SUMMARY REPORTS
Other Research in Progress

Cow-Calf-Stockers

Selection for Increased Growth Performance in Beef Cattle

R. R. Frahm and Glenn Selk

In order to meet the projected increase in consumer demand for beef and to realize a profit in spite of increasing production costs, cattlemen face a tremendous challenge to increase the level of production per cow in the breeding herd. Since the total quantity of beef produced has a direct bearing on realized profits, cattlement are justifiably concerned about the growth rate of their cattle. Consequently, some measure of growth rate is one of the principle traits utilized in performance testing and selection programs.

The beef cattle selection study initiated in 1964 at the Ft. Reno Livestock Research Station involves both purebred Angus and Hereford cattle. The objective of this study is to determine the direct and correlated genetic responses to selection based on weaning weight and yearling weight, respectively.

The study consists of six selection lines of 50 cows each: two Hereford lines (one selected for increased weaning weight and the other selected for increased yearling weight) and four Angus lines (one selected for increased weaning weight, one selected for increased yearling weight, one selected for increased weaning weight based on progeny test information and one serves as an unselected control line). A more complete experimental design for this study is presented in Okla. Agr. Exp. Sta. Misc. Pub. 85:150.

It is too early in the study to determine the actual rate of genetic improvement resulting from selection. However, it is apparent that thus far in the study no major differences in growth performance as measured by weaning weight or yearling weight have occurred between the weaning weight and yearling weight selection lines within either breed. This

implies that the genetic changes that have occurred thus far for growth performance have been similar in both the weaning weight and yearling weight lines.

Examination of the growth performance of the selected bulls gives some indication of why the weaning weight and yearling weight lines are performing at a similar level. The 10 Hereford bulls selected and used in the weaning weight line during the past five years had an average 205-day weaning weight ratio of 1.17 and a yearling weight ratio of 1.12. The 10 Angus bulls selected in the weaning weight line had an average weaning weight ratio of 1.13 and a yearling weight ratio of 1.08. Although these bulls were selected on the basis of weaning weight performance they also had a higher genetic potential for heavy yearling weight than the average of the line.

The weaning weight and yearling weight ratios for the 10 Hereford bulls selected in the yearling weight line were 1.13 and 1.16, respectively and 1.09 and 1.13, respectively, for the 10 bulls selected in the Angus yearling weight line. Use of any of these 4 sets of bulls would be expected to increase both weaning weight and yearling weight in their respective lines.

Publications

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Comparison of Cow Productivity Among Certain Two-Breed Crosses

R. R. Frahm and Todd Stanforth

Research has clearly demonstrated that crossbreeding among the traditional beef breeds in the U.S. can increase production in terms of pounds of calf weaned per cow exposed for breeding by at least 15 percent. Crossbreeding improves production by providing an opportunity to capitalize on combining the desirable characteristics of two or more breeds and by taking advantage of heterosis.

The amount of heterosis expressed for a particular trait is dependent upon the genetic differences between the breeds involved and the amount of non-additive genetic variation for that trait. Thus, heterosis is expected to be larger, and has generally been found to be larger, for traits with a low heritability such as those traits involved with reproductive efficiency and maternal performance of the cow and early growth rate of the calf. Consequently, the crossbred cow is an essential component of increased production through crossbreeding.

Adequate numbers of straightbred animals of many of the more recently imported breeds are not available to determine the actual level of heterosis resulting from crossing with the more traditional breeds. However, it is possible to compare the level of performance of these crossbreds with existing breeding stock to determine the merit of these imported breeds for total production under management systems that exist in the U.S.

The purpose of this study is to compare lifetime productivity under range conditions of eight different two-breed cross cow groups (Angus-Hereford, Hereford-Angus, Simmental-Angus, Simmental-Hereford, Brown Swiss-Angus, Brown Swiss-Hereford, Jersey-Angus and Jersey-Hereford) when mated to terminal cross sires of a third breed. Each of the eight crossbred cow groups will consist of approximately 45 cows resulting from appropriate matings to comparable sets of Angus and Hereford cows over a three year period.

A foundation herd of approximately 200 Angus and 200 Hereford cows that are typical of good commercial cattle in Oklahoma were assembled at the Lake Carl Blackwell research range near Stillwater and were bred to the respective sire breeds during the 1972 breeding season to produce the first set of crossbred calves during February - April of 1973. Lifetime productivity of each crossbred cow group (approximately 10 calf crops) will be compared when mated to the same set of sires

of a breed other than those involved in the composition of the cows.

Feedlot performance and carcass merit will be measured on the two-breed cross steers as well as on the three-breed cross calves that will be produced by the crossbred cows. Shorthorn and Red Poll bulls will be used to sire the calves produced by the crossbred cows as 2-year-olds. Charolais bulls will be used for the second and subsequent calves until the three different age groups of crossbred cows all reach maturity. At that time one other breed can be introduced in any one year for comparison with Charolais as a terminal cross sire breed.

Data will be collected on reproductive and maternal performance of cows, winter supplementation and total nutritional requirements of cows, growth rate of calves to weaning, and feedlot performance and carcass evaluation of the calves.

Results from this study will provide basic information that will be essential in developing systematic crossbreeding programs utilizing available genetic resources (breeds) that will optimize production under Oklahoma range conditions.

Problems Associated with Induced Superovulation and Superfetation in Beef Cows

E. J. Turman, J. G. MaGee, M. R. Johnson and D. F. Stephens

Previous research carried out as a part of this project has demonstrated that the incidence of multiple births in beef cattle can be greatly increased by the injection of the gonadotropic hormone preparations PMS and HCG. In early studies the PMS injections were given on days 5 and 17 of the estrual cycle timed from a naturally occurring estrus. However, as reported elsewhere in this publication, the PMS injections may be timed from a synchronized estrus.

The HCG injections have been given at, or near, the first post-PMS estrus to insure that all follicles stimulated by the PMS will be ovulated. However, there is some question as to whether there is a need for additional leutinizing hormone, which is the predominant gonadotropic hormone found in HCG. Accordingly, a small study was carried out in the spring of 1971 to test whether this injection was needed.

Thirty-one lactating cows were checked for the occurrence of estrus and injected subcutaneously with 1000 IU PMS on day-5 and 1500 IU PMS on day-17 of the cycle counting the day of estrus as day-0. Following the second PMS injection the cows were placed with fertile bulls. As the cows were observed to be in estrus they were alternately assigned to either receive HCG or not receive HCG. Only 14 of the 31 cows were observed in estrus, therefore, only seven cows were assigned to each group. However, at least seven additional cows were in estrus, but not observed, since they conceived at this estrus, resulting in data in 14 cows not receiving HCG, but on only seven receiving HCG.

Of the seven cows receiving HCG, one conceived at the first post-PMS estrus and produced twins. Of the 14 cows not receiving HCG, 10 conceived and produced 5 singles, 3 sets of twins and 2 sets of triplets. While numbers of animals are too small to permit definite conclusions, these results suggest that the HCG injections are not necessary.

Publications

Turman, E. J., J. G. MaGee and D. F. Stephens. 1972. Weaning more calves per cow. Okla. Agr. Exp. Sta. Res. Rpt. P-673:1.

Meat and Carcass Evaluation

A Method for Measuring Shear Force for An Individual Muscle Fiber

R. L. Henrickson, R. D. Morrison and J. L. Marsden

Abstract

The microsensitive shear instrument, a device designed to measure the shear force of individual muscle fibers, was elvaluated in a uniformity trial, and in a comparison of bovine Sartorius muscle excised after being conditioned in the carcass for 2, 5, and 8 hours, at 16° C. Each of 299 randomly drawn fibers were evaluated for diameter, percent kinkiness, and shear force.

In a comparison of "cold" excised Sartorius muscle fibers and Sartorius fibers conditioned for 2, 5, and 8 hours post-morten, 3600 fibers were evaluated for diameter, percent kinkiness, and shear force. Data from the uniformity trial established the feasibility of measuring shear force for individual muscle fibers. The mean shear force for the 299 fibers was 2.30 gm./U^2.

In the comparison of the Sartorius muscle excised "Cold" and those excised after 2, 5, and 8 hours post-mortem, a difference was found to be statistically significant (P 0.01) for the 2 hour post-mortem holding period for diameter, percent kinkiness, and shear force. At the 5 and 8 hour conditioning periods, no significant differences were detected for the three fiber parameters.

The Potassium Concentration in Four Major Protein Fractions of Bovine Longissimus Muscle

J. J. Guenther, J. R. Escoubas and J. D. Gresham

Total muscle, or fat-free lean, and total muscle potassium are, purportedly, highly correlated. In fact, this concept forms the basis upon which various prediction equations to estimate total fat-free lean in live

animals, via live animal ^{40}K analysis, have been developed. This apparent importance of and extensive use of total muscle potassium in estimating the lean content of breeding stock has prompted the authors to determine the concentration of potassium in the major protein fractions comprising whole muscle.

For this study, samples of longissimus muscle were obtained from ten mature beef steers. The steers were of the choice grade and averaged 432 kg. alive. Following procedures developed in our laboratory the muscle samples were partitioned into the following protein fractions: Sarcoplasmic; Myofibrillar; Stroma and Lipo-protein. The potassium concentration of each of these fractions was determined by Atomic Absorption Spectroscopy. Digestion of the protein fractions was accomplished in a perchloric (70 percent) -nitric acid mixture (3:1). Results were expressed as milligrams potassium per gram of wet tissue.

The mean values from the muscle potassium analyses are shown in Table 1. These results are presented on an absolute as well as on a percentage basis. The data show that whole bovine longissimus muscle contains about 3.612 mg potassium per gram of tissue. It is obvious from these results that muscle potassium is located primarily in the Sarcoplasmic protein fraction of muscle, which contained 3.570 mg K/g. tissue or 98.84 percent of the total muscle potassium. The myofibrillar fraction contained only 0.61 percent of the total potassium, which was a little more than twice the amount found in either the Stroma or Lipoprotein fractions.

These data raise some interesting questions as to the ultimate quantitative and qualitative attributes of meat carcasses if the selection of breeding stock is based too strongly on the muscle potassium: fat-free lean relationship. Further study is planned to elucidate some of these effects.

Table 1. Potassium Concentration in the Major Protein Fractions of Bovine Longissimus Muscle

	Muscle Fraction				
	Total	Sarcoplasmic	Myofibrillar	Stroma	Lipo-Protein
mg. K/g. tissue	3.612[1]	3.570	0.022	0.010	0.010
% of total	100.0	98.84	0.61	0.28	0.28

[1] All values are averages of 10 muscle samples

Use of K^{40} Net Count as a Monitor of Body Composition Changes in Growing and Fattening Beef Cattle and Swine

Lowell E. Walters, T. R. Carr and R. F. Queener

Earlier work at this station dealing with the association between live net K^{40} count and pounds of fat-free lean in the carcass of forty yearling Angus bulls and sixty Yorkshire barrows has stimulated considerable interest in this method as an aid to more effective livestock selection. Results of these and other studies form the basis of prediction equations currently in use with the K^{40} technique at the O.S.U. Live Animal Evaluation Center for appraising 1000 pound beef cattle and 220-240 pound hogs for muscle content on a "custom" evaluation basis as well as for continuing live animal evaluation research.

Among known sources of variation in results from the application of radiation technology to problems of a biological nature, such as with meat animals, are included such variables as sample to detector geometry, size and conformation of the test animals, as well as the age, sex and condition of the animals at the time of evaluation.

Previous research at the Oklahoma Agricultural Experiment Station has been conducted with groups of animals that were as uniform in age, breed, weight and condition as was possible to obtain in order to subject the O.S.U. K^{40} whole-body counter to a critical test of its capability to estimate differences in muscling among meat animals.

Questions have arisen concerning the application of this technique to cattle and swine of younger ages and lighter body weights with the thought that considerable saving in time and expense could possibly be achieved if K^{40} prediction equations were available for such animals. With these thoughts as a background, research is currently in progress which is designed to answer questions pertinent to the application of the principles of radiation technology (K^{40}) to the live evaluation of more youthful, lighter weight beef cattle and swine. The following is the plan of research currently in progress:

Cattle: Ninety-six beef steers representing four weight groups and two body types are being evaluated using new detector arrangements in the O.S.U. K^{40} counter. The arrangement of detectors provides for a radiation monitoring system located as close to the animal as is possible in attempts to improve K^{40} counting efficiency over a range of live weights. In order to accomplish this, new detector hangers have been constructed in accordance with height and width dimensions of the cattle in each of four weight categories.

Three replications of 16 steer calves each weighing approximately 400 pounds and representing "intermediate" beef type are being randomly allotted to slaughter weight groups of 500, 700, 900 and 1100 pounds and placed on feed in the dry lot. From each replication, 4 steers are allotted to each weight group, making a total of 12 "intermediate" type steers for each of the four slaughter weights. Three additional replications of 16 steer calves each weighing approximately 400 pounds and representing "large scale, growthy" beef type are being randomly allotted to slaughter weight groups of 500, 700, 900 and 1100 pounds and placed on feed in the dry lot.

From each replication four steers are being allotted to each weight group, making a total of 12 "large scale, growthy" type steers for each of the four slaughter weight groups. As the steers reach the shrunk live weights of 500, 700, 900 and 1100 pounds, they are taken off-feed for 24 hours, thoroughly washed to remove possible radiation contaminating materials and then evaluated by the K^{40} whole-body counter, using the detector configuration which most closely fits that particular weight and type.

Those steers designated at the outset of the experiment to be slaughtered at a particular weight are moved to the Meat Laboratory for slaughter and carcass evaluation. The carcasses are evaluated for carcass quality and cutability grade along with additional measurements including average fat thickness at 12th rib, rib eye area, weight of boneless, closely trimmed round, loin, rib and chuck, total pounds of fat trim and total boneless, closely trimmed minor wholesale cuts. Chemical analyses for ether-extract and muscle potassium in the boneless closely trimmed muscle mass from the right half of each carcass are in progress. Fat-free lean is determined by subtracting total ether-extractable materials from the weight of the boneless, closely trimmed muscle mass from the right carcass half.

Correlation and regression studies of the association between net K^{40} count and fat-free lean in the animals at different ages and weights will then be made. These studies also include an attempt to describe possible changes in the pattern of potassium concentration in selected beef muscles over a range of ages and live weights in each of the two types. For this purpose, chemical analyses for potassium are being conducted on the longissimus dorsi, trapezius, supraspinatus, semitendinosus and biceps femoris muscles from each carcass. Slaughter and carcass evaluation is nearing completion for Replication I for both types of cattle. A full report of the results will be made at a later date.

Swine: One hundred market barrows (50 Hampshire and 50 Yorkshires) representing five weight groups are being evaluated by the K^{40} whole-body counter. A new detector arrangement is utilized in the count-

ing of the swine in an attempt to improve K^{40} counting efficiency over a range of live weights. The new arrangement of detectors provides for more flexibility in the adaptation of the instrument to pigs over a range of live weights from 100 to 300 pounds than has been possible in previous swine studies.

Ten replications of 10 feeder pigs each weighing 60-70 pounds are randomly allotted to slaughter weight groups of 100, 150, 200, 250 and 300 pounds and placed on a growing-fattening ration. From each replication, two pigs are randomly assigned to each slaughter weight group, making a total of 20 pigs for each of the five slaughter weights as is shown in Table 1.

As the pigs reach the shrunk live weights of 100, 150, 200, 250 and 300 pounds, they are taken off-feed for 24 hours, thoroughly washed to remove any foreign material that might influence the K^{40} count and then evaluated by the K^{40} whole-body counter, using the dector configuration which most nearly fits that particular weight. Those pigs which were designated at the beginning of the experiment to be slaughtered at a particular weight are taken to the Meat Laboratory for slaughter and carcass evaluation. Live animal measurements taken are a whole-body K^{40} count and a lean-meter probe. Carcass measurements taken include length, average backfat, loin eye area, weight of trimmed ham, loin and shoulder, weight of total fat trim, and weight of boneless, closely trimmed lean from the right carcass half.

Ether-extract and potassium analyses are conducted on ground lean samples of the right carcass halves and total pounds of fat-free lean are determined by difference. In addition, the biceps femoris, semimembranosus, and longissimus dorsi muscle are excised and analyzed chemically for potassium and ether-extract.

Table 1. Experimental Design

Replication	Slaughter Weight Groups (pounds)				
	100	150	200	250	300
I	2[1]	2	2	2	2
II	2	2	2	2	2
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
X	2	2	2	2	2
Total	20[2]	20	20	20	20

[1] Number of animals per replication per weight group.
[2] Total number of animals per weight group.

Two replications of this work have been completed and one-half of the animals involved in Replications III, IV, V and VI have been slaughtered. Ether-extract and potassium analyses have been conducted on the muscle samples taken from the lean of those animals in Replications I and II. Statistical analysis of the data will be conducted.

Preliminary Results:

While statistical analyses are not available at this time, graphic plots of certain of the data point to trends in the data and are presented in Figures 1 and 2.

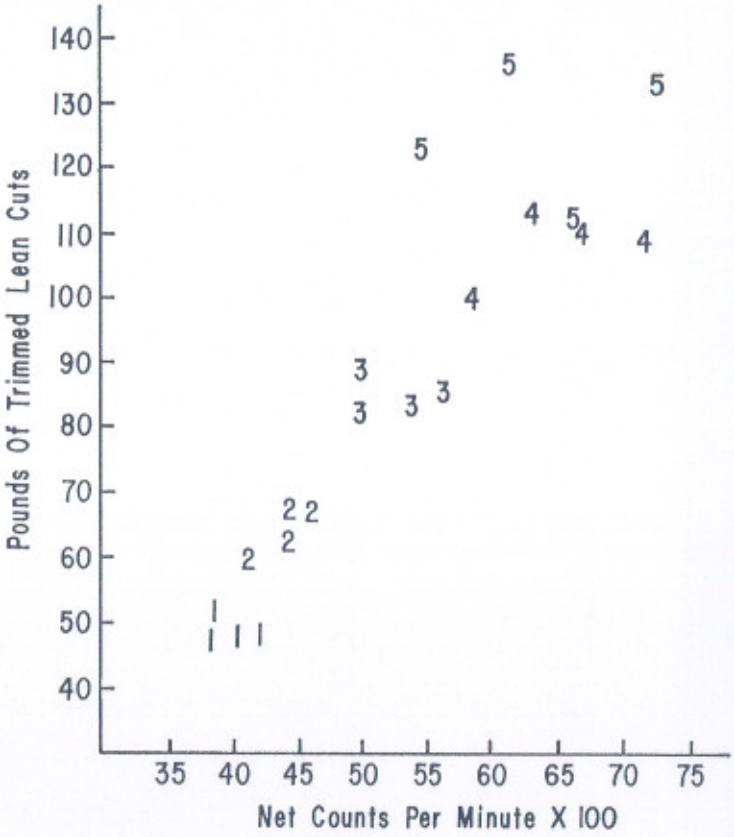

Figure 1. Net K^{40} count and weight group as related to pounds of closely trimmed lean cuts.

The plotted numbers 1, 2, 3, 4 and 5 represent animals in the weight groups 100, 150, 200, 250 and 300 pounds, respectively.

The plot of net K^{40} count, live weight and pounds of closely trimmed lean cuts is presented in Figure 1. There appears to be a rather strong positive linear relationship between K^{40} count and total pounds of closely trimmed lean cuts.

These preliminary data suggest that as slaughter weights of the pigs increase, there is greater variation in pounds of lean cuts among animals of the same weight group. Some of this variation may be "real" while a portion may be attributable to one's inability to remove equal amounts of intermuscular fat from the lean cuts. The inability to remove any of the intramuscular fat (marbling) from the lean cuts may also be a source of variation. At least a part of this variation is to be expected, inasmuch as pigs in the 100 pound group are much leaner (i.e., have a

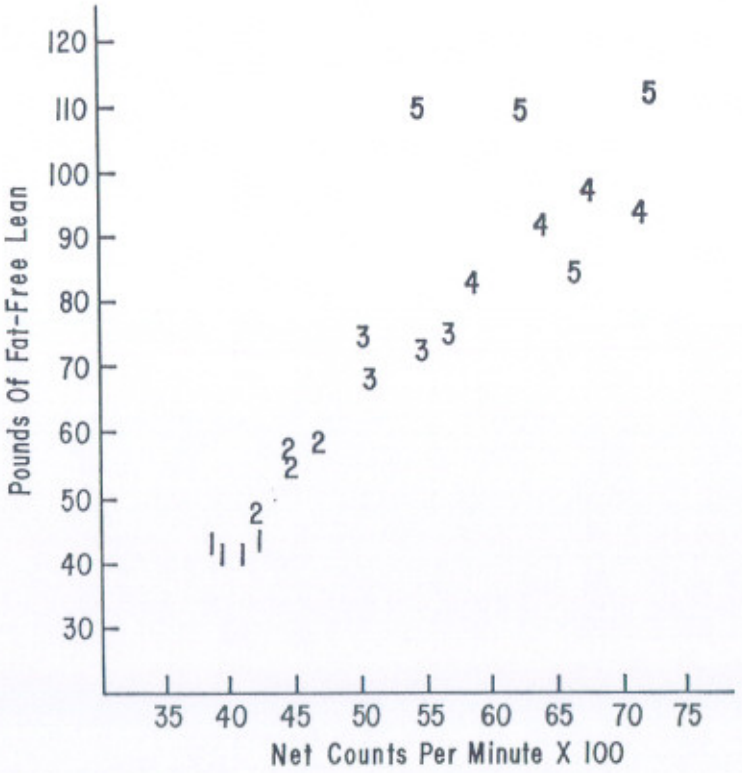

Figure 2. Net K^{40} count and weight group as related to pounds of fat-free lean.

The plotted numbers 1, 2, 3, 4 and 5 represent animals in the weight groups 100, 150, 200, 250 and 300 pounds, respectively.

much lower fat to lean ratio) than those of the 250 and 300 pound groups.

In lean and fat separation, one is able to remove much more fat proportionately from the cuts of the carcass from the 100 pound pig than from those in the heavier weights. Thus, lean cuts from heavier weight groups are not as good an estimator of carcass muscle as are those from the lighter weight groups of pigs.

A plot of net K^{40} counts, live weight and pounds of fat-free lean from pigs in Replications I and II is presented in Figure 2. The plot of these data suggests a rather strong positive linear relationship between pounds of fat-free lean and net K^{40} count in each of the five weight groups. There appears to be greater variation in pounds of fat-free lean among animals in the heavier weight groups than in the light weight groups. Further, the association between K^{40} net count and pounds of fat-free lean does not appear to be as strong at live weights of near 300 pounds as is apparent in the lighter weights.

A part of this variation among animals in heavier weights may be attributed to the self-absorption of gamma rays emitted from the muscle in the animal. The larger the animal, the greater is the likelihood that a gamma ray will lose part of its energy before leaving the animal and interacting with the detectors thus reducing the number of disintegrations detected.

Another possible source of variation may involve the fat. We do not know, for example, to what extent a layer of fat may act as a shield, thus influencing the number of gamma rays that have sufficient levels of energy to pass through the animal mass and become detectable.

While the plots of the data in Figures 1 and 2 are quite similar, there appears to be a greater linear trend in the 100, 150, 200 and 250 pound groups in fat-free lean estimation than for that of trimmed lean cuts. A complete report of the results of this study will be made at a later date.

Swine

Influence of Heat Stress on Reproductive Performance of Boars

R. P. Wettemann, I. T. Omtvedt, M. E. Wells, C. E. Pope, E. J. Turman and T. W. Williams

Decreased conception rates and increased breeding problems occur in swine herds during the summer months. This decrease in reproductive efficiency may be a result of elevated ambient temperature on the boar since gilts exposed to heat stress prior to breeding tend to have normal reproductive performance.

The objective of this study is to evaluate changes in semen quality, testicular physiology, hormone secretion and fertility of boars exposed to high ambient temperatures. A total of 12 yearling boars that previously produced fertile matings and 180 gilts will be used in this study.

The project was initiated in the fall of 1972. In the first replicate, three boars were randomly allotted to each of the two temperature-controlled environmental chambers at the Fort Reno Experiment Station. Boars were given a 15-day adjustment period at 74°F. On day 15, the temperature in one chamber was elevated to 94°±2°F for 8 hours and lowered to 88°±2°F for the remaining 16 hours during each 24 hr. period. The temperature in the other chamber (control) was maintained at 74°F continuously. Boars in both chambers were exposed to 12 hours of light daily.

Semen quality for each boar was evaluated twice weekly for six weeks during heat stress. After the boars had been maintained under these conditions throughout one complete spermatogenic cycle (42 days), the semen from each boar was used to artifically inseminate 15 sexually mature crossbred gilts. Ninety days after the boars were first subjected to the elevated temperatures, all six boars were castrated and testicular and epididymal evaluations were made. Gilts were slaughtered 30 days postbreeding and their reproductive tracts were recovered to evaluate fertility, embryo survival and early embryo development.

The second replicate of this project will be completed during 1973 and the data now available are too limited to make definite conclusions on the influence of heat stress on fertility in boars. In general, rectal temperatures and respiration rates of boars increased due to elevated ambient temperature. Within two weeks the boars partially compensated

to the elevated temperature and rectal temperatures decreased slightly but respiration rates were still elevated. Semen was collected from all boars during the treatment period, but sperm motility was decreased and there was an increase in the percentage of aged acrosomes.

Dairy

The Undesirable Flavor in Milk Resulting From Grazing Cows on Wheat Pasture

P. E. Johnson, L. J. Bush, G. V. Odell and E. L. Smith

In Oklahoma and other states of the Southwest, wheat is a very important pasture crop for the grazing of livestock. It is used by dairymen to a limited extent and would be used much more extensively if it did not cause a very objectional flavor in milk. The occurrence of wheat flavor in milk is highly inconsistant. Some dairymen seem never to have difficulty with the problem while others experience the problem even when they practice all recommended control measures. The only solution of their problem is complete abandonment of wheat pasture. The inconsistency in the occurrence of the wheat problem has been responsible for serious economic losses to Oklahoma dairymen. During February, 1972, several tanker loads of milk were rejected because of wheat flavor. On one single day, eleven tanker loads were rejected in Oklahoma City. The problem is most severe in February but not to the same degree each year.

There appear to be many variables associated with the wheat problem. Some of the more important ones appear to be individuality of cows, stage and rate of growth of the wheat plants, the influence of freezing on the wheat plant, feeding and management practices on the dairy farm, etc.

The objectives of this study are: 1. To study the effect of such variables as stage and rate of growth of wheat pasture, the time grazing,

and concentrateforage ratio on the production of wheat flavor in milk. 2. To isolate, and quantitatively measure chemical compound (s) in milk and wheat pasture samples responsible for objectionable flavor in milk. 3. To develop a simple, reliable field test to aid in the detection of wheat flavor. To date, some of these objectives have been accomplished, and the study is continuing.

Triumph 64 wheat was seeded September 15, 1972; and the grazing studies began on November 15, 1972. Twelve Holstein cows were used in this study. They were assigned at random to three groups of four cows each. All groups received the same treatment except for grazing on wheat pasture. Group I was never allowed to graze. Group II was allowed to graze for 30 minutes, and Group III was allowed to graze for 120 minutes. Both groups were removed from pasture two hours before milking. Milk samples were collected from each of the 12 cows at milking time; and, in addition, the entire quantity of milk produced by Cow No. 296 of Group III was collected. The 12 individual milk samples were divided into two portions, and these 24 portions were randomized and coded before they were examined by four experienced milk judges. The judges first examined each sample by tasting and again by smelling the samples after they had rendered slightly basic by the addition of NaOH. The quantity of milk from Cow No. 296 was analyzed for compound (s) responsible for the wheat flavor. This procedure is described briefly as follows: The milk was made basic by the addition of NaOH to release the volatiles believed to be responsible for wheat flavor. A stream of nitrogen was bubbled slowly through the milk for several hours. The nitrogen carried the volatiles from the milk into a series of traps which were charged with a weak HGl solution. The contents of the traps were concentrated and held cold until crystals appeared. The crystals were analyzed by mass spectrophotometry. Similar work is underway on wheat samples and work on other objectives will be started shortly.

The results of the organoliptic evaluations of milk produced by the three groups of cows are summarized in Figure 1. The observations made by smelling alone were more uniform than those made by tasting. The distinction between the two groups which were grazed on wheat and the control group is also more striking. The irregularities occurring in Trial 7 are, no doubt, due to a coating of ice on the wheat plants on this particular day. The intensity of wheat flavor was generally somewhat greater for Group III than it was for Group II, indicating the influence of length of grazing time. The flavor intensity for Group I increased somewhat during Trials 4 through 7, which corresponds to a period when weather conditions grew increasingly worse. During this period, it was impossible to keep lots and shelters

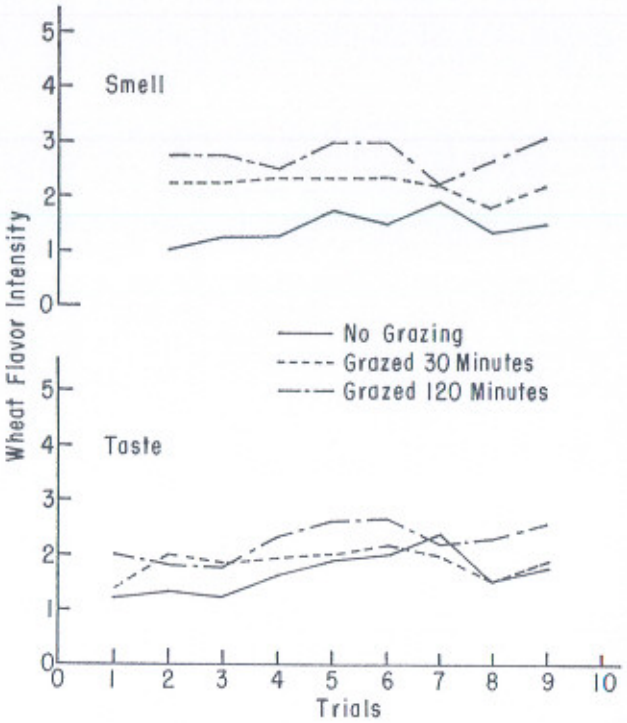

Figure 1. Average wheat flavor intensity in milk from cows grazed on wheat pasture.

in a satisfactorily condition, and the cows were forced to breath air that was contaminated with undesirable odors which might have been transferred to their milk. These odors are believed to have interfered with the judges ability to identify wheat flavor. The fact that this condition was more striking in the taste evaluations than it was in the smell evaluations further supports this premise.

The difference in the tendency of individual cows to impart wheat flavor into milk was also observed in this study. Table 1 shows average flavor intensity ranges between the individual cows of each group. Since an intensity value of 1.0 indicates no detectable wheat flavor and 2.0 indicates a very slight wheat flavor, it can be concluded that no wheat flavor occurred in Group I. Table 1 also indicates that there were individuals in both Group II and III with average flavor intensities of less than 2.0, but there were certain trials when each

Table 1. Range Between Average Flavor Intensities of Individual Cows

Group	Range	
	Taste	Smell
I	1.5-1.7	1.3-1.6
II	1.6-2.3	1.9-2.5
III	1.6-2.6	2.5-3.1

individual cow of both groups produced milk with a definite wheat flavor. Cow No. 296 never produced milk that was free from wheat flavor. This was true for Trial 7 when the wheat plants were covered with ice. The average flavor evaluations on her milk by the four judges on this date were 2.6 for taste and 3.0 for smell.

The analyses by mass spectrophotometry has definitely identified a single compound, trimethylamine, as being responsible for wheat flavor in milk. This development will be extremely valuable in further research on Oklahoma's No. 1 milk flavor problem.

Dairy Foods

Emulsifiers in Foods for the Elderly

J. B. Mickle, Wanda Smith, Sue Knight and Olive Pryor

During the last 12 years, research concerning emulsifiers in foods at O.S.U. has resulted in several new products including low calorie spreads, new cake shortenings, and candy bases. These studies with emulsifiers are continuing, and the objective of this research is to develop ideas which can be used to manufacture foods for the elderly of our population.

Present studies are aimed toward the development of high protein puddings which will be acceptable to the elderly. As a first step in this work, pudding and custard recipes were obtained from cookbooks that were from 40-80 years old. Dishes prepared from these recipes have a

taste, texture, and aroma which are familiar to the elderly people. Analyses indicated that a high proportion of the calories came from carbohydrates. Analyses of the canned puddings currently available on the market for elderly people showed that these also had a high proportion of carbohydrate calories and a low proportion of protein calories.

In addition, this survey also revealed that present-day puddings had a rather mild taste and that the textures were sometimes undesirable, in some cases being too watery to stay on the spoon. The recipes from the old cookbooks were then changed to lower the percentage of calories obtained from carbohydrates and to increase the percentage from protein. It is now possible to make a pudding with more than twice the protein content of available commercial puddings but which still seems to have an acceptable texture and taste.

For any food to have wide acceptance among the elderly, it must be appetizing as well as moderate in price. Thus, any protein additives must be relatively inexpensive. This first work has been accomplished using non-fat dry milk solids. Future work will involve whey solids and other inexpensive sources of high quality protein.

Taste panel trials have been arranged so that these puddings can be tasted by a variety of elderly groups: a group of retired but still active people, a group of older people who are relatively inactive, and a group confined to rest homes. The taste panel work will be divided into two parts. First we will determine what types of flavors these people seem to prefer. Then the knowledge of stabilizers and emulsifiers acquired in this laboratory will be used to modify the product so that it has a texture that is appealing to these people. After determining the proper texture and flavor, modifications will be made so that the product will retain this texture and flavor during heat processing and prolonged storage.

Poultry Nutrition

Lipid Metabolism in Laying Hens

Rollin H. Thayer, E. C. Nelson, R. D. Morrison and A. L. Malle

The laying hen is unique with respect to lipid biosynthesis. The yolk in a two ounce egg contains approximately seven grams of lipid, all of which is synthesized in a 20 gram liver, transported to the ovary, and deposited in the yolk. With the introduction of management procedures involving individually caged layers and the development through poultry breeding of hybrid strains of laying hens, difficulties have been encountered which may be related to lipid biosynthesis and/or transport. The result is an excessive accumulation of lipid in the liver, abdominal cavity, and intestinal mesentary. In addition, the liver may have hematomas and hemorrhages. Under commercial production conditions substantial economic losses are suffered by egg producers when high producing hens develop this condition.

Experimental data are not yet available to describe the series of events which do take place in lipid biosynthesis and transport in the laying hens during the complete laying cycle. Neither is it known at what point this overall situation moves from "normal" to "pathological", and what factors including nutrient intake and confinement may be responsible for the change. Studies designed to provide new data in this area with the laying hen may provide data relavent to corculatory problems in humans which are thought to be associated with lipid metabolism and degree of physical activity.

Caged layers at the Oklahoma Agricultural Experiment Station which were fed a specific layer ration accumulated an excessive amount of lipid in the liver. The condition was further characterized by measuring the changes in the quantity and composition of total lipid, triglyceride, cholesterol, phospholipid, and triglyceride fatty acids present in the liver during an egg production period of 36 weeks. Although the percentage of phospholipid, cholestrol and cholestrol ester remained constant, the total lpid concentration increased at a greater rate than dry liver weight. The increase lipid was due to increased triglyceride concentration. With the onset of egg production, the relative concentration of fatty acids in the triglyceride fraction changed, and by 4 weeks resembled within 1 or 2 percent the relative distribution of fatty acids in egg yolk. Research studies now underway are designed to identify possible changes in fatty acid metabolism and transport within the liver which may develop as the total liver lipid concentration increases.

Nutrient Intake Requirements of Caged Turkey Breeder Hens

Rollin H. Thayer, E. T. Clemens, R. R. Johnson, E. C. Nelson and A. L. Malle

Market turkey producers in Europe are using a management system with turkey breeder hens in which the hens are maintained in laying cages. These breeder hens are relatively small in size with an average body weight of from 8 to 10 pounds. They are prolific layers and produce a large number of eggs with a minimum of feed intake. The breeder toms which are mated to these hens are extremely large, averaging in body weight from 30 to 50 pounds. Fertile hatching eggs are produced through the use of artificial insemination. The market turkeys produced through this mating are intermediate in size and have desirable characteristics from the standpoint of growth, efficiency of feed conversion, and market finish.

This system makes it possible to produce poults at a much lower cost than can be done under floor management conditions. Reduction in poult cost through this means in the United States would bring about a significant decrease in the overall cost of producing market turkeys. For this reason, market turkey producers in the United States are considering this management technique.

Research at Oklahoma State University has been designed to determine the nutrient intake requirements of turkey breeder hens maintained under this management system. Current emphasis is being placed upon protein and energy intake requirements. Data collected to date indicate that these small turkey hens (minihens) require a daily intake of 335 kilocalories of metabolizable energy, and approximately 30 grams of protein. Studies are being conducted to pinpoint more exactly, energy and protein intake requirements and additional studies will be undertaken to determine vitamin and mineral intake requirements.

It is anticipated that data from this project will be of interest to market turkey producers in the United States as they give consideration to the adoption of management procedures in which turkey breeder hens are maintained in cages. The trend in the Poultry Industry in the United States is toward confinement in cages. In-so-far as turkeys are concerned, it required considerable research in all phases of management and nutrition in order to develop procedures to successfully produce market turkeys on a second economic basis under domestic conditions as contrasted to the natural habitat. Difficulties of a similar

nature in both management and nutrition are being encountered as poultrymen work toward the development of systems to produce hatching eggs and market turkeys under strict confinement conditions in cages. A great deal of research effort will need to be directed toward the solving of these problems.

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CORRECTIONS FOR TABLE 4. MILK PRODUCTION, PAGE 37.

Table 4. Milk Production Data

Item	Hereford		Hereford x Holstein		Holstein		
	Mod-erate	High	Mod-erate	High	Mod-erate	High	Very High
Total lactation yield, lb.	3223	3156	4247	5380	7655	6679	7448
Daily yield, lb.	13.4	13.2	17.7	22.4	31.9	27.8	31.0