STUDIES WITH RECONSTITUTED WHEAT FOR FEEDLOT CATTLE

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Bachelor of Science

Kansas State University

Manhattan, Kansas

1970

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
May, 1973

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FOR FEEDLOT CATTLE

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ACKNOWLEDGMENTS

The author expresses his sincere appreciation to Dr. Donald G. Wagner, Associate Professor of Animal Science, for his counsel and guidance during the course of this study and in preparation of this thesis. Appreciation is also extended to Dr. I. T. Omtvedt, Dr. J. E. McCroskey, Dr. Robert Totusek and Dr. R. H. Thayer for their help in the preparation of this manuscript.

Grateful acknowledgment is also extended to Dr. Herman E. Kiesling for his assistance involving the net energy analysis and also to Jack W. Butterbaugh for his help in the analysis of the volatile fatty acid data.

The author is also grateful to Don Croka, Art Dean, Bill Holloway, Wilburn Holloway, Rodger Johnson, Bob Kropp, Keith Lusby, Mike Sharp, Peter Rounds, Ivan Rush and other fellow graduate students for their assistance and encouragement during the course of this study.

Further acknowledgment is also extended to David Holloway, David Sturgeon and Mike Thralls for their assistance handling the cattle and work conducted in the laboratory.

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CHAPTER I

INTRODUCTION

Wheat represents a major economic crop in Oklahoma. Production is now approaching 100 million bushels annually in normal crop years. This is nearly four times the quantity of milo produced in Oklahoma. Due to the low wheat prices during the past few years and the readily available supply of wheat, considerable quantities of wheat have been and are being fed to feedlot cattle.

The use of wheat in beef cattle rations is not new. As early as 1894, F. D. Coburn indicated in a survey of Kansas farmers that, "when corn and wheat approximate the same price per bushel, it is neither unprofitable nor wicked to feed the wheat." Since then many experiments have been done to study the correct procedure for feeding wheat.

In recent years, there has been much interest in the proper way to process wheat for beef cattle. In general, this interest has been generated by research results showing that some processing techniques, such as reconstitution, have proven beneficial for substantially increasing the nutritive value of some grains, particularly milo, for feedlot cattle. To date, practically no research has been done to study the influence of reconstituted wheat fed in high concentrate rations to finishing beef cattle. The object of this study, therefore, was to compare different methods of reconstituting wheat with dry rolled wheat and dry rolled milo for feedlot cattle.

CHAPTER II

LITERATURE REVIEW

High Moisture Harvested Grain

For many years it has been suggested that in some cases high moisture harvested grain compared favorably to dry or mature grain when fed to beef cattle. Kennedy et al. (1904) reported that corn which contained 35% moisture compared very favorably with mature dry corn when fed to finishing beef cattle. Since then much work has been done on harvesting, processing and storing high moisture grain.

Corn

Beeson and Perry (1958) conducted a trial in which high moisture (32% moisture) ground ear corn was stored in glass lined silos. They found that the high moisture ear corn is utilized 10 to 15% more efficiently than regular ground ear corn on a dry matter basis. Gains on the high moisture corn were essentially the same as on the dry ground corn.

Mohrman et al. (1959), compared digestion coefficients of corn harvested at 14.5% moisture to that of corn harvested at 25, 30 and 35% moisture, and found no significant differences between any of the treatments.

Heuberger et al. (1959) reported a 4% increase in feed efficiency with gains slightly higher and intake slightly lower for high moisture corn (24 and 29% moisture). However, corn ensiled at 36% moisture produced gains 20% less than for dry shelled corn, while both consumption and feed efficiency were 14% lower for the high moisture corn. Percent losses in the silo were least for the 36% and highest for the 29% corn (24% was intermediate).

Perry, Beeson and Cope (1959, 1960) found no advantage for high moisture harvested shelled corn. Gains and feed efficiency on the high moisture corn were slightly lower than on dry shelled corn from the same source. This was a result of lower feed intakes, which resulted in a reduced rate of gain.

On the contrary, Martin et al. (1969) reported that steers fed high moisture harvested milo or high moisture harvested corn gained 10% faster, with 19.0 and 23.9% greater feed efficiency on milo and corn, respectively, than steers on dry milo. Net energy values for this study followed the same trends as feed efficiency.

Martin et al. (1970) reported that steers fed high moisture harvested shelled corn not only gained faster, but required 0.95 and 1.43 lb less feed per lb of gain than dry shelled corn and high moisture harvested ear corn fed cattle, respectively.

Milo

Riggs *et al*. (1959) found that ground high moisture harvested sorghum grain (23% moisture) produced gains on finishing steers equal or superior to ground dry sorghum grain on 18% less grain (D.M. basis) and 12% less total feed (D.M. basis). The unground high moisture sorghum grain was stored successfully without spoilage in an air-tight, glass-lined silo. When moist ensiled grain was fed whole, it failed to produce satisfactory gain or finish when fed to yearling steers during a 126-day feeding trial. The animals fed the moist ground milo required 331 lb less grain per 100 lb of gain than did similar steers fed whole moist milo. Equal gains were observed on the ground moist grain and the dry ground grain.

Franke *et al*. (1960) compared dry and moist sorghum grain which contained 10 and 31% moisture, respectively, fed a growing and a fattening period. During the 112-day growing period, in which weaned steer calves were fed a full feed of roughage and 4 pounds of 31% early harvested high moisture or dry sorghum grain with a protein supplement, the cattle fed high moisture grain required 10% less feed (D.M.) per pound of gain. During the 140-day finishing period, the cattle fed dry sorghum grain required 17.6% more feed (D.M.) per pound of gain. During both periods combined, the groups fed dry sorghum grain required about 13% more feed to produce 100 lb of gain than those on moist grain. No significant differences in carcass grades and dressing percent were noted.

Brethour and Duitsman (1962) reported steers on preground high moisture (36%) ensiled sorghum grain were 12% more efficient than cattle fed dry grain. The steers on the preground high moisture grain also gained 2.76 lb per day compared to 2.39 for steers fed grain ground after ensiling. Since a concrete-lined trench silo was used, considerable loss was noted with the ensiled whole wet grain.

A year later, in a similar trial, Brethour and Duitsman (1963) ensiled high-moisture ground sorghum grain at two levels, 27 and 36%, and compared them to finely ground and coarsely rolled milo. The grain for both high moisture milo treatments was ground prior to ensiling in trench silos. Less dry matter was required per unit of gain with 36% moisture harvested milo than with 27% moisture milo. Cattle on the moist grain treatments required less feed per lb of gain than those which received dry grain. Daily gains and feed conversion ratios for 36% moisture, 27% moisture, finely ground and coarsely rolled milo were 2.78, 5.44; 2.78, 5.85; 2.73, 6.43; and 3.03, 6.51, respectively.

Brethour and Duitsman (1964) found no significant difference in gain or feed efficiency with 26% ensiled grain and dry rolled sorghum grain. Rate of gain and feed efficiency were 2.87, 9.60; and 2.95, 9.66 lb for the ensiled and dry rolled grain, respectively.

Neuhaus (1971) conducted *in vitro* studies to determine the effect of length of storage time, moisture level and temperature on digestibilities of high moisture harvested grain. Moisture levels of 13, 17, 22, 26, 30, and 36 percent; temperatures of 40, 75, and 110 degrees Fahrenheit; and storage periods of 10, 20, and 30 days were studied in a factorial design. All milo treatments were stored whole and ground prior to *in vitro* digestion. No significant difference in length of time stored was found although interaction was found between time and moisture. It was suggested that increased moisture was required to maintain or increase starch availability with increased time. The data showed time and temperature to be independent. Temperature was significantly detrimental at low moisture levels (below 26%) and beneficial at high moisture levels. This then suggested that higher moisture grains (above 26%) may be more efficiently utilized if stored anaerobically in the summer months. Moisture did have a significant effect on dry matter disappearance. Dry matter disappearance increased only slightly at 17 and 22% moisture levels compared to 13% moisture grain, but there was a substantial increase in digestion which occurred between 22 and 26% moisture at all time and temperature levels. The highest dry matter disappearance occurred at 35% moisture which also suggests that *in vitro* digestibility increases as moisture content of grain increases.

Reconstituted Grain

In recent years much interest has been directed toward reconstituting grain or the practice of adding water to and ensiling dry grain. By the mid 1960's, it was fairly well established that certain forms of high moisture harvested milo and corn were more efficient than dry grain. As a result, grains were then reconstituted in an effort to duplicate the chemical and physical properties of high moisture harvested grain.

Milo

Parrett et al. (1966) compared high moisture harvested (28% moisture) milo, dry milo reconstituted to 29.72% moisture, and dry milo. He reported that cattle fed reconstituted grain were 15% more efficient than those fed dry ground milo and only 2% less efficient than those fed the high moisture harvested milo. There were no significant differences in daily gain.

In a study which summarized seven feeding trials, McGinty and Riggs (1967) compared dry rolled milo to early harvested or reconstituted milo. Cattle fed early harvested grain required approximately 22% less grain and 11.5% less total dry matter. However, there were no significant differences in daily gain. It was proposed that the improved feed efficiencies were due to an alteration in the protein structure and/or the starch molecule which permitted more rapid fermentation in the rumen or more complete digestion in the small intestine.

Buchanan-Smith, Totusek and Tillman (1968) using 12 steers and 12 wethers conducted digestion trials in which they compared coarse ground, fine ground, steam processed and rolled and reconstituted sorghum grain from one source. The rations contained 78.26 and 21.74% milo and protein-mineral-vitamin supplement, respectively. The reconstituted sorghum grain was prepared by increasing the moisture content of the grain to 25.5% and storing the grain anaerobically for three weeks prior to rolling. In cattle, the digestibility of the reconstituted grain was significantly higher for dry matter, organic matter and non-protein organic matter than for the two dry processed forms.

McGinty, Breuer and Riggs (1967) used four yearling Angus bulls in a reversal trial to determine digestion coefficients for dry and reconstituted (29.72% moisture) sorghum grain. Digestion coefficients for dry matter, organic matter and non-protein organic matter for the dry and reconstituted grains were 64.42, 83.08; 66.06, 85.06; and 68.70, 89.10%, respectively. Protein digestibilities for the dry and reconstituted grains were 44.45 and 51.70%, respectively. These differences were significant, so it was suggested that reconstitution did improve the digestibility of sorghum grain.

Neuhaus (1971) conducted an experiment to determine the effects of moisture, time and temperature on the _in vitro_ digestion of reconstituted sorghum grain. A 6 x 3 x 3 factorial design was used in the experiment. The following factors were studied: moisture levels of 15, 18, 23, 26, 30 and 34%; temperatures of 40, 75 and 110 degrees Fahrenheit; and lengths of oxygen-free storage of 10, 20 and 30 days. The treatments were stored in both the whole and ground form. Analysis of moisture levels showed moisture had a significant effect on dry matter disappearance. It was noted that dry matter disappearance was not greatly increased by reconstituting the grain to 18 or 23% moisture; however, there was a substantial increase when the moisture level was increased to 26%, with further increases at the 30 and 34% moisture levels. This would suggest maximum utilization at the highest moisture levels studied. Time had a significant effect on dry matter disappearance. There was a higher percent dry matter disappearance for grain stored 20 days than for grain stored 10 days. This suggests that break-down of starch into a more available form may have occurred during the additional storage time. Additional storage time beyond 20 days (30 da.) increased dry matter disappearance only at the 30 and 34% moisture levels. Dry grain reconstituted to 30% showed a 11.1% greater percent dry matter disappearance in 10 days, with a further improvement of only 3.7% during the next 20 days. Temperature also significantly affected dry matter disappearance. Grain which contained 15, 18 and 23% moisture were affected very little by temperature during storage, while those which contained 26, 30 and 34% moisture showed a considerable increase in dry matter disappearance with increased temperature during storage. It was suggested then that high moisture levels are required in conjunction with the higher storage temperatures to realize maximum in vitro digestibility. It was noted that this does seem feasible since moisture is required in fermentation or degradation processes and since additional heat may serve as a catalyst in the reactions taking place during storage.

Brethour and Duitsman (1970) compared dry rolled milo, high moisture harvested (30% moisture) milo and reconstituted (30% moisture) milo. Both high moisture forms of the grain were rolled prior to ensiling in cement-lined trench silos. It was reported that exceptionally good performance was obtained from both ensiled grains. Rate of gain was significantly increased and feed conversion improved. The amount of dry milo replaced by 1 lb of high moisture harvested or reconstituted milo were 1.15 and 1.22 lb, respectively. This improved utilization of milo ensiled after the kernel was broken is contrary to previous findings by Texas and Oklahoma workers in which little or no improvement in feed utilization was obtained from reconstituted milo not ensiled in the whole form.

McGinty, Penic and Bowers (1968) compared milo which was ground prior to reconstitution and stored for 30 days, reconstituted whole for 30 days and then ground, and dry rolled milo. The cattle fed the dry rolled and preground reconstituted milo required 13 and 18% more dry matter per kg gain, respectively, than those fed the postground reconstituted grain.

Similar results were reported by Penic et al. (1968) when yearling steers were divided into three groups and fed a ration which contained 91% milo in one of the following forms: dry ground 10% moisture, reconstituted whole with 30% moisture, stored oxygen free for 21 days and ground prior to feeding, or ground milo which was reconstituted to 30% moisture and then stored oxygen free for 21 days. Reconstituting sorghum grain in the whole form increased efficiency 11%, while reconstituting the same grain in ground form failed to increase efficiency of utilization compared with ground dry grain. It is suggested that certain physical pathways of enzyme action for starch hydrolysis exist in the intact grain and that disruption of these pathways by grinding before reconstitution prevents the beneficial effects of the reconstitution process.

White et al. (1969) studied the feedlot performance of calves fed three types of processed milo: (1) fine ground-dry, (2) reconstituted ground (reconstituted whole, stored 21 days, ground before feeding), and (3) ground reconstituted (ground prior to reconstitution, stored for 21 days). Although feed intake was almost identical on all treatments, cattle on reconstituted-ground milo gained significantly faster than on ground-reconstituted milo. The calves on reconstituted-ground milo required 9.0% less feed per kg of gain than those on finely ground grain.

Neuhaus (1971) reported _in vitro_ fermentation studies which indicated that reconstituting sorghum grain in the ground form did not improve digestibility, but the whole form showed a significant improvement.

Martin _et al_. (1970) reported that cattle fed whole milo soaked for three days, allowed to sprout and then ground prior to ensiling required approximately 1.7 lb less feed per lb of gain than when milo was ensiled or reconstituted immediately after grinding.

The method of breaking the milo kernel after reconstituting and storing has been studied in Oklahoma. Totusek _et al_. (1967) reported that reconstituted milo, rolled or steam rolled prior to feeding, was 11.9% more efficient than coarsely rolled milo. Rolled reconstituted milo was 8.2% more efficient than dry rolled grain. Newsom (1968) reported that reconstituted whole milo which was rolled prior to feeding produced a significantly lower feed intake than that which was ground. The reconstituted ground and reconstituted rolled milo showed 5 and 14% improvements in feed efficiency, respectively, over dry coarsely ground milo. In a study by White _et al_. (1969), 5.92 lb of feed per lb of gain were required when cattle were fed reconstituted rolled milo as compared with 6.60 lb on reconstituted grain represent a substantial investment by the cattle feeder. Experiments have been conducted in Texas and

Oklahoma to determine minimum storage time necessary for maximum utilization.

Neuhaus (1971) concluded that digestibility of reconstituted grain increased as storage time increased from 1 to 32 days, especially at high moisture levels (30 and 34%). A large increase in digestibility was noted one day following reconstitution, with considerable, but diminishing, increases to 10 days, and from 10 to 20 days. There was little or no dry matter loss during oxygen-free storage.

McGinty et al. (1968) reported that heifers fed reconstituted milo ground after 10 and 20 days storage had feed conversion ratios of 5.21 and 5.10, respectively. These treatments were significantly different.

Pantin, Riggs and Bowers (1969) studied digestibility of reconstituted milo (28% moisture), stored either 10 or 20 days. The milo stored for 20 days had higher digestion coefficients, however, the difference was non-significant.

Neuhaus (1971) found that nearly one-half of the 15% increase in in vitro disappearance of reconstituted milo over dry milo occurred in the first day of oxygen-free storage. Indications are that more than one day of anaerobic storage is needed to alter the composition of milo to a more utilizable form.

Schneider (1971) conducted a trial to determine the effect of steeping and length of storage of reconstituted milo on the performance of finishing cattle. The treatments were (1) dry rolled, (2) reconstituted in whole form at 30%

moisture - stored five days and rolled, (3) reconstituted in whole form at 30% moisture - stored 10 days and rolled, (4) reconstituted in whole form at 30% moisture - stored 20 days and rolled, and (5) steeped in water for 48 hours, drained 24 hours and rolled. Although no significant difference was obtained in feed conversion for any of the treatments, mean values showed a tendency for the reconstituted 20-day treatment to be most efficiently converted, requiring 0.76 kg less feed per kg gain than the dry rolled treatment. This represents an 11.3% increase in feed utilization over dry rolled milo.

Wagner, Christiansen and Holloway (1971) reported a trial in which five methods of processing milo were used to study the influence of storage time and moisture level on the feeding value of whole reconstituted milo. The treatments compared were as follows: (1) dry rolled, (2) reconstituted whole - stored 10 days at 30% moisture, (3) reconstituted whole - stored 10 days at 38% moisture, (4) reconstituted whole - stored 20 days at 30% moisture, and (5) reconstituted whole - stored 20 days at 38% moisture. All four reconstituted milo treatments showed significant improvements in feed efficiency over dry rolled milo.

Corn

Larson, Embry and Nygard (1966) compared dry shelled corn and reconstituted high moisture corn (28% moisture) stored in air tight silos for 23 days. The corn was rolled prior to feeding. The average daily gains and feed conversion were not significantly different.

Matsushima and Stenquist (1967) compared dry ground corn with ground shelled corn reconstituted to 30% just prior to feeding. They concluded that as moisture in shelled corn was increased, daily consumption and rate of gain decreased. The average daily gain was 0.24 lb less for the moist corn, and the feed intake was 0.7 lb more feed per lb of gain.

In contrast to the previous studies, Henderson and Bergen (1970) observed favorable results from high moisture corn treatments. The treatments were as follows: (1) 20% ground hay - 80% rolled, dry, shelled corn; (2) 20% ground hay - 80% rolled, high moisture (33%) harvested, shelled corn; and (3) ensiled mixture of direct cut alfalfa and 80% ground, dry, shelled corn. The hay and dry corn fed steers gained 4% faster, but required 13% more feed per lb of gain than those fed the ensiled mixture. Gain and feed efficiency were not significantly different, however, between those fed the ensiled mixture or the high moisture harvested corn - ground hay ration.

Wheat

The value of wheat as a replacement for sorghum grain in high energy rations has been studied by Kansas and Oklahoma researchers. Brethour (1966) evaluated different levels of wheat and milo in finishing rations. The rolled grain portion of the three rations were fed as follows: (1) 100% milo, (2) 100% wheat, and (3) 50:50 ratio of milo and wheat. The average daily grain intake and lb of grain per lb of gain were, respectively: (1) 18.1, 5.40; (2) 14.3, 4.53; and (3) 16.6, 4.76. Feed efficiency was significantly greater on both wheat rations; however, it was noted that cattle which received wheat as the only grain scoured frequently and were difficult to keep on feed.

Totusek et al. (1968) compared the performance of steam rolled wheat, wheat-milo and milo rations. The three groups received 100% wheat, equal parts of milo and wheat or 100% milo, respectively, as the grain portion of their ration. Although differences were slight, gains and feed conversions favored milo (2.25, 6.65), followed by wheat (2.07, 6.96) and the combination of the two (2.05, 7.08). No significant differences were obtained for either the total or individual volatile fatty acids.

Richardson et al. (1967) made a study of different combinations of wheat and milo in finishing rations fed free choice with roughage fed at the rate of 4 lb per head per day. The grain portions of the rations were as follows: all milo, 75% milo and 25% wheat, 50% milo and 50% wheat, 75% wheat and 25% milo, and 100% wheat. Average daily gains were similar on all treatments. Average daily grain consumption and feed conversions were: 17.8, 6.26; 17.6, 6.26; 16.1, 5.81; 14.0, 5.18; and 14.4, 5.48 on the same treatments, respectively. Grain consumption was reduced on rations containing 50% and 75% wheat, although average daily gain remained similar. These results suggest that wheat was not as efficiently utilized by itself as when mixed with sorghum grain in finishing rations.

Brethour and Duitsman (1971) used five rations to study reconstituted wheat. The treatments consisted of rolled milo, rolled wheat and rolled milo in equal parts, rolled milo and reconstituted wheat in equal parts, all rolled wheat, and all rolled wheat plus 1/2 pound sodium bentonite per animal per day. The reconstituted wheat contained 28% moisture and was stored in plastic bags for at least two weeks. The wheat was then rolled just prior to feeding. It was noted that rolling the reconstituted wheat was difficult because the wet wheat was gummy and stuck to the rollers. A hard red winter variety, Scout, was used. The average daily gains and feed conversions on each treatment were 2.67, 9.44; 2.83, 7.65; 2.64, 8.55; 2.75, 6.92; and 2.30, 8.10, respectively. It was stated that they found no advantage in reconstituting wheat.

CHAPTER III

MATERIALS AND METHODS

General

Three feedlot trials were conducted to determine the effect of physical form of reconstituted wheat during storage on the feeding value of wheat for feedlot cattle. The processing methods were evaluated by feedlot performance, carcass merit, net energy value, and volatile fatty acid analysis. *In vitro* dry matter disappearance studies were conducted on each ration.

Identification of the three trials will be as follows: Trial I, 1970; Trial II, 1971; Trial III, 1971-72.

Experimental procedures common to all three trials will be discussed under the headings of allotment, grain processing methods, feeding, data obtained and net energy determination. A discussion of procedures specific for each trial will follow.

Allotment

Angus, Hereford and crossbred (Angus x Hereford x Holstein) steers were used in Trial I. Angus heifers were used in both Trials II and III. The calves selected for Trials I and II were from the University experimental herds.

Calves used for Trial III were purchased at the Oklahoma City stockyards and selected for uniformity of age and condition. In Trials I and II, the calves were blocked on the basis of weight and randomly assigned to treatment within each block. Because of the uniformity of the cattle in Trial III, the calves were not blocked, but assigned at random to each treatment.

Grain Processing Methods

The milo and wheat for the dry rolled treatments were rolled through a 12 x 18 inch roller mill with a roller spacing of .003 inch. (Each processing method studied will be discussed with its respective trial.) The wheat for all the reconstituted wheat treatments was reconstituted to 30% moisture, followed by storage in air tight plastic bags for 21 days prior to feeding. The wheat used was hard red winter wheat. Temperature during storage of the reconstituted grain was a minimum of 70 degrees F.

Feeding

A high concentrate ration of 90% concentrate and 10% roughage was fed *ad libitum* in all three trials. The rations were formulated to be isonitrogenous. The non-concentrate ingredients in the rations were combined into a premix. Diethylstilbestrol was fed at the level of 10 mg per head per day, with the exception of Trial I in which 36 mg was implanted per steer.

Feed was prepared and fed one time daily in quantities adequate to permit availability of feed until the next feeding. Any unconsumed feed was weighed back to assure a supply of fresh feed at all times. The cattle were gradually adapted to a high concentrate ration over a three-week preliminary period. All animals had access to an open-sided shed, outside lot and automatic waterers with thermostatically controlled heating.

Data Obtained

Performance data obtained included average daily gain, average daily feed intake, and feed per kilogram of gain. Daily feed consumption records were kept. Live shrunk weight was used to determine daily gain and feed per unit of gain. Initial and final weights were taken after a 16-hour shrink off feed and water in Trial I; whereas, in Trial II and III, the initial and final weights were taken full with a 4% pencil shrink. Intermediate weights were taken at 28-day intervals.

All animals were slaughtered at the termination of the feeding trials. Following a 24-hour chill, carcass data obtained included carcass grade, marbling, ribeye area, fat thickness over the ribeye, chilled carcass weight and percent kidney fat. From these data, dressing percentage and cutability were calculated.[1] The right side of the carcass was quartered, weighed first in air, and then in water to allow calculation of carcass specific gravity.

Grains were sieved and weights per bushel taken to characterize the processed grains as to particle size and density, respectively.

Rumen fluid samples were collected twice during the feeding period in Trials I and II, and once in Trial III. Samples were obtained by using an electric suction pump. Fluid was obtained via a tube inserted down the throat and esophagus to the rumen. All samples were taken approximately two hours after feeding. The rumen fluid was immediately checked for pH. A 40 ml sample was saved for volatile fatty acid analysis.

Duncan's New Multiple Range Test (Steele and Torrie, 1960) was used to compare treatment means whenever a significant F value was obtained.

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[1]Cutability, or percent boneless retail cut yield, was estimated by the equation of Murphey _et al_. (1960), which is:

$$Y = 52.66 - (5.33 \times A) - (0.979 \times B) + (0.665 \times C) - (0.008 \times D)$$ where,

Y = boneless retail cuts, as % of carcass
A = average fat thickness over ribeye (in)
B = % kidney fat
C = ribeye area (sq in)
D = chilled carcass weight (lb)

Net Energy Determinations

A representative slaughter group was used to estimate the initial composition of the experimental animals used in Trial I. Because of the great expense involved in obtaining slaughter samples, in Trials II and III, slaughter samples were used from previous studies at Oklahoma State, in which animals were very similar to those used in these two trials.

Carcass specific gravity was calculated by dividing carcass weight in air by carcass weight in air minus carcass weight in water. Net energy calculations and equations used for body composition were the same as those reported by Newsom (1968). Feed intake was on a pen basis; therefore, net energy values are valid only for a pen of animals. The computer program was designed to use the mean intake of a pen of animals to compare with the caloric gain and maintenance requirement of each animal. Final net energy values were obtained by averaging the mean values of the pens of cattle within each respective treatment.

In Vitro Dry Matter Disappearance

A modification of the Tilley and Terry procedure, as discussed by Schneider (1971), was used to determine *in vitro* digestibilities. Statistical design will be discussed with each respective study.

Volatile Fatty Acid Analysis

As soon as rumen fluid samples were collected from the animals, pH was measured. Mercuric chloride was then added to each sample to prevent further fermentation. The samples were immediately frozen. Later these samples were centrifuged and five ml portions of each sample were saved for gas liquid chromatography VFA analysis. Two injections of each sample were analyzed. Volatile fatty acid analysis was completed by the procedure of Ervin et al. (1961) with a Bendix Series 2,500 Gas Chromatograph.[2] Column length was 183.0 cm with an inside diameter of 2 mm. The column packing material used was 10% SP 1,200 on Chromasorb W, acid washed, 80/100 mesh.[3] Nitrogen, carrier gas, flow was maintained at 60 cc/min and hydrogen flow at 40 cc/min. Air flow was regulated to flow rate of 1.6 cc/min. Column temperature was maintained at 120° C. Calculation of VFA data was by the rectangular method suggested by Carroll (1961).

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[2]The Bendix Corporation, Ronceverte, W. Va.

[3]Supelco, Inc., Bellefonte, Pa.

Trial I

Allotment

Fifty Angus, Hereford and crossbred (Angus x Hereford x Holstein) steers, averaging 300.3 kg, were started on trial July 7, 1970, to compare four types of processed wheat using dry rolled milo as a control. The experimental design used for this trial is shown in Table I.

TABLE I

TRIAL I: EXPERIMENTAL DESIGN SHOWING NUMBER OF ANIMALS PER TREATMENT

	Treatments					
Blocks	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	Total Number
1	5	5	5	5	5	25
2	5	5	5	5	5	25
	10	10	10	10	10	50

The 50 steers were blocked into two groups on the basis of weight and randomly alloted within each block to the five treatments with equal breed distribution in each pen (one Angus, two Herefords and two crossbreds).

Processing Treatment

The rations used in this study were as follows:

(1) Dry rolled milo (DRM)
(2) Dry rolled wheat (DRW)
(3) Ground reconstituted wheat (GRW)
(4) Rolled reconstituted wheat (RRW)
(5) Whole reconstituted rolled wheat (WRRW)

The ground reconstituted wheat was obtained by grinding the wheat through a 1/8 inch hammermill screen prior to reconstitution and storage. The rolled reconstituted wheat was rolled through a 12 x 18 inch roller mill, as specified earlier, prior to reconstitution and storage. The whole reconstituted wheat was reconstituted in the whole form and then rolled just prior to feeding. Thus, the physical form of the reconstituted wheat during storage was either ground, rolled or whole, respectively.

Feeding

Each grain preparation was fed in a 90% concentrate mixture. The non-cereal grain ingredients in the ration were combined into a premix.

The compositions of the experimental rations are given in Table II for the dry rolled milo treatment and Table III for the four wheat treatments.

The proximate analysis of the respective grains are shown in Table IV.

TABLE II

TRIAL I: MILO RATION COMPOSITION

Ingredient	Percent [1]
Milo	84.00
Cottonseed Hulls	4.80
Alfalfa Meal	4.80
Soybean Meal	4.48
Urea	.64
Salt	.46
Dicalcium Phosphate	.40
Calcium Carbonate	.40
Aurofac 50	.02
	100.00
40,000,000 I.U. Vitamin A per 4,000 lb	

[1] 90% dry matter basis.

TABLE III

TRIAL I: WHEAT RATION COMPOSITION

Ingredient	Percent[1]
Wheat	70.00
Milo	18.59
Cottonseed Hulls	4.80
Alfalfa Meal	4.80
Urea	.48
Salt	.50
Dicalcium Phosphate	.40
Calcium Carbonate	.40
Aurofac 50	.02
Vitamin A (30,000 I.U./gm)	.01
	100.00

[1] 90% dry matter basis.

TABLE IV

TRIAL I: PROXIMATE ANALYSIS OF FEEDS EXPRESSED IN PERCENTAGE

Feedstuff	Dry Matter	Crude Protein[1]	Ash[1]	Ether Extract[1]	CHO[1,2]
Dry Rolled Milo	87.2	10.2[3]	1.4	2.9	85.5
Wheat					
Dry Rolled	89.2	13.4[4]	2.0	1.7	82.9
Ground Recon.	69.0	14.7[4]	2.1	1.0	82.2
Rolled Recon.	69.1	14.4[4]	2.1	1.2	82.3
Whole Recon. Rolled	69.4	14.1[4]	2.1	1.4	82.4
Premix	91.6	31.0[3]	12.7	1.3	55.0

[1]Values expressed on 100 percent D.M. basis.

[2]100 - (Sum of figures for crude protein, ash and ether extract).

[3]6.25 x percent Nitrogen = percent crude protein.

[4]5.71 x percent Nitrogen = percent crude protein.

Data Obtained

The experimental animals were slaughtered after 137 days on feed. Individual steer data were analyzed for average daily gain and carcass merit. Pen averages were used in net energy, feed intake, and feed conversion analyses. All variables were subjected to analyses of variance, the components of which are shown in Table V.

TABLE V

TRIAL I: ANALYSIS OF VARIANCE

Source	df
For Feed Intake, Feed/Kg Gain and Net Energy Values:	
Total	9
Blocks	1
Treatments	4
Block x Treatment[1]	4
For Average Daily Gain and Carcass Data:	
Total	49
Blocks	1
Treatments	4
Block x Treatment[1]	4
Within Pen	40

[1]Error term used to test treatments.

Rumen fluid pH values were determined twice during the feeding period. At each sampling a 40 ml sample was frozen for later volatile fatty acid analysis. VFA production was determined using a Bendix gas chromatograph. Total VFA production was analyzed statistically by the use of a computer program.

Table VI illustrates the relative particle size (determined on as-fed basis) and density of the various treatments used in this trial.

TABLE VI

TRIAL I: PARTICLE SIZE AND DENSITY OF MILO AND PROCESSED WHEAT

	Screen Size[1]							
	4mm	2mm	1mm	500 micron	250 micron	125 micron	Through 125 micron	Wt. per Bu[2]
	% Retained						Through	lb
DRM	0.0	6.4	67.1	12.9	7.8	1.8	4.0	38.0
DRW	0.1	39.9	45.0	8.6	2.6	1.5	2.4	35.5
GRW	0.8	59.6	36.6	1.9	0.9	0.2	0.1	28.5
RRW	7.6	79.0	12.6	0.5	0.2	0.1	0.0	26.4
WRRW	25.0	69.1	4.1	1.6	0.2	0.0	0.0	25.7

[1]Particle Size: Four 100 gm samples of each grain were sieved.

[2]Test weights reported are the average of four determinations and are on a 90% dry matter basis.

Net Energy Determination

Following the preliminary period prior to placing the cattle on the experimental treatments, twelve steers were selected at random as an initial slaughter sample.

The NE_{m+p} and NE_m values of the milo premix were estimated to be 97.890 (Morrison, 1959) and 110.890 (Lofgreen and Garrett, 1967) kcal per kg, respectively, while and NE_{m+p} and NE_m values of the wheat premix were estimated to be 117.781 and 138.183 (Lofgreen and Garrett, 1967) kcal per kg, respectively.

In Vitro Dry Matter Disappearance

An *in vitro* dry matter disappearance experiment was conducted to determine the effects of treatments studied in Trial I on *in vitro* dry matter digestibility. A randomized complete block design, as shown in Table VII, was used. The experiment was blocked on four rumen samples; each block represented a separate *in vitro* trial consisting of 12 samples of each treatment. The analysis of variance components are shown in Table VIII. The five grain treatments were the same as those described in Trial I.

TABLE VII

EXPERIMENT I: EXPERIMENTAL DESIGN FOR *IN VITRO* STUDY

Blocks	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	Total Number
1	12	12	12	12	12	60
2	12	12	12	12	12	60
3	12	12	12	12	12	60
4	12	12	12	12	12	60
	48	48	48	48	48	240

TABLE VIII

EXPERIMENT I: ANALYSIS OF VARIANCE FOR *IN VITRO* STUDY

Source	df
Total	139
Block	3
Treatment	4
Block x Treatment[1]	12
Sampling	220

[1]Error term used to test treatments.

Trial II

Allotment

Forty-eight Angus feeder heifers averaging 185.1 kg were started on trial January 8, 1970, to further evaluate reconstitution of wheat. The heifers were blocked into three groups on the basis of weight and then randomly allotted within blocks to four treatments with 4 animals per pen, allowing 12 animals per treatment.

TABLE IX

TRIAL II: EXPERIMENTAL DESIGN SHOWING NUMBER OF ANIMALS PER TREATMENT

Blocks	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	Total Number
1	4	4	4	4	16
2	4	4	4	4	16
3	4	4	4	4	16
	12	12	12	12	48

Processing Treatment

The treatments used in this trial were as follows:

(1) Dry rolled milo (DRM)
(2) Dry rolled wheat (DRW)
(3) Rolled reconstituted wheat (RRW)
(4) Whole reconstituted rolled wheat (WRRW)

The rolled reconstituted wheat was rolled through the roller mill, as specified earlier, prior to reconstitution and storage. The whole reconstituted rolled wheat was reconstituted in the whole form and then rolled just prior to being fed. Thus, the physical form of the wheat during storage of the reconstituted grain was either rolled or whole, respectively.

Feeding

A 90% concentrate feedlot ration was used. The composition of premix and complete rations was the same as those used in Trial I, except that diethylstilbestrol was fed at the rate of 10 mg per head per day rather than implanted. The composition of the milo and wheat rations is shown in Tables X and XI, respectively.

The proximate analyses of the milo and wheat are shown in Table XII.

TABLE X

TRIAL II: MILO RATION COMPOSITION

Ingredient	Percent[1]
Milo	84.00
Cottonseed Hulls	4.80
Alfalfa Meal	4.80
Soybean Meal	4.48
Urea	.64
Salt	.50
Dicalcium Phosphate	.42
Calcium Carbonate	.41
Aurofac 50	.02
Stilbestrol	.03
	100.00
40,000,000 I.U. Vitamin A per 4,000 lb	

[1]90% dry matter basis.

TABLE XI

TRIAL II: WHEAT RATION COMPOSITION

Ingredient	Percent[1]
Wheat	70.00
Milo	18.58
Cottonseed Hulls	4.80
Alfalfa Meal	4.80
Urea	.48
Salt	.48
Dicalcium Phosphate	.40
Calcium Carbonate	.40
Aurofac 50	.02
Vitamin A (30,000 I.U./gm)	.01
Stilbestrol 2	.03
	100.00

[1]90% dry matter basis.

TABLE XII

TRIAL II: PROXIMATE ANALYSIS OF FEEDS EXPRESSED IN PERCENTAGE

Feedstuff	Dry Matter	Crude Protein[1]	Ash[1]	Ether Extract[1]	CHO[1,2]
Dry Rolled Milo	87.2	10.6[3]	1.3	1.6	86.5
Wheat					
Dry Rolled	88.4	12.2[4]	1.6	1.0	85.2
Rolled Recon.	67.7	13.0[4]	3.3	1.7	82.0
Whole Recon. Rolled	68.6	13.0[4]	3.1	1.7	82.2
Wheat Premix	90.5	19.6[3]	11.5	1.6	67.3
Milo Premix	90.4	31.7[3]	11.3	1.5	55.5

[1]Values expressed on 100 percent D.M. basis.

[2]100 - (Sum of figures for crude protein, ash and ether extract).

[3]6.25 x percent Nitrogen = percent crude protein.

[4]5.71 x percent Nitrogen = percent crude protein.

Data Obtained

The heifers were slaughtered after 136 days on feed. Analyses of variance procedures were the same as those for Trial I. Variance components are shown in Table XIII.

TABLE XIII

TRIAL II: ANALYSIS OF VARIANCE

Source	df
For Feed Intake, Feed/Kg Gain and Net Energy Values:	
Total	11
Blocks	2
Treatments	3
Block x Treatment[1]	6
For Average Daily Gain and Carcass Data:	
Total	47
Blocks	2
Treatments	3
Block x Treatment[1]	6
Within Pen	36

[1]Error term used to test treatments.

The relative particle size and density of the grains are shown in Table XIV.

TABLE XIV

TRIAL II: PARTICLE SIZE AND DENSITY OF MILO AND PROCESSED WHEAT

	Screen Size[1]							Wt. per Bu[2]
	4mm	2mm	1mm	500 micron	250 micron	125 micron	Through 125 micron	
	% Retained						Through	lb
DRM	0.1	7.5	73.8	9.2	3.0	2.1	4.6	37.8
DRW	0.1	45.7	33.5	9.5	4.4	2.8	3.9	34.6
RRW	8.4	77.6	12.4	0.9	0.4	0.2	0.1	30.0
WRRW	28.5	65.8	4.7	0.7	0.2	0.1	0.0	28.7

[1]Particle Size: Four 100 gm samples of each grain were sieved.

[2]Test weights reported are the average of four determinations and are on 90% dry matter basis.

Net Energy Determination

The slaughter group used in this trial to estimate initial body composition was obtained from a previous study conducted at Oklahoma State University in which similar animals were put on test December 16, 1969.

The NE_{m+p} and NE_m values of the premixes for the milo and wheat rations were the same as those used in Trial I.

In Vitro Dry Matter Disappearance

The treatments studied in feeding Trial II were compared to determine *in vitro* dry matter disappearance. As shown in Table XV, a completely randomized block design was used.

TABLE XV

EXPERIMENT II: EXPERIMENTAL DESIGN FOR *IN VITRO* EXPERIMENT

Blocks	DRM	DRW	RRW	WRRW	Total Number
1	12	12	12	12	48
2	12	12	12	12	48
3	12	12	12	12	48
4	12	12	12	12	48
	48	48	48	48	192

This experiment was blocked on 4 rumen samples and each block represented a separate *in vitro* trial consisting of 12 samples of each treatment. The components of the analysis of variance are shown in Table XVI. The four grain treatments are the same as those described in Trial II.

TABLE XVI

EXPERIMENT II: ANALYSIS OF VARIANCE FOR *IN VITRO* EXPERIMENT

Source	df
Total	191
Block	3
Treatment	3
Block x Treatment[1]	9
Sampling	176

[1]Error term used to test treatments.

Trial III

Allotment

Forty-eight Angus heifers were started on trial September 25, 1971, to further compare methods of reconstituting wheat with dry rolled wheat. The initial weight of the heifers was 198.9 kg. The experimental design is presented in Table XVII. Animals were randomly assigned to pens.

TABLE XVII

TRIAL III: EXPERIMENTAL DESIGN SHOWING NUMBER OF ANIMALS PER TREATMENT

Blocks	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	Total Number
1	4	4	4	12
2	4	4	4	12
3	4	4	4	12
4	4	4	4	12
	16	16	16	48

Processing Treatment

The wheat for each treatment was processed as follows:

(1) Dry rolled (DRW)
(2) Whole reconstituted (WRW)
(3) Whole reconstituted rolled (WRRW)

The dry rolled wheat was rolled in the manner described previously. The whole reconstituted wheat was produced by reconstituting whole wheat to 30% moisture, storing it for 21 days and then feeding the wheat in the whole form without any further processing. The whole reconstituted rolled treatment was processed the same as it was in Trials I and II, in which the wheat was reconstituted to 30% moisture, stored in the whole form for 21 days and then rolled just prior to feeding.

Feeding

The three types of processed wheat were fed in a 90% concentrate mixture. As in the previous trials, the non-cereal grain ingredients in the ration were combined into a premix. The compositions of the wheat rations were the same as those used in Trial II shown in Table XI. In an effort to improve the low average daily gains of the cattle during the first few weeks of this trial, the protein contents of the rations were increased by using the premix composition of the dry rolled milo premix used in Trial II (Table X). This premix contained soybean meal and more urea than the premix used during the first 55 days of this trial. The proximate analyses of the feeds are shown in Table XVIII.

TABLE XVIII

TRIAL III: PROXIMATE ANALYSIS OF FEEDS EXPRESSED IN PERCENTAGE

Feed	Dry Matter	Crude Protein[1]	Ash[1]	Ether Extract[1]	CHO[1,2]
Dry Rolled Wheat	89.3	12.5[4]	1.7	1.4	84.4
Whole Recon. Wheat	63.9	12.7[4]	1.8	1.3	84.2
Whole Recon. Rolled Wheat	65.7	12.5[4]	1.8	1.3	84.4
Milo	88.2	10.0[3]	1.0	2.6	86.4
Premix #1	91.8	21.1[3]	9.3	2.7	66.8
Premix #2	91.2	34.0[3]	9.7	2.8	53.5

[1]Values expressed 100 percent D.M. basis.

[2]100 - (Sum of figures for crude protein, ash and ether extract).

[3]6.25 x percent Nitrogen = percent crude protein.

[4]5.71 x percent Nitrogen = percent crude protein.

Data Obtained

After 129 days on feed, the performance data were summarized.

Analyses of variance procedures were the same as those for Trial I. Variance components are presented in Table XIX.

TABLE XIX

TRIAL III: ANALYSIS OF VARIANCE

Source	df
For Feed Intake, Feed/Kg Gain and Net Energy Values:	
Total	11
Treatments	2
Pen within Treatments[1]	9
For Average Daily Gain and Carcass Data:	
Total	47
Treatments	2
Pen within Treatments[1]	9
Sampling Error[1]	36

[1]Pen within Treatments and Sampling Error sum of squares pooled to test treatments.

The relative density and particle size of the processed wheat are shown in Table XX.

TABLE XX

TRIAL III: PARTICLE SIZE AND DENSITY OF PROCESSED WHEAT

	Screen Size[1]							
	4mm	2mm	1mm	500 micron	250 micron	125 micron	Through 125 micron	Wt. per Bu[2]
	----------------	----------------	----------------	% Retained	----------------	----------------	Through	lb
DRW	0.8	36.9	40.4	11.8	5.0	2.4	2.7	38.2
WRW	12.1	86.8	0.8	0.2	0.1	0.0	0.0	35.5
WRRW	78.8	19.7	1.1	0.2	0.1	0.1	0.0	29.0

[1]Particle Size: Four 100 gm samples of each grain were sieved.

[2]Test weights reported are the average of four determinations and are on 90% dry matter basis.

Net Energy Determination

The slaughter groups used in this trial were obtained from a previous study conducted at Oklahoma State University. As in Trial II, the similarities between the animals in this trial and those of the trial from which the slaughter sample was taken were assumed to be sufficient to make the use of this data feasible.

In Vitro Dry Matter Disappearance

This experiment was conducted to study the effect of treatments studied in Trial III on *in vitro* dry matter digestibility. The randomized complete block design used in this experiment is shown in Table XXI.

The experiment was blocked on 4 rumen samples and each block represented a separate *in vitro* trial consisting of 12 samples of each treatment. The three grain treatments were the same as those described in Trial III. The analysis of variance components are shown in Table XXII.

TABLE XXI

EXPERIMENT III: EXPERIMENTAL DESIGN FOR *IN VITRO* EXPERIMENT

Blocks	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	Total Number
1	12	12	12	36
2	12	12	12	36
3	12	12	12	36
4	12	12	12	36
	48	48	48	144

TABLE XXII

EXPERIMENT III: ANALYSIS OF VARIANCE

Source	df
Total	143
Block	3
Treatments	2
Block x Treatment[1]	6
Sampling	132

[1]Error term used to test treatments.

CHAPTER IV

RESULTS AND DISCUSSION

Feedlot Trial I

Feedlot Performance

Feedlot performance for the steers on the five treatments is shown in Table XXIII.

Average daily feed intakes on the dry rolled milo, dry rolled wheat, ground reconstituted wheat, rolled reconstituted wheat and whole reconstituted wheat treatments were 11.32, 9.86, 9.91, 10.09 and 10.78 kg, respectively, on a 90% dry matter basis. Average daily gains were 1.63, 1.49, 1.53, 1.57 and 1.81 kg, and the kilograms of feed required per kilogram of gain were 6.94, 6.63, 6.46, 6.45 and 5.97 for the same treatments, respectively.

Although mean values for rate of gain and feed efficiency tended to favor the whole reconstituted wheat treatment, the differences were not significant ($P > .05$). Any tendency for a somewhat superior feed conversion on the whole reconstituted rolled wheat treatment might be explained by somewhat greater intakes and gains. Increased intakes on any given ration and/or increased gains are usually reflected in improved feed conversions in feedlot cattle due to dilution of the maintenance requirement.

TABLE XXIII

TRIAL I: FEEDLOT PERFORMANCE (137 DAYS)

Item	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
No. steers	10	10	10	10	10		
Initial live shrunk wt, kg	299.09	302.27	298.64	303.64	301.36		
Final live shrunk wt, kg	522.27	505.91	508.64	519.09	548.18		
Av. daily gain, kg	1.63	1.49	1.53	1.57	1.81	.13	4.15
Av. daily intake, kg	11.32	9.86	9.91	10.09	10.78	.43	2.06
Total feed/kg gain, kg	6.94	6.63	6.46	6.45	5.97	.10	4.64
Initial EBW, kg	270.18	272.85	269.99	274.18	272.28		
Final EBW, kg	487.14	479.57	477.20	481.28	506.67		
Av. daily EBW gain, kg	1.58	1.50	1.51	1.51	1.71	.07	2.33
Total feed/kg EBW gain, kg	7.24	6.54	6.59	6.76	6.34	.17	4.61

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

Net Energy

The net energy values for NE_{m+g} of the total ration and for NE_{m+g}, NE_m and NE_g of the grain are shown in Table XXIV.

TABLE XXIV

TRIAL I: NET ENERGY VALUES OF MILO AND PROCESSED WHEAT

Net Energy Value	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
	Mcal/100 kg						
NE_{m+g} of total ration[3]	129.0	144.9	139.6	135.9	137.5	3.87	2.23
NE_{m+g} of grain[6]	135.0	156.7	149.0	143.8	146.1	5.30	2.23
NE_m of grain[4,6]	149.1	175.2	162.1	154.6	161.7	--	--
NE_g of grain[5,6]	99.4	116.8	108.1	103.1	107.8	4.81	1.85

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Energy for gain and maintenance ÷ intake of total ration.

[4]NE_p x 1.50, (1.50 = ratio of NE_m to NE_p on basis of ave. crude fiber content).

[5]Determined by dividing maintenance requirement and energy gained between grain and premix on basis of ratio in ration.

[6]Grain refers to milo in the dry rolled milo ration (84% milo, 16% premix) and to the wheat in the wheat rations (70% wheat, 14% milo, 16% premix).

The NE_{m+g}, NE_m and NE_g of the grain in the wheat treatments refer only to the wheat, which made up 70% of the total ration. No significant differences ($P > .05$) existed between treatments for any of the net energy values.

Reconstitution did not appear to measurably increase the nutritive value of the wheat for feedlot cattle in this experiment as is normally the case for sorghum grain; however, palatability of the whole reconstituted wheat may have been slightly better as indicated by the somewhat higher feed intakes. Schneider (1970) reported higher NE values for milo than those found in this study. In his study, the NE_g for dry rolled milo was 112.9 Mcal/kg. In general, the relatively lower net energy values observed in this experiment support previous research at Oklahoma State University (Kiesling, 1972) suggesting that heavy, fast gaining cattle may show relatively lower net energy values for the feed they are consuming than lighter, slower gaining cattle.

Carcass Merit

Carcass characteristics, percent cutability and dressing percentage for the animals in the experiment are shown in Table XXV. No significant differences ($P > .05$) were found between treatments for any of the carcass traits measured.

TABLE XXV

FEEDLOT TRIAL I: CARCASS MERIT

Item	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
No. steers	10	10	10	10	10		
Dressing percentage[3]	59.2	60.0	59.3	59.8	58.7	0.81	0.43
Carcass grade[4]	9.4	9.4	10.5	9.1	9.7	1.79	1.47
Ribeye area, sq in[5]	12.19	12.26	12.06	12.30	12.09	0.04	0.11
Fat thickness, in[6]	0.85	0.78	0.78	0.76	0.82	0.07	0.30
Marbling[7]	14.8	14.3	14.0	13.7	15.4	0.31	4.66
Cutability, percentage[8]	47.9	48.3	48.3	48.53	47.74	0.36	0.87

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Calculated on basis of final live shrunk weight and chilled carcass weight.

[4]U.S.D.A. grades converted to following numerical designations: high prime-15, ave. prime-14, low prime-13, high choice-12, ave. choice-11, low choice-10, high good-9, ave. good-8, low good-7.

[5]Determined by measurements of ribeye tracings at the 12th rib.

[6]Average of three measurements on ribeye tracings.

[7]Marbling scores, 1=devoid minus to 30=abundant plus, with 3 scores per classification (minus, ave., plus).

[8]Percent of boneless trimmed retail cuts on carcass basis=52.66-5.33 (fat thickness)-0.979 (% kidney fat)+0.665 (ribeye area)-0.008 (chilled carcass wt).

Rumen pH

Mean pH values for the five treatments are shown in Table XXVI.

Although it is known that high levels of wheat may be prone to inducing a lower rumen pH under some circumstances, no significant differences ($P > .05$) existed in rumen pH between treatments in this experiment.

TABLE XXVI

FEEDLOT TRIAL I: RUMEN FLUID pH

	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]
First collection	5.7	5.4	5.3	5.5	5.9	.13
Second collection	5.6	5.4	5.8	5.6	5.6	.18

[1]Standard error of treatment means.

Volatile Fatty Acid Concentration

Rumen volatile fatty acid concentrations for Trial I are presented in Tables XXVII and XXVIII. When concentration was expressed in micromoles per mililiter (Table XXVII), no significant differences were found between treatments for any of the acids studied, except valeric acid. The ground reconstituted and rolled reconstituted wheat treatments showed a significantly ($P < .01$) higher valeric acid concentration compared to the dry rolled milo and whole reconstituted rolled wheat treatments. The same trend existed when volatile fatty acid concentration was expressed on a molar percent basis (Table XXVIII). Total volatile fatty acids are presented in Table XXVII. Although no significant differences were found between treatments for total VFA, the wheat treatments tended to have a higher total VFA concentration than the dry rolled milo treatment.

TABLE XXVII

FEEDLOT TRIAL I: VFA CONCENTRATION (MICROMOLES PER ML)

VFA	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$
Acetic	42.58	55.55	52.31	59.54	50.04	4.07
Propionic	47.69	54.38	50.87	55.88	50.18	4.47
Butyric	10.27	13.30	11.91	12.70	7.69	1.61
Isovaleric	1.91	1.53	2.05	2.76	1.74	0.65
Valeric[1]	2.26^{a}	3.70^{ab}	4.75^{b}	4.98^{b}	2.54^{a}	0.52
Total VFA	104.72	128.46	121.89	135.87	112.19	8.83

[1]Values with different superscripts differ significantly ($P < .01$).

TABLE XXVIII

FEEDLOT TRIAL I: VFA CONCENTRATION (MOLAR PERCENT)

VFA	Dry Rolled Milo	Dry Rolled Wheat	Ground Recon. Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$
Acetic	40.35	43.26	42.94	44.96	43.82	2.14
Propionic	46.12	42.76	42.19	39.82	45.54	2.35
Butyric	9.32	9.94	9.22	9.05	6.91	0.84
Isovaleric	1.83	1.24	1.77	2.49	1.48	0.57
Valeric[1]	2.39^{ae}	2.80^{acef}	3.88^{bdf}	3.68^{cdf}	2.25^{ae}	0.32

[1]abcd: Values with different superscripts differ significantly ($P < .05$), ef: Values with different superscripts differ significantly ($P < .01$).

Feedlot Trial II

Feedlot Performance

Feedlot performance data obtained on the four treatments during the 136-day feeding period are shown in Table XXIX.

The average daily feed intakes (90% DM basis) on the dry rolled milo, dry rolled wheat, rolled reconstituted wheat and whole reconstituted rolled wheat treatments were 7.98, 6.62, 6.69 and 7.16 kg, respectively. The heifers on the dry rolled milo consumed significantly ($P < .05$) more feed per day than those on the three wheat treatments. The average daily gains on the dry rolled milo, dry rolled wheat, rolled reconstituted wheat and whole reconstituted rolled wheat treatments were 1.26, 1.21, 1.12 and 1.23 kg, respectively. These differences in rate of gain were not significant ($P > .05$). The significantly lower feed intakes on the three wheat treatments with nearly the same rate of gain were reflected in significantly better feed efficiencies on the wheat treatments. The kilograms of feed required per kilogram of gain were 6.34, 5.51, 5.90 and 5.86 kg for the same treatments, respectively. The feed required per unit of gain for dry rolled milo and dry rolled wheat treatments differed significantly ($P < .05$) from each other and also from the reconstituted wheat treatment. The two reconstituted wheat treatments, however, were not significantly different ($P > .05$).

As can be observed in Table XXIX, the average daily gains for the animals on the three wheat treatments (70% wheat in the total ration) averaged .07 kg per day less than those on the milo treatment.

TABLE XXIX

TRIAL II: FEEDLOT PERFORMANCE (136 DAYS)

Item	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
No. heifers	12	12	12	12		
Initial live shrunk wt, kg	185.91	185.45	186.36	184.55		
Final live shrunk wt, kg	358.18	348.64	340.45	351.36		
Av. daily gain, kg	1.26	1.21	1.12	1.23	.08	1.65
Av. daily intake, kg[4]	7.98[a]	6.62[b]	6.69[b]	7.16[b]	.22	7.97[3]
Total feed/kg gain, kg[4]	6.34[a]	5.51[b]	5.90[c]	5.86[c]	.04	28.048[3]
Initial EBW, kg	183.87	183.02	184.21	182.68		
Final EBW, kg	356.33	337.03	337.85	349.09		
Av. daily EBW gain, kg	1.26	1.13	1.12	1.22	.04	1.95
Total feed/kg EBW gain, kg	6.72	6.13	5.98	5.88	.24	5.21

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Significant ($P < .05$).

[4]Values without a common letter differ significantly ($P < .05$).

Although the differences in rate of gain were not significant ($P > .05$) among the milo and wheat treatments in this experiment, due likely to inadequate numbers, the slightly lower average gain on the wheat treatments is a trend consistent with observations in other experiments conducted at Oklahoma State University in which 70% wheat was included in a finishing ration (Wagner, 1971). In general, it has been observed that rations containing this level of wheat usually appear to lower gains approximately .05-.11 kg per day compared to all milo rations. Lower levels of wheat would undoubtedly produce less effect.

Net Energy

Net energy values obtained on the four different treatments are presented in Table XXX.

Net energy values reported for the NE_{m+g} of the total ration and NE_{m+g} of the grain for the milo treatment were significantly lower ($P < .05$) than for the three wheat treatments. The NE_g values for dry rolled milo, dry rolled wheat, rolled reconstituted wheat and whole reconstituted rolled wheat were 104.3, 122.5, 136.9 and 130.6 Mcal/100 kg, respectively. The NE_g for dry rolled milo was significantly lower ($P < .05$) than for either of the reconstituted wheat treatments. No difference ($P > .05$) existed in the NE_g among any of the wheat treatments.

TABLE XXX

TRIAL II: NET ENERGY VALUES OF MILO AND PROCESSED WHEAT

Net Energy Value	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
	----------Mcal/100 kg----------					
NE_{m+g} of total ration[3,4]	132.9[a]	151.2[b]	159.3[b]	154.5[b]	3.89	7.37[8]
NE_{m+g} of grain[4,7]	139.3[a]	165.7[b]	177.5[b]	170.3[b]	5.40	9.51[8]
NE_m of grain[5,7]	156.4	183.8	205.4	195.9	--	--
NE_g of grain[4,6,7]	104.3[a]	122.5[ab]	136.9[b]	130.6[b]	5.72	6.11[8]

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Energy for gain and maintenance ÷ intake of total ration.

[4]Any two values with different superscripts differ significantly ($P < .05$).

[5]NE_p x 1.50, (1.50 = ratio of NE_m to NE_p on basis of ave. crude fiber content).

[6]Determined by dividing maintenance requirement and energy gained between grain and premix on basis of ratio in ration.

[7]Grain refers to milo in the dry rolled milo ration (84% milo, 16% premix) and to the wheat in the wheat ration (70% wheat, 14% milo, 16% premix).

[8]Significant ($P < .05$).

Carcass Merit

The four treatments in this trial produced carcasses that were not significantly ($P > .05$) different for any of the parameters measured (Table XXXI).

Rumen pH

Values obtained for pH in this study are shown in Table XXXII. The values for rumen pH did not differ significantly ($P > .05$) between treatments.

Volatile Fatty Acid Concentration

Volatile fatty acid concentrations for Trial II are shown in Tables XXXIII and XXXIV. Propionic acid expressed as micromoles per mililiter was significantly higher ($P < .05$) on the dry rolled wheat treatment than on the other treatments (Table XXXIII). Expressed as molar percent, the rolled reconstituted wheat treatment produced a significantly lower ($P < .05$) level of propionic acid than the dry rolled milo and dry rolled wheat treatments (Table XXXIV). The rolled reconstituted wheat showed a highly significant ($P < .01$) increase in valeric acid compared to the other three treatments. Other VFA parameters did not differ ($P > .05$) between treatments. As in Trial I, total VFA concentrations did not differ significantly ($P > .05$) between treatments, but tended to be higher on the wheat treatments.

TABLE XXXI

FEEDLOT TRIAL II: CARCASS MERIT

Item	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
No. heifers	12	12	12	12		
Dressing percentage[3]	62.04	59.24	61.35	61.67	1.12	1.25
Carcass grade[4]	9.25	9.08	10.50	9.58	.32	3.82
Ribeye area, sq in[5]	10.60	9.89	10.12	10.37	.28	1.22
Fat thickness, in[6]	0.81	0.65	0.71	0.69	.04	4.44
Marbling[7]	14.66	14.25	18.41	15.41	.94	3.96
Cutability percentage[8]	48.55	49.52	49.02	49.02	.42	.86

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Calculated on basis of final live shrunk weight and chilled carcass weight.

[4]U.S.D.A. grades converted to following numerical designations: high prime-15, ave. prime-14, low prime-13, high choice-12, ave. choice-11, low choice-10, high good-9, ave. good-8, low good-7.

[5]Determined by measurements of ribeye tracings at the 12th rib.

[6]Average of three measurements on ribeye tracings.

[7]Marbling scores, 1=devoid minus to 30-abundant plus, with 3 scores per classification (minus, ave., plus).

[8]Percent of boneless trimmed retail cuts on carcass basis=52.66-5.33 (fat thickness)-0.979 (% kidney fat)+0.665 (ribeye area)-0.008 (chilled carcass wt).

TABLE XXXII

FEEDLOT TRIAL II: RUMEN FLUID pH

	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]
First collection	6.5	5.7	5.7	6.2	.16
Second collection	6.3	6.8	7.1	7.3	.22

[1]Standard error of treatment means.

TABLE XXXIII

FEEDLOT TRIAL II: VFA CONCENTRATION (MICROMOLES PER ML)

VFA	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[2]
Acetic	44.01	55.43	44.98	45.71	3.52
Propionic[1]	45.77[a]	60.09[b]	41.65[a]	47.27[a]	4.39
Butyric	8.87	10.42	9.02	10.61	1.50
Isovaleric	1.08	0.74	1.22	1.08	.23
Valeric	2.68	3.49	4.21	3.06	.39
Total VFA	102.41	130.17	101.09	107.74	8.92

[1]Values without a common letter differ significantly ($P < .05$).

[2]Standard error of treatment means.

TABLE XXXIV

FEEDLOT TRIAL II: VFA CONCENTRATION (MOLAR PERCENT)

VFA	Dry Rolled Milo	Dry Rolled Wheat	Rolled Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[3]
Acetic	43.65	42.84	45.20	42.97	1.06
Propionic[1]	44.74[b]	46.23[b]	40.51[a]	44.15[ab]	1.29
Butyric	7.87	7.66	8.70	8.92	.90
Isovaleric	1.06	0.58	1.47	1.13	.26
Valeric[2]	2.69[c]	2.69[c]	4.11[d]	2.83[c]	.22

[1]Values with different superscripts differ significantly ($P < .05$).

[2]Values with different superscripts differ significantly ($P < .01$).

[3]Standard error of treatment means.

Feedlot Trial III

Feedlot Performance

Feedlot performance for the heifers in Trial III is presented in Table XXXV.

Average daily feed intakes on the dry rolled wheat, whole reconstituted wheat and whole reconstituted rolled wheat treatments were 4.83, 6.66 and 5.22 kg, respectively, on a 90% dry matter basis. The heifers consumed significantly ($P < .01$) more feed on the whole reconstituted wheat treatment than on either of the other two wheat treatments. Average daily gains were .76, .94 and .91 kg on the same treatments, respectively. The heifers fed the dry rolled wheat gained significantly ($P < .01$) less than those fed the whole reconstituted wheat and the whole reconstituted rolled wheat. The kilograms of feed required per kilogram of gain on the dry rolled wheat, whole reconstituted wheat and whole reconstituted rolled wheat were 7.15, 7.99 and 6.42, respectively. The heifers fed the whole reconstituted wheat required significantly ($P < .05$) more feed per kilogram of gain than the heifers fed the whole reconstituted rolled wheat. The dry rolled wheat treatment did not differ significantly ($P > .05$) in feed efficiency from either of the other two treatments. These results suggest that the whole reconstituted wheat fed whole was not utilized as efficiently as the whole reconstituted wheat rolled prior to feeding. Apparently, wheat must be processed by some means, such as rolling, to obtain maximum utilization of the grain by beef cattle.

TABLE XXXV

TRIAL III: FEEDLOT PERFORMANCE
(129 DAYS)

Item	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
No. heifers	16	16	16		
Initial live shrunk wt, kg	194.55	204.09	199.09		
Final live shrunk wt, kg	291.82	324.96	316.09		
Av. daily gain, kg[4]	.76[c]	.94[d]	.91[d]	.04	5.22[6]
Av. daily intake, kg[4]	4.83[d]	6.66[c]	5.22[d]	.23	18.78[6]
Total feed/kg gain, kg[3]	7.15[ab]	7.99[a]	6.42[b]	.35	5.13[5]
Initial EBW, kg	192.09	200.88	196.15		
Final EBW, kg	294.10	325.14	318.89		
Av. daily EBW gain, kg[4]	.79[c]	.96[d]	.95[d]	.04	10.52[6]
Total feed/kg EBW gain, kg[3]	6.90[ab]	7.87[a]	6.09[b]	.40	4.68[5]

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Values with different superscripts differ significantly ($P < .05$).

[4]Values with different superscripts differ significantly ($P < .01$).

[5]Significant ($P < .05$).

[6]Significant ($P < .01$).

Net Energy

Net energy values are presented in Table XXXVI. The net energy values of the grain refer only to the wheat component of the ration which made up 70% of the total ration on a 90% dry matter basis. No significant differences existed between treatments for any of the net energy values studied, although values did tend to be lower for the whole reconstituted wheat treatments when compared to the other two treatments.

Carcass Merit

Carcass traits are presented in Table XXXVII. A significant ($P < .05$) F value was obtained for dressing percentage. Comparison of treatment means indicated that the whole reconstituted wheat produced the highest dressing percent, with dry rolled wheat showing the lowest value. Whole reconstituted rolled wheat was not significantly ($P > .05$) different from the other two treatments.

The cattle fed the dry rolled wheat showed a significantly higher ($P < .05$) percent cutability than those fed the whole reconstituted wheat. Those fed whole reconstituted rolled wheat showed an intermediate value not significantly different ($P > .05$) from the other treatments. All other carcass traits showed no significant ($P > .05$) differences between treatments.

TABLE XXXVI

TRIAL III: NET ENERGY VALUES OF PROCESSED WHEAT

Net Energy Value	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
	--------Mcal/100 kg--------				
NE_{m+g} of total ration[3]	169.342	141.585	174.393	9.13	3.90
NE_{m+g} of grain[6]	194.738	155.084	201.954	12.92	3.82
NE_m of grain[4,6]	219.671	168.110	237.512	--	--
NE_g of grain[5,6]	146.447	112.073	158.341	15.36	2.45

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Energy for gain and maintenance ÷ intake of total ration.

[4]NE_p x 1.50, (1.50 = ratio of NE_m to NE_p on basis of ave. crude fiber content).

[5]Determined by dividing maintenance requirement and energy gained between grain and premix on basis of ratio in ration.

[6]Grain refers only to wheat (70% wheat, 14% milo, 16% premix).

TABLE XXXVII

FEEDLOT TRIAL III: CARCASS MERIT

Item	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[1]	F[2]
No. heifers	16	16	16		
Dressing percentage[3,9]	60.4[a]	62.0[b]	61.5[ab]	.44	3.70[10]
Carcass grade[4]	10.12	9.75	10.06	.36	.32
Ribeye area, sq in[5]	9.45	9.56	9.61	.21	.17
Fat thickness, in[6]	.62	.75	.66	.05	1.67
Marbling[7]	22.67	21.08	21.92	.95	.38
Cutability percentage[8,9]	49.46[a]	48.17[b]	48.84[ab]	.35	3.92[10]

[1]Standard error of treatment means.

[2]Calculated F value from analysis of variance.

[3]Calculated on basis of final live shrunk weight and chilled carcass weight.

[4]U.S.D.A. grades converted to following numerical designations: high prime-15, ave. prime-14, low prime-13, high choice-12, ave. choice-11, low choice-10, high good-9, ave. good-8, low good-7.

[5]Determined by measurements of ribeye tracings at the 12th rib.

[6]Average of three measurements on ribeye tracings.

[7]Marbling scores, 1=devoid minus to 30-abundant plus, with 3 scores per classification (minus, ave., plus).

[8]Percent of boneless trimmed retail cuts on carcass basis=52.66-5.33 (fat thickness)-0.979 (% kidney fat)+0.665 (ribeye area)-0.008 (chilled carcass wt).

[9]Any two values without a common letter differ significantly ($P < .05$).

[10]Significant ($P < .05$).

Rumen Fluid pH

Rumen fluid pH values are shown in Table XXXVIII. Whole reconstituted wheat produced a significantly ($P < .05$) higher fluid pH than either dry rolled wheat or whole reconstituted rolled wheat.

Volatile Fatty Acid Concentration

Tables XXXIX and XL show volatile fatty acid concentrations for Trial III. When concentration was expressed as micromoles per mililiter, the whole reconstituted wheat treatment produced a significantly ($P < .05$) greater butyric acid concentration. The same trend was observed when concentration was expressed as molar percent. The whole reconstituted wheat treatment produced a highly significantly greater ($P < .01$) butyric acid concentration. Propionic acid was also significantly ($P < .01$) lower on the whole reconstituted wheat treatment. Other acids did not differ significantly ($P > .05$) between trials. No significant difference ($P > .05$) was found between treatments in total VFA concentration.

TABLE XXXVIII

FEEDLOT TRIAL III: RUMEN FLUID pH

	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[3]	F
Rumen Fluid pH[1]	5.5[a]	6.4[b]	5.5[a]	.10	6.96[2]

[1]Values with different superscripts differ significantly ($P < .05$).

[2]Significant ($P < .05$).

[3]Standard error of treatment means.

TABLE XXXIX

FEEDLOT TRIAL III: VFA CONCENTRATION (MICROMOLES PER ML)

VFA	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[2]
Acetic	27.33	33.72	27.14	3.42
Propionic	30.85	26.15	33.68	3.83
Butyric[1]	8.56[a]	14.82[b]	7.96[a]	1.72
Isovaleric	2.07	4.20	2.05	.90
Valeric	4.77	5.51	5.68	.90
Total VFA	73.58	84.40	76.50	8.63

[1]Values without a common letter differ significantly ($P < .05$).

[2]Standard error of treatment means.

TABLE XL

FEEDLOT TRIAL III: VFA CONCENTRATION (MOLAR PERCENT)

VFA	Dry Rolled Wheat	Whole Recon. Wheat	Whole Recon. Rolled Wheat	$S\bar{x}$[2]
Acetic	37.46	40.20	36.08	1.52
Propionic[1]	41.00[c]	30.51[d]	44.60[c]	2.13
Butyric[1]	11.68[c]	17.11[d]	9.81[c]	1.37
Isovaleric	2.92	5.43	2.31	.99
Valeric	6.94	6.75	7.19	.79

[1]Values without a common letter differ significantly ($P < .01$).

[2]Standard error of treatment means.

In Vitro Dry Matter Digestibility Studies

Experiment I

In vitro dry matter digestibilities for the three experiments corresponding with the three feedlot trials are presented in Figures 1, 2 and 3.

In vitro Experiment I compared the treatments used in feedlot Trial I. As indicated in Figure 1, dry rolled milo and whole reconstituted rolled wheat were significantly ($P < .01$) lower in 24 hr *in vitro* dry matter disappearance than the dry rolled, ground reconstituted and rolled reconstituted wheat treatments. The dry rolled, ground reconstituted and rolled reconstituted wheat showed no significant difference ($P > .05$) between treatments. Milo, which is reconstituted whole and then rolled prior to feeding, produces a fluffy, floury appearing flake. Whole wheat, which is reconstituted to approximately 30% moisture and rolled prior to feeding, however, produces a large, intact, flat flake with a gummy texture. Thus, wheat reconstituted in this manner may not possess as much surface area for rapid *in vitro* enzymatic digestion as the other forms of processed wheat.

Experiment II

Experiment II compared the treatments used in feedlot Trial II. Significant treatment ($P < .01$) F values were obtained. As in Experiment I, the dry rolled milo and whole reconstituted rolled wheat were significantly lower ($P < .01$) in dry matter digestibility than the dry rolled and rolled reconstituted wheat. Again, as in Experiment I, this may suggest that the whole reconstituted rolled wheat was not processed flat enough to obtain maximum *in vitro* enzymatic digestion.

Experiment III

Experiment III investigated *in vitro* dry matter disappearance of those treatments used in feedlot Trial III. All three treatments differed significantly ($P < .05$). Furthermore, the dry rolled wheat and whole reconstituted rolled wheat showed a highly significantly greater ($P < .01$) digestibility than the whole reconstituted wheat. These data indicate that reconstituted wheat fed in the whole form is not in a form susceptible to rapid enzymatic digestion in the rumen. An effort was made to produce a flatter flake for the whole reconstituted rolled wheat in Trial III than in the previous two trials. This was reflected in what appears to be higher *in vitro* dry matter digestibilities for the whole reconstituted rolled wheat in Experiment III as compared to Experiments I and II. As suggested by the feed conversion values obtained in Trial III, apparently wheat must go through some form of physical processing to obtain maximum *in vitro* digestion.

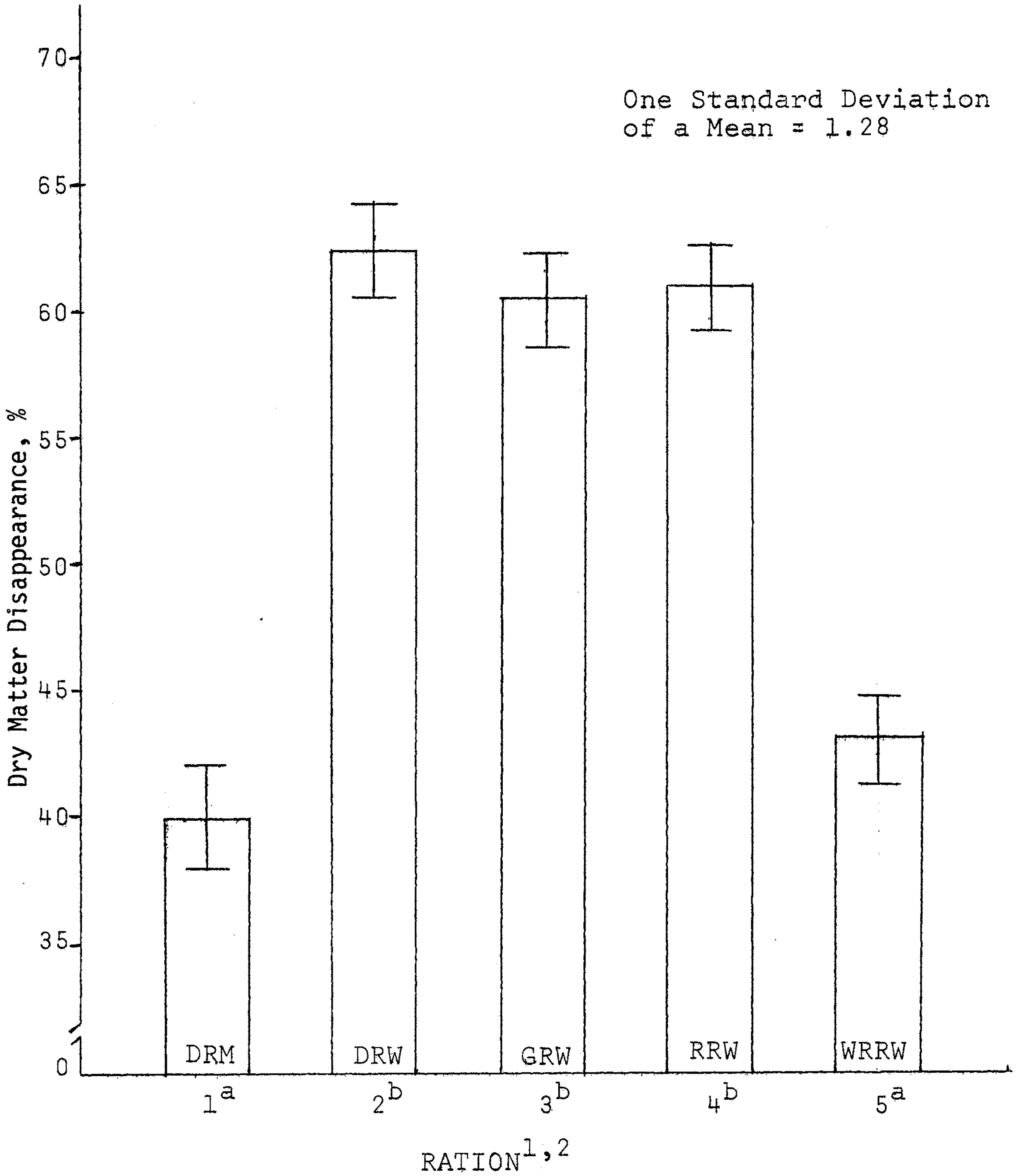

Figure 1. Experiment I: <u>In Vitro</u> Dry Matter Digestibilities

[1]Ration #1: Dry Rolled Milo, 39.92. Ration #2: Dry Rolled Wheat, 62.58. Ration #3: Ground Recon. Wheat, 61.66. Ration #4: Rolled Recon. Wheat, 61.89. Ration #5: Whole Recon. Rolled Wheat, 43.31.

[2]Values without a common letter differ significantly ($P < .01$).

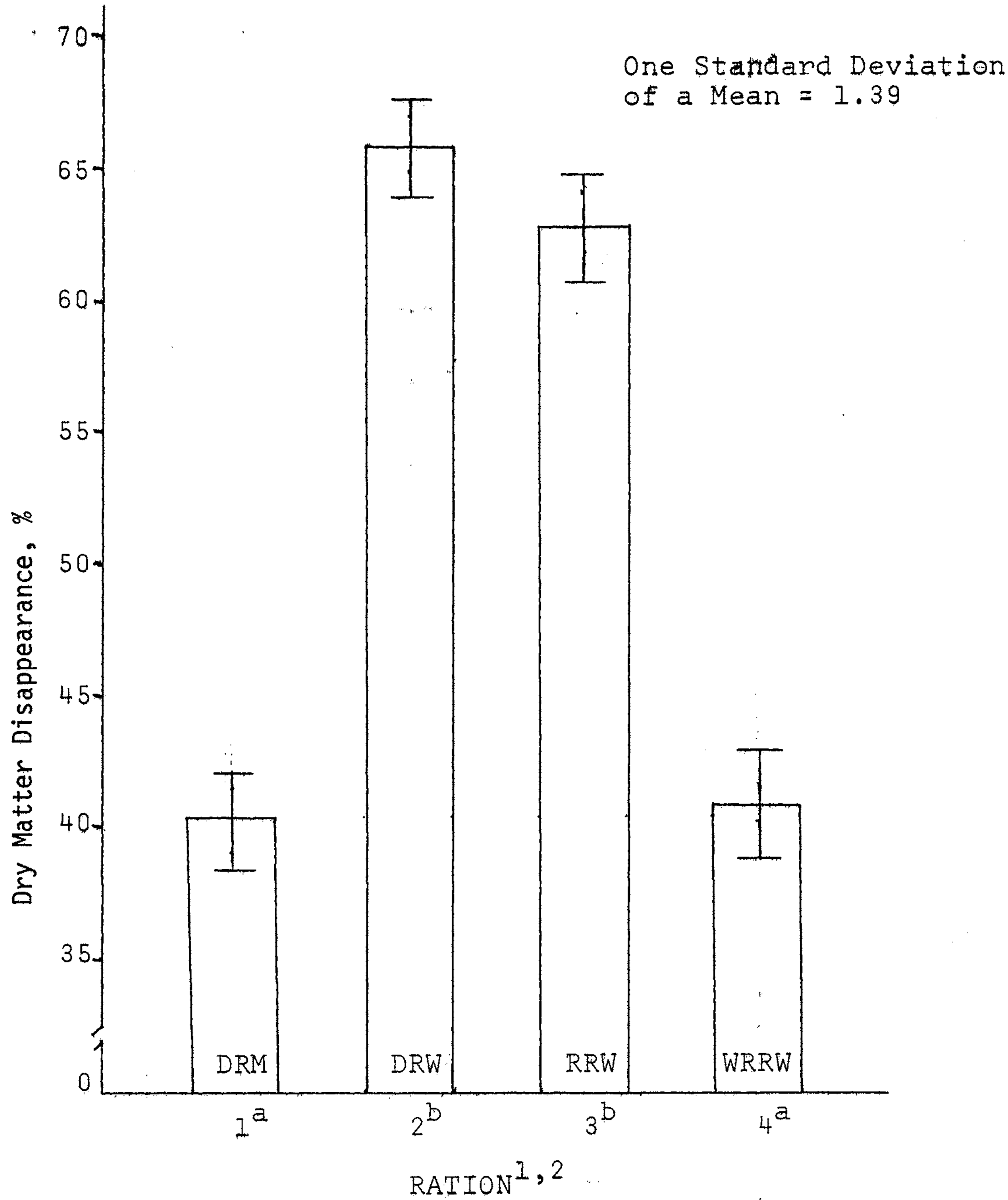

Figure 2. Experiment II: <u>In Vitro</u> Dry Matter Digestibilities

[1]Ration #1: Dry Rolled Milo, 40.33. Ration #2: Dry Rolled Wheat, 65.75. Ration #3: Rolled Recon. Wheat, 63.09. Ration #4: Whole Recon. Rolled Wheat, 40.62.

[2]Values without a common letter differ significantly ($P < .01$).

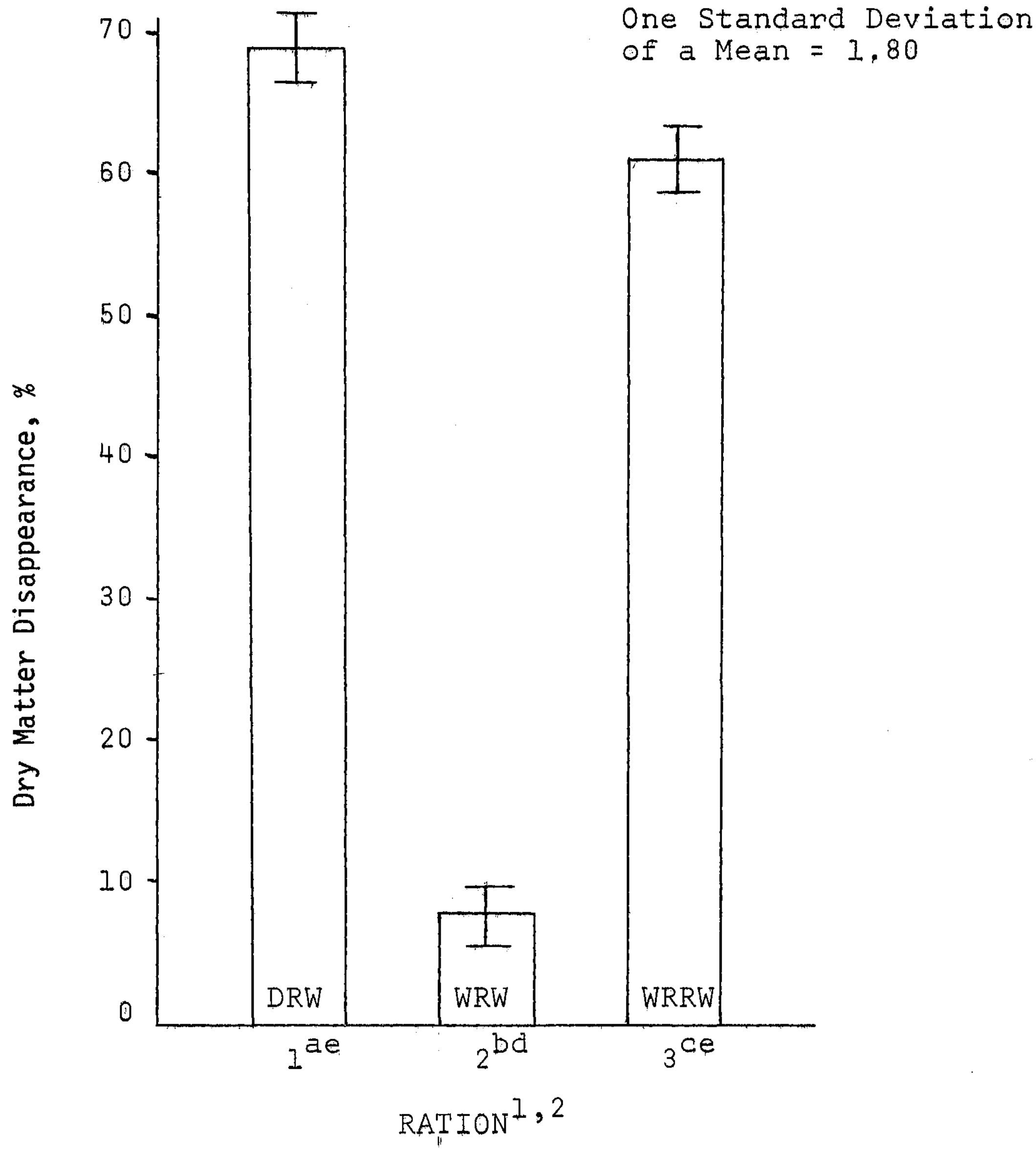

Figure 3. Experiment III: *In Vitro* Dry Matter Digestibilities

[1]Ration #1: Dry Rolled Wheat, 69.28. Ration #2: Whole Recon. Wheat, 8.40. Ration #3: Whole Recon. Rolled Wheat, 60.44.

[2]abc: Values without common letter differ significantly ($P < .05$).

de: Values without common letter differ significantly ($P < .01$).

CHAPTER V

SUMMARY AND CONCLUSIONS

Three feeding trials were conducted to compare different methods of reconstituting wheat with dry rolled wheat and dry rolled milo.

Trial I included dry rolled milo, dry rolled wheat, ground reconstituted wheat, rolled reconstituted wheat and whole reconstituted rolled wheat. Ground reconstituted wheat and rolled reconstituted wheat were ground and rolled, respectively, before reconstituting to 30% moisture and storing for 21 days. Whole reconstituted rolled wheat was reconstituted and stored in the whole form prior to feeding. Trial II consisted of the same treatments as Trial I with the exclusion of ground reconstituted wheat. Trial III included dry rolled wheat, whole reconstituted wheat rolled prior to feeding and whole reconstituted wheat fed whole.

Evaluation was on the basis of feedlot performance, net energy value, carcass merit and volatile fatty acid production. Three experiments were also conducted to evaluate the <u>in vitro</u> digestibilities of the same processed grains fed in Trials I, II and III.

No significant ($P > .05$) differences existed among treatments for feedlot performance in Trial I. In Trial II the cattle fed the dry rolled wheat were more efficient ($P < .05$) when compared to all other treatments; however, no significant difference existed in average daily gain. The cattle fed the two reconstituted wheat treatments in Trial III had higher average daily gains ($P < .01$) when compared to the cattle fed dry rolled wheat. Cattle fed whole reconstituted rolled wheat treatment showed the most efficient feed conversion and were lower ($P < .05$) than those fed the whole reconstituted wheat.

In Trial II the reconstituted wheat treatments had a significantly higher NE_g value than the dry rolled milo. Net energy values did not differ significantly ($P > .05$) between wheat treatments in any of the trials.

Cattle fed whole reconstituted wheat showed significantly higher ($P < .05$) rumen pH values than those fed dry rolled or whole reconstituted rolled wheat in Trial III. In the other trials, pH did not differ significantly ($P > .05$) between treatments.

Total volatile fatty acid concentration showed no significant difference ($P > .05$) among treatments studied in any of the trials.

In general, the three in vitro dry matter disappearance experiments showed dry rolled wheat, ground reconstituted wheat and rolled reconstituted wheat to be more completely digested ($P < .05$) than the dry rolled milo and whole reconstituted rolled wheat. Furthermore, in Experiment III the whole reconstituted wheat had a significantly lower ($P < .01$)

in vitro digestibility than the dry rolled wheat and whole reconstituted rolled wheat. This agreed with the feedlot trial in which the feed efficiency value obtained for the whole reconstituted wheat was higher ($P < .05$) than that of the whole reconstituted rolled wheat. Apparently some physical breaking of the wheat kernel is essential for maximum utilization by the beef animal.

This study, in general, agrees with previous work at this station suggesting that wheat can be successfully fed to finishing beef cattle; however, the methods employed to reconstitute wheat in this study did not materially improve its feeding value as compared to dry rolled wheat.

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