 ± .42	3.4 ± .27
20% Bran	38.2 ± .77	51.6 ± .76	48.2 ± 1.25	65.3 ± 1.27	3.3 ± .24	3.5 ± 1.89
40% Bran	38.8 ± 2.35	53.1 ± 2.08	48.6 ± 1.87	66.6 ± 1.14	3.3 ± .38	3.5 ± .63
Combined--Group and Individually Fed Pigs						
Basal	36.3 ± 1.43	48.9 ± .64	46.5 ± 1.39	62.7 ± .61	3.2 ± .35	3.3 ± .30
20% Bran	36.3 ± 2.15	49.7 ± .95	46.6 ± 2.07	63.8 ± .90	3.2 ± .31	3.4 ± .28
40% Bran	37.6 ± 2.14	52.1 ± .73*	47.4 ± 2.04	65.8 ± .60*	3.3 ± .34	3.4 ± .48

*($P < 0.05$) from both the basal and 20% lots.
[a]Includes New York shoulder, loin, and ham.
[b]Includes New York shoulder, loin, ham, and belly.

significantly larger ($P < 0.05$) in carcasses from the 40% bran lot than in carcasses from either the basal or 20% bran lots. On the other hand, the dressing percentage of pigs from the 40% lot was significantly lower ($P < 0.05$) than that of the pigs from the basal lot. There was significantly more fill in the large intestines of pigs from the 40% bran lot than of pigs from the basal lot (table 15). Thus, the amount of feed and water retained in the digestive tract appeared to contribute some to the lower dressing percentage. The weights of the empty stomach, small intestine and empty large intestine were not significantly affected by any of the rations.

The Effect of Rations Containing 0, 10, and 20% Alfalfa Meal Upon Growth and Carcasses Characteristics

Trial III

The feedlot performance results are presented in table 13 while the results of the carcass traits are given in tables 14 and 14A. In this trial the daily gains of pigs in the basal lot were much lower than the average gains for the basal lots of the other

Table 13

Means and Standard Deviations of Feedlot Performance for Trial III

Ration	No. Pigs	Initial Weight (lbs.)	Average Daily Gains (lbs.)	Feed per Pound of Gain (lbs.)	Final Feedlot Wt. (lbs.)
I. Group Fed Pigs					
Basal	5	27.2	1.35 ± .13	3.45	208.4
+ 10% Alfalfa Meal	5	27.2	1.29 ± .09	3.80	210.6
+ 20% Alfalfa Meal	5	27.2	1.16 ± .15	4.43	207.6
II. Individually Fed Pigs					
Basal	4	45.0	1.50 ± .31	4.03 - .68	208.7
+ 10% Alfalfa Meal	4	44.5	1.39 ± .19	4.27 - .33	211.7
+ 20% Alfalfa Meal	4	44.3	1.30 ± .21	5.29 - .17	207.0
III. Combined--Group and Individually Fed Pigs					
Basal	9	35.1	1.41	3.70	208.5
+ 10% Alfalfa Meal	9	34.8	1.33	4.01	211.0
+ 20% Alfalfa Meal	9	34.7	1.22	4.81	207.3

Table 14

Means and Standard Deviations of Carcass Traits for Trial III

Ration	Av. Slaughter Wt. (Lbs.)	Backfat[a] Thickness (In.)	Carcass[b] Length (In.)	Dressing Percentage	Percent Fat Trim
Group Fed Pigs					
Basal	199.8	1.84 ± .27	28.5 ± .71	74.8 ± .81	25.8 ± 2.99
10% Alfalfa Meal	202.0	1.71 ± .19	28.8 ± 1.24	72.8 ± 2.20	26.5 ± 2.86
20% Alfalfa Meal	197.2	1.64 ± .10	28.8 ± .86	73.5 ± .41	24.1 ± 1.23
Individually Fed Pigs					
Basal	197.8	1.56 ± .14	29.1 ± .68	74.0 ± .65	25.7 ± 2.85
10% Alfalfa Meal	201.3	1.54 ± .06	29.7 ± .30	73.3 ± .44	24.5 ± 3.13
20% Alfalfa Meal	198.0	1.49 ± .09	29.7 ± .83	73.5 ± 2.41	23.8 ± 3.14
Combined--Group and Individually Fed Pigs					
Basal	198.8	1.71 ± .09	28.7 ± .26	74.5 ± .29	25.8 ± .97
10% Alfalfa Meal	201.6	1.63 ± .06	29.2 ± .33	73.0 ± .56	25.6 ± 1.05
20% Alfalfa Meal	197.5	1.57 ± .04	29.2 ± .33	73.5 ± .51	24.0 ± .75

[a]Average thickness measured at the first, seventh, and last rib and last lumbar.

[b]Measured from the anterior edge of aitchbone to the anterior edge of the first rib.

Table 14A

Means and Standard Deviations of Carcass Traits for Trial III (Continued)

Ration	Lean Cuts[a] Live Basis Percent	Lean Cuts[a] Carcass Basis Percent	Primal Cuts[b] Live Basis Percent	Primal Cuts[b] Carcass Basis Percent	Area Longissimus Dorsi Tenth Rib Sq. In.	Area Longissimus Dorsi Last Rib Sq. In.
Group Fed Pigs						
Basal	37.2 ± 1.75	49.7 ± 2.69	47.6 ± 1.86	63.6 ± 2.82	3.7 ± .45	4.0 ± .43
10% Alfalfa	36.9 ± 1.60	50.4 ± 1.73	47.8 ± 1.01	65.2 ± 1.93	3.7 ± .42	4.2 ± .53
20% Alfalfa	37.5 ± .97	50.9 ± 1.08	48.0 ± 1.16	65.4 ± 1.28	3.6 ± .49	4.0 ± .44
Individually Fed Pigs						
Basal	37.9 ± 2.31	51.2 ± 2.83	48.7 ± 2.15	65.8 ± 2.51	4.4 ± .56	4.1 ± .41
10% Alfalfa	37.8 ± 1.60	51.6 ± 2.04	47.9 ± 1.53	65.4 ± 1.81	4.1 ± .56	3.9 ± .59
20% Alfalfa	38.9 ± 2.20	52.9 ± 2.93	48.8 ± 1.96	66.4 ± 2.47	4.2 ± .71	4.2 ± .61
Combined--Group and Individually Fed Pigs						
Basal	37.5 ± 1.92	50.3 ± .95	48.1 ± 1.96	64.6 ± .97	3.9 ± .60	4.0 ± .40
10% Alfalfa	37.3 ± 1.58	50.9 ± .66	47.9 ± 1.18	65.3 ± .62	3.8 ± .51	4.1 ± .53
20% Alfalfa	38.1 ± 1.69	51.9 ± .78	48.4 ± 1.51	65.8 ± .65	3.9 ± .65	4.1 ± .50

[a]Includes New York shoulder, loin, and ham.

[b]Includes New York shoulder, loin, ham, and belly.

three trials. The author has no valid explanation for the reduced gains.

There were no significant differences due to treatment, in feedlot performance or carcass traits studied. However, certain trends are apparent. These include a tendency for the rate of gain to decrease as the level of alfalfa meal was increased (table 12). There was also a tendency for the carcasses from pigs on 20% alfalfa meal ration to be leaner than those from the basal lot as indicated by the backfat thickness and percent fat trim. There were no significant differences between treatments in the weight of any parts of the gastrointestinal tract.

DISCUSSION AND COMPARISONS OF COMBINED TRIALS

Figure 1, page 29, shows the general trend of the effects that the various rations had on daily gain and backfat thickness. There was a tendency for the daily gain and backfat thickness to decrease as the fiber content of the ration was increased. There was a correlation of .484 between daily gain and backfat thickness (see table 15). While this may not be a high correlation it does indicate that there is a tendency for the backfat thickness to decrease as the rate of gain is slowed up. Blunn and Baker (1947) reported a correlation of .29 between rate of gain and depth of backfat and Dickerson (1947) reported a correlation of .6 between rate of gain and degree of fatness. This is also in agreement with Crampton et al. (1954).

Carcasses can be divided into three main portions: bone, muscle, and fat; and a change in the percentage of any one of the three affects the percentage of the others. Since the bone is included in the lean and primal cuts, a decrease in the amount of fat would tend to increase percentage lean and primal cuts in

Table 15

Correlations

Correlation	Trial				
	I (Oats)	II (Bran)	III (Alfalfa)	IV (Bran)	Combined
Between fiber and daily gains	-.341	-.683**	-.415*	-.523**	-.429**
Between TDN and daily gains	.348	.663**	.329	.526**	.543**
Between fiber and backfat thickness	-.249	-.479**	-.306	-.668**	-.295**
Between TDN and backfat thickness	.245	.479**	.242	.666**	.481**
Between daily gains and backfat thickness	.353	.515**	-.085	.388*	.484**
Between fiber and percent fat trim	.023	-.351	-.284	-.659**	-.303**
Between TDN and percent fat trim	-.002	.341	.224	.696**	.367**
Between fiber and dressing percentage	.015	-.303	-.282	-.530**	-.172
Between TDN and dressing percentage	-.031	.289	.229	.537**	.366**
Between fiber and lean cuts (carcass basis)	.012	.395*	.08	.518**	.255**
Between TDN and lean cuts (carcass basis)	-.021	-.384*	-.218	-.513**	-.384**
Between fiber and primal cuts (carcass basis)	.052	.467*	.246	.546**	.266**
Between TDN and primal cuts (carcass basis)	-.048	-.454*	-.193	-.541**	-.425**

*Significant at .05. **Significant at .01.

the carcass. Therefore the other correlations given in table 15 are more or less related to the backfat thickness of the carcass. For this reason the individual correlations are not specifically discussed.

Carcass length and area of the longissimus dorsi were not measurably affected by any of the rations. The data indicate that the source of the fiber influenced the feedlot performance and such carcass characteristics as backfat thickness, percent of fat trim, lean and primal cuts, and dressing percentage. This is in support of work carried out by Forbes and Hamilton (1955) and Bohstedt and Fargo (1933).

HISTOLOGICAL STUDY

Tissues from the center of the fundus region of the stomach, anterior portion of the duodenum, and middle portion of the colon were fixed in a solution of FAA[1] for microscopic inspection. The tissues were imbedded in parafin, sectioned at 8 micra, cleared in xylene, and stained with hematoxylin and eosin to reveal cell arrangement.

Microscopic examination did not reveal any differences in thickness of smooth muscle or cell arrangement of the mucosa, that could be related to the rations fed.

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[1]Formalin, 15%; 95% ethanol, 80%; glacial acetic acid, 5%.

SUMMARY

Twenty-seven pigs were used in each of four trials designed to study the effect of replacing part of a basal ration with different fibrous feeds. Data were obtained on feedlot performance and carcass traits. In the first trial, oats replaced 20 and 40% of the basal ration. There were no significant differences between treatments in the first trial. In the second trial, wheat bran replaced 20 and 40% of the basal ration. In this trial, there was a highly significant ($P < .01$) decrease in daily gain accompanied by a significant ($P < .05$) increase in the feed required per pound of gain, between pigs receiving 40% wheat bran and those receiving the basal ration. In the third trial, alfalfa meal replaced 10 and 20% of the basal ration. The results exhibited nonsignificant trends similar to the second trial. Wheat bran was repeated in the fourth trial at the same levels as the second. In this trial, there was a significant ($P < .05$) decrease in rate of gain, backfat thickness, dressing percentage, and a highly significant ($P < .01$) decrease

in percent of fat trim and an increase in feed per pound of gain, between pigs receiving the 40% wheat bran ration and those receiving the basal ration. The carcasses of the 40% lot exhibited a significant ($P < .05$) increase in both the percent of lean cuts and primal cuts (carcass basis) over both the basal and 20% wheat bran lots. The large intestines from pigs fed the 40% wheat bran rations (trials II and IV) contained significantly ($P < .05$) more fecal material than those fed the basal rations. There were no significant differences, in the fill or any parts of the gastrointestinal tract, between the alfalfa rations. Carcass length or area of the *longissimus dorsi* at the tenth and last rib were not measurably affected by any of the treatments.

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APPENDIX

Appendix Table 1. Means and Standard Deviations for Feedlot Performance

Ration	Initial Weight lbs.	Average daily gains: Group[1] fed lbs.	Average daily gains: Individually fed[2] lbs.	Average daily gains: Combined[3] lbs.	Average feed per lb. of gain: Group[1] fed lbs.	Average feed per lb. of gain: Individually fed[2] lbs.	Average feed per lb. of gain: Combined[3] lbs.	Final Feed lot Weight lbs.
<u>Trial I</u>								
Basal	41.1	1.6±.15	1.7±.08	1.7±.05	3.5	3.6±.18	3.6	209
+20% Oats	40.6	1.6±.08	1.6±.13	1.6±.04	3.5	3.6±.11	3.5	209
+40% Oats	40.2	1.6±.05	1.6±.08	1.6±.03	3.7	3.7±.11	3.7	208
<u>Trial II</u>								
Basal	38.7	1.6±.17	1.8±.09	1.7±.06	3.5	3.7±.11	3.6	209
+20% Wheat Bran	39.8	1.5±.11	1.7±.16	1.6±.08	3.8	4.5±.34*	4.1	207
+40% Wheat Bran	38.9	1.4±.04	1.4±.08	1.4±.02**	4.0	4.6±.17*	4.3	207
<u>Trial III</u>								
Basal	35.1	1.4±.13	1.5±.31	1.4±.08	3.5	4.0±.68	3.7	208
+10% Alfalfa Meal	34.9	1.3±.09	1.4±.19	1.3±.05	3.8	4.3±.33	4.0	211
+20% Alfalfa Meal	34.8	1.2±.15	1.3±.21	1.2±.06	4.4	5.3±.17	4.8	207
<u>Trial IV</u>								
Basal	32.0	1.6±.13	1.5±.08	1.6±.04	3.4	3.5±.06	3.5	215
+20% Wheat Bran	32.5	1.6±.15	1.4±.15	1.5±.06	3.6	4.0±.21	3.8	212
+40% Wheat Bran	32.4	1.4±.06	1.3±.31	1.3±.07*	4.0	4.6±.05**	4.3	210

*Significant at 5% level.
**Significant at 1% level.
[1]There were 5 pigs per treatment.
[2]There were 4 pigs per treatment.
[3]There were 9 pigs per treatment.

Appendix Table 2. Means and Standard Deviations of Various Carcass Characteristics of Group Fed Lots

	Backfat thickness (inches)	Carcass length (inches)	Dressing percentage (Percent)	Lean cuts carcass basis (Percent)	Primal cuts carcass basis (Percent)	Percent of fat trim (Percent)
Trial I						
Basal	2.0 ± .28	28.9 ± .70	76.0 ± 1.07	46.1 ± 1.36	60.6 ± 1.21	27.2 ± 2.10
+20% Oats	1.8 ± .05	28.9 ± .37	75.4 ± .95	46.6 ± 2.18	61.5 ± 1.52	26.8 ± 1.38
+40% Oats	1.9 ± .11	28.0 ± .72	75.0 ± 1.25	46.9 ± 3.39	61.5 ± 3.38	27.1 ± 3.22
Trial II						
Basal	1.9 ± .12	28.1 ± .92	75.1 ± .97	48.4 ± 1.39	61.6 ± 1.45	28.9 ± 1.97
+20% Wheat Bran	1.8 ± .28	27.5 ± .77	74.7 ± 2.62	47.1 ± 2.99	61.5 ± 2.30	27.6 ± 3.76
+40% Wheat Bran	1.6 ± .05	28.3 ± .41	73.4 ± 1.39	49.3 ± 1.47	64.0 ± 2.81	26.3 ± 1.81
Trial III						
Basal	1.8 ± .27	28.5 ± .71	74.8 ± .81	49.7 ± 2.69	63.6 ± 2.82	25.8 ± 2.99
+10% Alfalfa Meal	1.7 ± .19	28.8 ± 1.24	72.8 ± 2.20	50.4 ± 1.73	65.2 ± 1.93	26.5 ± 2.86
+20% Alfalfa Meal	1.6 ± .10	28.8 ± .86	73.5 ± .41	51.0 ± 1.08	65.4 ± 1.28	24.1 ± 1.23
Trial IV						
Basal	1.8 ± .16	29.0 ± .43	74.0 ± .95	48.8 ± 2.46	62.7 ± 2.25	27.5 ± 2.23
+20% Wheat Bran	1.7 ± .12	29.3 ± .69	72.4 ± 1.34	48.2 ± 2.74	62.5 ± 2.74	26.9 ± 2.08
+40% Wheat Bran	1.5 ± .12	29.6 ± .44	71.4 ± 1.56	51.4 ± 1.88	65.3 ± 1.18	23.9 ± 2.19

Appendix Table 3. Means and Standard Deviations of Various Carcass Characteristics of Individually Fed Lots.

Trial	Backfat thickness (inches	Carcass length (inches)	Dressing percentage (percent)	Lean cuts carcass basis (percent)	Primal cuts carcass basis (percent)	Percent of fat trim (percent)
<u>Trial I</u>						
Basal	1.9 ± .20	28.4 ± .78	75.5 ± 1.67	47.9 ± 2.34	61.8 ± 2.07	25.2 ± 2.89
+20% Oats	2.0 ± .06	28.6 ± .74	75.1 ± .97	46.6 ± 1.77	61.2 ± 1.66	26.6 ± 1.13
+40% Oats	1.8 ± .21	28.1 ± 1.62	77.1 ± 2.00	47.1 ± 1.63	61.2 ± 2.38	25.3 ± 3.41
<u>Trial II</u>						
Basal	1.8 ± .18	28.3 ± .44	74.9 ± 1.54	47.8 ± 1.93	62.5 ± 2.58	27.1 ± 1.90
+20% Wheat Bran	1.7 ± .12	27.8 ± .10	75.0 ± 1.11	48.9 ± 1.28	64.1 ± .67	25.9 ± 1.30
+40% Wheat Bran	1.7 ± .19	28.0 ± .43	75.2 ± .36	49.1 ± 1.69	64.8 ± 1.43	25.7 ± 3.75
<u>Trial III</u>						
Basal	1.6 ± .14	29.1 ± .68	74.0 ± .65	51.2 ± 2.83	65.8 ± 2.51	25.7 ± 2.85
+10% Alfalfa Meal	1.5 ± .06	29.7 ± .30	73.3 ± .44	51.6 ± 2.04	65.4 ± 1.81	24.5 ± 3.13
+20% Alfalfa Meal	1.5 ± .09	29.7 ± .83	73.5 ± 2.41	53.0 ± 2.93	66.4 ± 2.47	23.8 ± 3.14
<u>Trial IV</u>						
Basal	1.7 ± .11	29.3 ± .61	74.3 ± 1.71	49.0 ± .82	62.7 ± 1.07	27.3 ± 1.63
+20% Wheat Bran	1.7 ± .07	29.9 ± .21	73.7 ± .61	51.6 ± .76	65.3 ± 1.27	23.8 ± .70
+40% Wheat Bran	1.5 ± .04	30.1 ± .96	73.0 ± 1.58	53.1 ± 2.08	66.6 ± 1.14	22.0 ± 1.68

Appendix Table 4. Means and Standard Deviation of Various Carcass Characteristics of Group and Individually Fed Lots Combined

Ration	Backfat thickness (inches)	Carcass length (inches)	Dressing percentage (percent)	Lean cuts carcass basis (percent)	Primal cuts carcass basis (percent)	Percent of fat trim (percent)
Trial I						
Basal	2.0 $\pm$ .08	28.8 $\pm$ .26	75.8 $\pm$ .46	46.9 $\pm$ .70	61.1 $\pm$ .59	26.3 $\pm$ .89
+20% Oats	1.9 $\pm$ .03	28.8 $\pm$ .19	75.3 $\pm$ .32	46.6 $\pm$ .67	61.4 $\pm$ .53	26.7 $\pm$ .42
+40% Oats	1.9 $\pm$ .06	28.1 $\pm$ .39	75.9 $\pm$ .66	47.0 $\pm$ .92	61.4 $\pm$ 1.01	26.3 $\pm$ 1.14
Trial II						
Basal	1.8 $\pm$ .05	28.2 $\pm$ .25	75.0 $\pm$ .42	48.1 $\pm$ .55	61.9 $\pm$ .69	28.1 $\pm$ .72
+20% Wheat Bran	1.8 $\pm$ .07	27.8 $\pm$ .22	74.7 $\pm$ .75	48.0 $\pm$ .81	62.8 $\pm$ .69	26.7 $\pm$ .99
+40% Wheat Bran	1.6 $\pm$ .04	28.1 $\pm$ .15	74.2 $\pm$ .54	49.2 $\pm$ .52	64.3 $\pm$ .78	26.0 $\pm$ .93
Trial III						
Basal	1.7 $\pm$ .09	28.7 $\pm$ .26	74.5 $\pm$ .29	50.3 $\pm$ .95	64.6 $\pm$ .97	25.8 $\pm$ .97
+10% Alfalfa Meal	1.6 $\pm$ .06	29.2 $\pm$ .33	73.0 $\pm$ .56	50.9 $\pm$ .66	65.3 $\pm$ .62	25.6 $\pm$ 1.05
+20% Alfalfa Meal	1.6 $\pm$ .04	29.2 $\pm$ .33	73.5 $\pm$ .51	51.9 $\pm$ .78	65.8 $\pm$ .65	24.0 $\pm$ .75
Trial IV						
Basal	1.8 $\pm$ .05	29.1 $\pm$ .18	74.1 $\pm$ .44	48.9 $\pm$ .64	62.7 $\pm$ .61	27.4 $\pm$ .66
+20% Wheat Bran	1.7 $\pm$ .05	29.6 $\pm$ .21	73.0 $\pm$ .44	49.7 $\pm$ .95	63.8 $\pm$ .90	25.5 $\pm$ .80
+40% Wheat Bran	1.5 $\pm$ .03[d]	29.8 $\pm$ .25	72.0 $\pm$ .62[a]	52.1 $\pm$ .73[c]	65.8 $\pm$ .60[c]	23.1 $\pm$ .75[b]

Nine pigs per treatment.
[a]Significant from basal ($P < 0.05$)
[b]Significant from basal ($P < 0.01$)
[c]Significant from both basal and 20% lot ($P < 0.05$).
[d]Significant from both basal and 20% lot ($P < 0.01$).