Summary Reports

Meat and Carcass Evaluation

The Association Between Net K^{40} Count and Carcass Composition of Gestating Gilts

D.D. Johnson, L.E. Walters, C.V. Maxwell and B.W. Lambert

Previous work at the Oklahoma Agricultural Experiment Station has shown a significant increase in nitrogen storage in bred gilts when fed high protein diets. Other work in swine nutrition suggests that a part of the increased nitrogen storage may be in increased muscle growth. Information leading to storage sites for this nitrogen (in addition to embryonic storage) would be of considerable benefit to swine nutritionists in efforts to more thoroughly describe the nature of bred gilt nutrition.

Inasmuch as the K^{40} whole-body counter has proven to be an effective instrument for predicting fat-free lean in 220 to 240 pound market hogs, the question of its application in monitoring muscle growth in gestating gilts has arisen. In an effort to study the application of the K^{40} whole-body counting technique to muscle deposition during gestation, twenty-two gilts with an average weight of 283 pounds were K^{40} counted and subsequently bred. Following breeding, the gilts were placed on rations containing three different levels of protein and two levels of energy. The gilts were then K^{40} counted on days 30, 60, and 90 of gestation. At the same time, backfat thickness was estimated by an ultra sound probing technique (Scanogram). All animals were slaughtered at the 90th day of gestation, at which time weights of the placenta (with fetus) and the amount of amnionic fluid was measured. After chilling for 48 hours, each right carcass half was cut into the standard wholesale cuts. Each of these cuts was then separated into very closely trimmed lean, fat, and bone. Table 1 presents means of the data collected to this

Table 1. Means of certain live and carcass measurements

Gilt wt. (lbs.)	Carcass wt. (lbs.)	Days of gestation	Net K^{40} count	Backfat probe (in.)	Lbs. of cl. tr. lean	Lbs. of fat trim
312		30	5546	.88		
357		60	5677	.96		
385	238.9	90	6098	1.06	138.26	73.90

point for gilt weight, net K^{40} count, carcass weight, pounds of closely trimmed lean, backfat probe, and fat trim. The simple correlation between mean net K^{40} count and pounds of very closely trimmed lean was found to be 0.85, which sugggests a positive relationship between the last K^{40} count and the actual pounds of muscle in the animal. Greater numbers of animals must be studied before meaningful prediction equations can be developed. When total pounds of fat trim were compared to the Scanogram fat measurement, the data also suggested a positive relationship, from twenty-eight observations, of 0.75 between these two measurements.

In an effort to more accurately identify muscle development in gestating gilts, the effect of weight on the counting efficiency of the K^{40} counter must be determined. It has been demonstrated previously at this station that in beef cattle as weight or mass increases, the efficiency of the K^{40} counter decreases. Other workers in this area have demonstrated that "background depression" and "self-absorption" of the naturally occuring K^{40} is primarily responsible for this loss in counting efficiency. A study is now underway in an effort to identify this loss in counting efficiency in phantoms of weights similar to those of bred gilts between the weights of 240 and 440 pounds. Upon completion of data collection and statistical analyses, a more detailed report of the findings will be presented.

The Estimation of Muscle Cell Numbers in Cattle

J. J. Guenther and R. V. Felber

This research was initiated to develop methods for estimating muscle cell population in bovine muscle. The semitendinosus, biceps brachii, sartorius, and tricepts brachii muscles from a fifteen-day-old Jersey and a fifteen-day-old Holstein calf were removed immediately post-mortem. These muscles were selected for initial investigation because the fibers from these muscles run in one direction, facilitating the obtaining of true cross-sections. The number of muscle cells was estimated, using a microscopic procedure, in cross-sectional areas at 25, 50, and 75 percent of the muscle length. Average cell number for the above named muscles from the Jersey calf were 92.5, 28.4, 34.1 and 47.5 X 10^4, respectively. Cell counts for the Holstein calf were significantly higher, averaging 114.8, 42.2, 48.8 and 59.7 X 10^4, respectively. A strong positive relationship between cell number and muscle weight was indicated by the results.

Muscle Nitrogen Deposition During Growth in Cattle Differing in Body Size

J.J. Guenther

The current profit squeeze has caused beef producers to become more acutely aware of the importance of maximizing production efficiency, with their ultimate goal being to produce quality lean tissue or muscle at the least possible cost. As a result, much interest has been generated in comparing the muscling capabilities of various newer or "exotic" breeds of cattle with those of the standard British breeds in use in the U.S.

The principal constituent of muscle, except for water, is protein. Muscle protein may be separated into its major components: myofibrillar protein, which gives structure to the muscle; sarcoplasmic protein, which contains various enzymes and pigments; and stroma proteins, which comprises the connective tissue of muscle. Each of these components may be conveniently quantitated on the basis of its individual nitrogen content.

This study was conducted to obtain information on the influence of body size in beef muscle nitrogen deposition from early life to a constant market age.

Muscle samples were obtained, via live-animal biopsy, from the longissimus dorsi muscles of eight Angus and eight Charolais crossbred steer calves, beginning when the calves were about one month of age, and subsequently at two month intervals until the calves were about 15 months of age. The Angus calves were selected to represent the small scale body type and were not intended to be representative of the Angus breed. The Charolais calves were selected to represent the large scale body type. Protein nitrogen was extracted, and partitioned into the appropriate fractions following procedures developed in our laboratory.

Results from the muscle nitrogen analyses are presented in Figure 1. The data are presented on a percent of wet tissue basis rather than on an absolute basis in order to show a more direct comparison between the two breed types. Percent total protein nitrogen increased during growth ($P<0.01$) in both breed types, and this component was greater ($P<0.05$) for the large scale (Charolais) cattle. The rate of deposition of total muscle protein nitrogen proceeded at its maximum between the five and eleven-month test periods for the Charolais steers. In general, the small scale (Angus) cattle showed trends similar to those of the large scale cattle in total muscle protein nitrogen deposition. However, the Angus calves appeared to attain maximal rate of increase in this component about sixty days earlier than the Charolais.

Myofibrillar protein nitrogen deposition increased during growth ($P<0.05$) in both breed types, but there were no significant differences be-

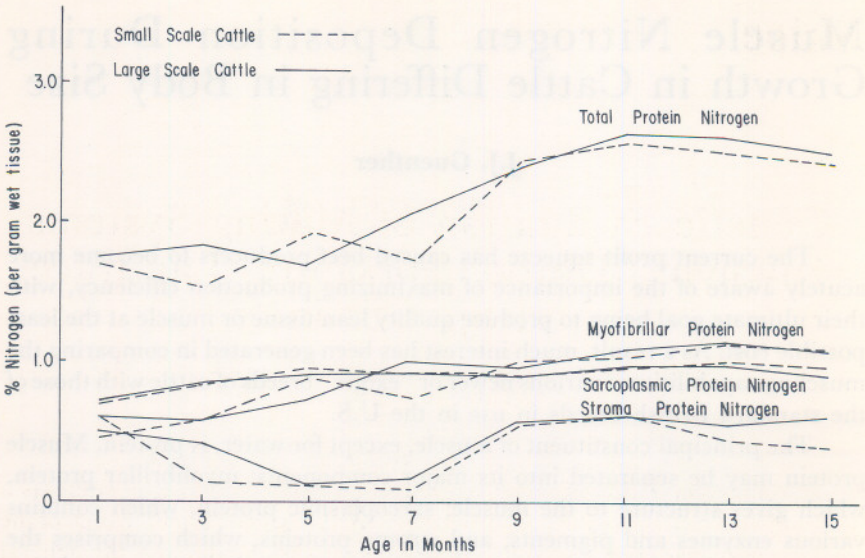

Figure 1. Changes in percent muscle nitrogen during growth in cattle of different body size.

tween breed types. Sarcoplasmic protein nitrogen exhibited only slight increases during growth, and was about the same for both types of cattle. Stroma protein nitrogen decreased during early life, but increased post-weaning ($P<0.01$), and was higher ($P<0.05$) for the Charolais calves.

Swine

Genetic Evaluation of Mating Systems Involving Duroc, Yorkshire, Landrace and Spot Swine

R.K. Johnson

Commercial swine producers recognize the value of crossbreeding as a very high percentage of the pigs produced are of crossbred origin. Much of the swine crossbreeding research has been done at Oklahoma, and the general response from crossbreeding is known. Of all traits evaluated, reproductive performance has shown the greatest response. Crossbred sows farrow and wean larger litters than purebred sows, and crossbred pigs grow faster and more efficiently than purebreds.

However, there is little information available on the performance of some potentially productive breeds. Also, male reproductive efficiency has not been sufficiently evaluated to identify mating systems that maximize total production efficiency. Are specific combinations of three or four breeds more efficient than rotation crosses? How important is the boar to reproductive efficiency? Can total efficiency be improved with the use of crossbred boars and crossbred sows?

In an effort to answer these questions, Project 1620 was initiated to evaluate the purebred performance, and the combining ability of Duroc, Yorkshire, Spot, and Landrace in two-breed, three-breed, and four-breed crosses.

Four purebred herds were establihed at the Experimental Swine Farm at Stillwater. In the first phase, purebred boars and gilts are mated in all combinations to produce purebred and two-breed cross pigs. The first pig crop was produced in the fall of 1977 and consisted of 19 litters from purebred Duroc females, 20 from purebred Yorkshire females, and 18 from each of purebred Spot and Landrace females. Crossbred gilts from these litters will be mated to purebred and crossbred boars to evaluate three and four-breed cross systems. Thirty boars and 180 gilts will be mated at the Southwest Livestock and Forage Research Station. All breeding stock for this phase will come from

In cooperation with U.S.D.A., Agricultural Research Service, Southern Region.

the Stillwater foundation herds. Differences in conception rate and litter size between purebred and crossbred boars and between various combinations of crossbred gilts will be evaluated. In addition, boars will be castrated to evaluate testicular and sexual development.

Several replications of each phase will be completed. New boars are constantly being introduced into the foundation herds at Stillwater to maintain a broad genetic base for each breed.

Fermentation of Ground High Moisture Corn Treated With Aqueous Ammonia

J.H. Thornton, F.N. Owens and M. Arnold

Treating corn silage at ensiling time with aqueous ammonia, or anhydrous ammonia by use of a cold chamber, is reported to produce a high quality product containing more nitrogen, less solubilized corn plant protein, and greater quantities of organic acids than untreated corn silage. Whether treating ground high moisture corn grain before ensiling would induce similar changes was uncertain. This preliminary study was initiated to determine if favorable alterations in fermentation could be induced by ammonia addition and, if so, what level of ammonia would be needed.

Aqueous ammonia was applied to ground high moisture (27 percent moisture) corn grain to supply 0.0, 0.1, 0.15, 0.2, 0.3, 0.4, 0.6, 0.8 and 1.2 percent ammonia. After thorough mixing, material was packed in eight replicate lab silos (quart glass jars), sealed, and allowed to ferment for 7, 14, 28 or 56 days. Upon opening, pH, lactate, ammonia nitrogen (N), total N, soluble N, and soluble non-protein N were determined.

Untreated material had the lowest pH (Figure 1) in each time period, and pH declined through 28 days at all treatment levels. Lactate (Figure 2) generally increased with time ensiled. Ammonia additions from 0.1 through 0.4 percent increased lactate levels over the control (0 ammonia), with peak lactate levels appearing at 0.3 or 0.4 percent ammonia. Higher ammonia levels, 0.6 through 1.2 percent, inhibited fermentation. Soluble nitrogen (Figure 3) increased with time, and ammonia additions slightly reduced solubilization of corn protein.

This preliminary study indicates that low levels of ammonia, below 0.4 percent, will stimulate fermentation and increase lactate production. With levels of 0.3 percent ammonia or less, resulting pH was low enough for good preservation, and no noticeable ammonia odor was present. Higher levels of ammonia, 0.6 percent and above, inhibited fermentation. Such material may not preserve for extended time periods and may have objectionable odors due to residual ammonia.

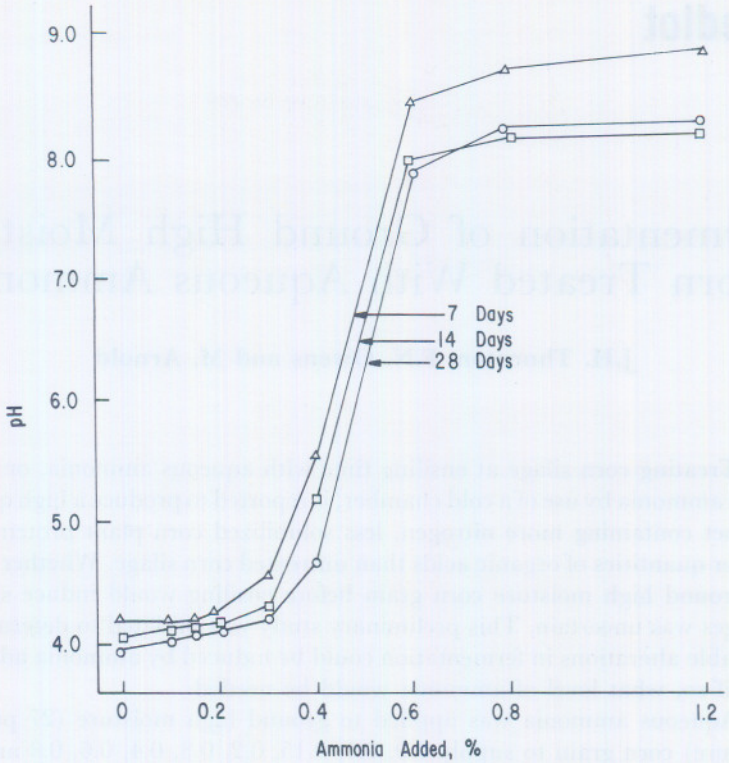

Figure 1. Effect of ammonia additions and time after ensiling on pH of ensiled ground high moisture corn grain.

Based on this preliminary study, a larger quantity of ground high moisture corn grain was treated with 0.3 percent ammonia and a feeding trial with this material is currently underway.

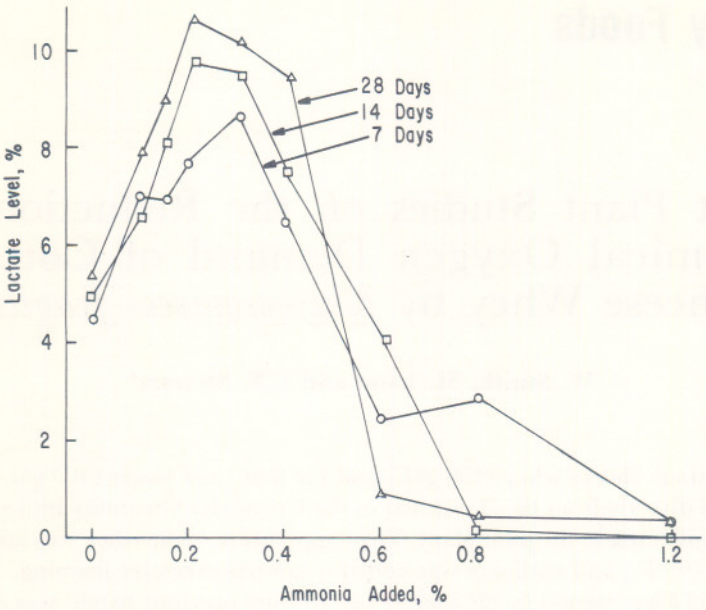

Figure 2. Effect of ammonia additions and time after ensiling on lactate of ensiled ground high moisture corn

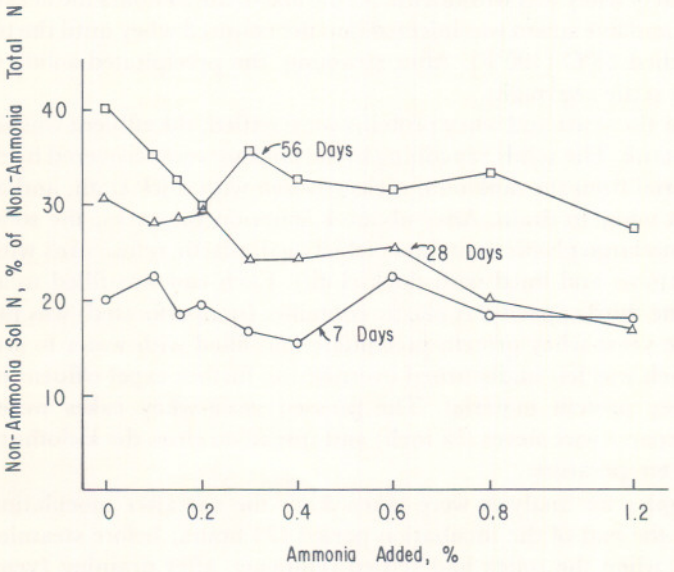

Figure 3. Effect of ammonia addition and time after ensiling on non-ammonia soluble nitrogen

Dairy Foods

Pilot Plant Studies on the Reduction of Chemical Oxygen Demand of Cottage Cheese Whey by *Kluyveromyces fragilis*

W. Smith, M. Lane and C.F. Stewart[1]

Cottage cheese whey (450 gal.) and the first rinse water (400 gal.) were pumped directly from the cheese vat in the University Creamery into a 1,000 gallon milk tank in the pilot plant. The temperature of the whey was adjusted to 35°C (95°F), and antifoam was added to control excessive foaming. Thirty gallons of *Kluyveromyces fragilis* starter (saved from previous batch) was added, and the mixture was allowed to incubate 24 hours with continuous aeration. The system was aerated by sparging air through a perforated stainless steel pipe in the bottom of the tank. At the end of 16 hours, sufficient starter for the next batch of whey was withdrawn. At the end of the 24 hours the aeration was stopped, and live steam was injected into the cultured whey until the temperature reached 88°C (190°F). After steaming, the precipitated solids were allowed to settle overnight.

After the yeast and whey proteins were settled, the effluent was siphoned from the tank. The solids remaining in the bottom were recovered by draining the material from the tank onto racks covered with duck cloth, and allowing the spent whey to drain. After about 4 hours on the racks, the solids were placed into large plastic containers (thirty gal. plastic refuse cans with perforated bottoms and lined with duck cloth). Each can was filled to approximately one third capacity. A plastic container (nonperforated) was placed on top of the yeast-whey protein precipitate and filled with water to serve as a press. Each was left undisturbed overnight to further expel effluent from the yeast-whey protein material. The pressed yeast-whey cakes were forced through coarse wire sieves (¼ inch) and spread on clean duck cloths to dry at ambient temperature.

Samples for analysis were taken from the vat after inoculation ("O" time), at the end of the incubation period (24 hours) before steaming, after steaming when the solids had settled (effluent), after draining (yeast-whey

[1]Agricultural Marketing Research Institute, ARS, Beltsville, Md.

Table 1. Analyses of samples from cottage cheese whey cultured with *K. fragilis*

	Lactose %	Protein %	BOD's mg/l	COD mg/l	pH
"O" time	2.15	0.46	24,172	50,120	4.7
24 hours	0	0.36			5.0
Effluent		0.14	12,943	25,457	5.1
Yeast-whey paste		10.13			
Dried yeast-whey		73.75			

paste), and after drying (dried yeast-whey). The results of these analyses are presented in Table 1.

K. fragilis completely utilized the lactose in the cottage cheese whey and reduced the BOD's and COD of the whey 46 percent and 49 percent, respectively. The yeast-whey protein material obtained can be used in formulating human or animal foods. The dried material contained 73.75 percent protein.

The Continuing Study of Wheat Pasture Flavor in Milk

R.L. Von Gunten, L.J. Bush, M.E. Wells, E.L. Smith and G.D. Adams

The lush green wheat pastures available to the dairyman each fall and spring are a lure to trouble. The cows consume it readily and as a result the milk produced has a highly undesirable taste and odor. This odor is "fishy" in nature and has been analyzed to be trimethylamine. Earlier work from this station confirmed that the amount of wheat consumed was directly related to the amount of fishy flavor in the milk.

Current work is being undertaken to determine if there is a high grain yielding variety of wheat that can be grazed with less off flavor being generated in the milk. Tam-101, Osage, and Triumph-64 varieties have been investigated with only slight variation observed in the off flavor produced after grazing. There was not enough variance to influence the grain selection by the dairy farmer.

It would appear that herd management to control the extent and time of grazing is the best tool currently available to limit the production of trimethylamine.

Endocrine Function in Laying Hens as Related to Egg Shell Quality

J.S. Curl and R.H. Thayer

One of the highest priority problems in the commercial egg industry in the United States today is a deterioration in egg shell quality which takes place as the egg laying period progresses. Under commercial production conditions the egg shell quality problem routinely develops in the following way. Egg shell quality appears to be good during the initial four to six months of the laying period. Beginning at this time and extending through the remainder of the egg production period, there is a significant progressive deterioration in egg shell quality which is characterized by a decrease in shell thickness, shell texture, and shell strength. This decrease in egg shell quality develops in about 25 percent of the layers in any given flock. While the eggs are being processed and moved in market channels, a large number of these thin shelled eggs may become cracked, checked, or broken. As a result, the economic loss to the producer is substantial. Counter measures of many kinds have been taken to correct the problem, but none have been entirely effective.

One of the most promising areas for study on this problem involves endocrine function as it is related to calcium and phosphorus intake, mobilization, and deposition in the egg shell. No data are available to indicate what fluxuations, if any, occur in the blood plasma concentrations of the different hormones under practical production conditions during an extended egg production period. In addition, it is not known whether changes in plasma hormone levels, if they do occur during this time, are related to the determination of egg shell quality.

A strain of commercial hybrid hens, which is known to develop the egg shell quality problem, has been divided into groups according to degree of shell thickness, shell texture, and shell strength by measuring egg specific gravity. Clutch size, time sequence of ovulation, and time sequence of oviposition for hens with both good and poor shell quality have been established. Blood samples have been taken by heart puncture from hens within each shell quality classification six hours prior to ovulation. These blood samples are to be analyzed by radioimmunoassay for estradiol, testosterone, and proges-

terone. Data obtained on plasma concentrations of these hormones will be used to determine if any correlation exists between possible differences in plasma hormone levels and egg shell quality. If correlations do exist, further studies involving these and other hormones will be undertaken.

Acknowledgements

Many companies, organizations, and individuals have contributed money, materials, and/or services to aid Animal Science Research, Teaching or Extension Programs as indicated below. These contributions were instrumental in furthering the various programs of the Department and are gratefully acknowledged.

On campus, the cooperation of staff in the College of Veterinary Medicine, and the Departments of Biochemistry, Agronomy, Agricultural Economics, Agricultural Engineering, Microbiology, and Entomology was important in the design and implementation of several projects.

Studies at the Southwestern Livestock and Forage Research Station at El Reno, Oklahoma, were conducted in cooperation with U.S.D.A., Agricultural Research Service, Southern Region, Texas-Oklahoma Area. The assistance and counsel of Dr. M. B. Gould, present Superintendent of the Station, is gratefully acknowledged. Several studies at Stillwater were part of regional research projects.

The following is a listing of those who have contributed to research programs of the Animal Science Department during the preceding year.

Abbott Laboratories, North Chicago, Illinois, for hormones for physiology research.

Adams Ranch, Pawhuska, Oklahoma, Dick Whetsel, Manager, for the donation of service bulls.

American Hereford Association, Kansas City, Missouri, for providing a graduate assistantship to support research on size and milk production in beef cattle.

American Lecithin Co., Atlanta, Georgia, for supplying soybean lecithin for research on lipid metabolism in laying hens.

Associated Milk Producers, Inc. (Oklahoma Division) Oklahoma City, Oklahoma, for financial assistance of dairy management research.

Booker Custom Packing Company, Booker, Texas, for aid in the collection of carcass data on feedlot cattle.

Brown Swiss Enterprises, Inc., for financial assistance in beef cattle breeding research.

Celanese Chemical Company, Corpus Christi, Texas, for supplying chemical hay and grain preservative, Chemstor.

Clinton Corn Processing Co., Clinton, Iowa, for supplying corn oil for research on lipid metabolism in laying hens and turkeys.

Cooperative State Research Service for a research grant to study postpartum reproduction in cattle.

Cornett Packing Co., Oklahoma City, Oklahoma, for assistance in obtaining data on animals slaughtered for extension programs.

Degussa Chemicals, Inc., Frankfort, Germany, for support and materials for beef cattle research.

Diamond V. Mills, Inc., Cedar Rapids, Iowa, for funds and materials to support research with caged turkey breeders and broilers.

E. I. duPont de Nemours and Company, Wilmington, Delaware, for providing a BiVac packaging unit and film for meat research.

Elanco Products Company, Division of Eli Lilly and Company, Greenfield, Indiana, for providing drugs monesin and a financial grant to support monesin research with range cows, and feedlot cattle.

Enviornmental Protection Agency for financial assistance in research.

Farmland Industries, Kansas City, Missouri, for providing financial support for research in meat processing, dairy, and beef cattle nutrition.

Farr Better Feeds, Guymon, Oklahoma, for providing feed ingredients for nutrition research.

Grain Utilization Research, Guymon, Oklahoma, for assistance in beef cattle nutrition research.

Hitch Feedlots, Guymon, Oklahoma, for funds, feed and cattle to support studies in beef cattle nutrition research.

International Minerals and Chemical Corporation, Skokie, Illinois, for supplying 2000 pounds of monoammonium phosphate.

Lonza Inc., Fair Lawn, New Jersey, for assistance in beef cattle nutrition research.

Master Feeders, Inc., Hooker, Oklahoma, for a grant to support the symposium on "Methods for Improving the Utilization of High Moisture Grains", and for feed to support studies in beef cattle nutrition research.

Master Feeders II, Inc., Garden City, Kansas, for a grant to support the symposium on "Methods for Improving the Utilization of High Moisture Grains."

Master Veterinary Service, Guymon, Oklahoma, for funds to support research on grain processing.

Merck & Co., Rahway, New Jersey for providing Lysine for swine nutrition research.

National Feed Ingredient Association, West Des Moines, Iowa, for assistance in beef cattle nutrition research.

NIPAC Chemical Company, Pryor, Oklahoma, for supplying urea support for range cow research.

North American Limousin Foundation, Denver, Colorado, for financial support of the beef cattle genetics research program.

Oklahoma Feed Manufacturers Association, for providing assistance with the graduate research scholarship and the undergraduate scholarship program.

Oklahoma Medical Research Foundation, Oklahoma City, Oklahoma, for assistance in lipid metabolism studies with chickens and turkeys.

Oklahoma Pork Commission for a research grant to study effects of heat stress on boars, swine management and swine nutrition.

Peterson Farms, Inc., Decatur, Arkansas for field test data on broilers.

Ralph's Packing Co., Perkins, Oklahoma, for assistance in obtaining data on animals slaughtered for extension programs.

Schwab and Co., Oklahoma City, Oklahoma, for assistance in obtaining data on animals slaughtered for extension programs.

Star-Labs, Inc., St. Joseph, Missouri, for funds and materials to support research with broilers.

Syntex Agribusiness, Inc., Springfield, Missouri, for assistance with animal nutrition research.

USDA Agriculture Research Service for a research contract to study the treatment of cheese whey to reduce pollution.

U.S. Energy Research and Development Administration, for support of research on "Energy Conservation in the Meat Processing Industry"

Wilson and Company, Oklahoma City, Oklahoma, for assistance in obtaining data on animals slaughtered for research and extension programs.

W. W. Feeders, Garden City, Kansas, for funds to support research on grain processing.