Milk Flavors

J. B. Mickle, M. S. Borges, and R. D. Morrison

Much of this research on milk flavors and cows' feed energy was reported last year (MP-92, p. 278). Final analysis of the data showed two additional findings.

None of the changes made in the cow's feed or daily routine caused all animals in the group to react in the same manner. These changes included underfeeding and changing the animal's hay to grain ratio. They also involved violent exercise immediately before milking, getting the cow out of her normal place in the milking line, and changes in weather conditions. In all cases the cows reacted as individuals to these changes. Thus, when flavor difficulties arise in a milking herd, one should not expect that the whole herd has trouble, i.e., changing feeds may cause undesirable flavors in the milk of one cow while the one beside her may have no trouble at all with her milk flavor.

If flavor troubles persist in a herd's milk, the only solution is to taste the milk of each cow individually, and remove those cows from the milking line which have undesirable flavors. Milk from the remainder of the herd can be collected and sold. The effects of feed changes on milk flavor are usually short lived, providing the cow is healthy. Thus, if a cow has to be removed from the milking line because of flavor troubles, it is quite probable that this individual will adjust herself to the change within two or three days. She then can be put back in the milking line and her milk sold as usual.

A second observation from these data was that milk nearly always tastes acceptable if tasted immediately after milking. Of the 240 milk samples tasted during this experiment, only 7 percent of these (18 milk samples) showed any flavor defects when the milk was fresh. The 18 samples with undesirable milk flavors came from two or three cows. Had their milk been removed from the tank, no undesirable flavor could have been detected during the first 12 hours after milking. On the other hand, after the milk samples had been stored in the refrigerator for three days, additional milk samples developed "off-flavors". What this means, is that there is a slight flavor defect in the milk, it cannot be detected at first,

but over time this flavor becomes worse. Thus, it is undesirable that a tank of milk may taste normal when fresh on the farm, but have an unacceptable flavor by the time it reaches its destination at the milk plant three or four days later.

One must remember that in this work we are trying to upset the cows and cause undesirable milk flavors. Over 40 percent of our samples had off-flavors after three days storage, such high percentages never happen under normal herd conditions. Thus, even when flavor difficulties occur, one would expect that only a few animals are causing the difficulty. The problem is, that if the milk from these animals is put in the tank with the rest of the good milk, it will eventually spoil the flavor of the whole tank. If those few animals with undesirable milk flavors could be handled in such a way that their milk does not go in the good milk, many of the tanks of milk which now are rejected because of milk flavors, might be salable.

Table 1. Number of Cows Whose Milk Had Various Flavor Changes When Samples Held at 5° from 12 to 72 hours.

FLAVOR CHANGE[2]		GROUP I – PERIOD AND TREATMENT[1]				
12 hr.	72 hr.	1-N	2-L	3-N	4-N	5-N
F	F	8	13	18	12	6
F	O	8	15	8	14	5
F	C		5	3	5	
F	R		2	2	2	1
C	O					
C	C	2	1			
R	R			3	3	3
		GROUP II – PERIOD AND TREATMENT				
		1-N	2-N	3-N	4-L	5-N
F	F	12	14	12	13	12
F	O		4	9	5	
F	C		3	1	3	
F	R					
C	O					
C	C		3	2		
R	R					

[1] Group I contained six cows, periods 1 and 5 included 3 days, periods 2, 3, and 4 included 6 days. N = "normal" ration with 100% of NRC energy requirements; L = "low" ration with 80% of NRC energy requirements. Group II contained only 4 cows.
[2] Flavor code: F = feed, O = oxidized, C = cowy, R = rancid.

Problems Associated With Induced Superovulation and Superfetation in Beef Cows

E. J. Turman, D. M. Hallford, R. P. Wettemann and C. E. Pope

Research continued on the use of the gonadotropic hormone preparation, pregnant mare serum or PMS, to induce multiple births in beef cows. Studies conducted during the past year were largely of a very basic nature and all analyses are not yet completed and summarized.

The study involved 31 lactating 3-year-old Angus cows and 23 nonlactating 2-year-old Angus heifers. Twelve heifers and 15 cows received a sequence of 2 subcutaneous PMS injections, 1500 IU on day 5 and 2000 IU on day 17 of the cycle, and 11 heifers and 16 cows received a single injection of 2000 IU PMS on day 17. Blood samples were taken from each animal on days 1, 3, 5, 6, 7, 9, 11, 13, 15, 17 and daily until estrus occurred. They were bred by natural service to Angus bulls at the post-PMS estrus. Ovulation rates were determined by means of a high lumbar laparatomy performed 7 to 11 days after estrus.

Estrus occurred following the PMS injections in 75.0 percent and 63.6 percent of the cows and heifers, respectively, that received the single injection of PMS, with ovulation rates being, respectively, 2.25 and 3.09 eggs. In the animals receiving the sequence of 2 PMS injections, estrus was observed in 66.7 percent and 100 percent of the cows and heifers, respectively, with ovulation rates being, respectively, 1.27 and 4.35 eggs.

Conception rates to natural service at the post-PMS estrus were: for animals receiving a single PMS injection, 62.5 percent for the cows and 45.4 percent for the heifers; for animals receiving the sequence of 2 PMS injections, 60.0 percent for the cows and 75.0 percent for the heifers. It was not possible to determine why the heifers performed best on the sequence of two injections while the cows performed best on the single injection.

The blood samples were centrifuged immediately following each bleeding, and the plasma frozen and stored until determination of levels of progesterone, estrogens and LH could be made by radioimmunoassay. These are now being completed and will be presented at a later date. It is anticipated that a consideration of the changes in the blood levels of these hormones will provide a better understanding of the physiological mechanisms involved in the response of cows to PMS.

In cooperation with USDA, Agricultural Research Service, Southern Region.

Use of the Emme as a Measure of Leanness in Swine

Dennis M. Stiffler, Lowell E. Walters, R. K. Johnson and Richard F. Queener

A precise, non-destructive measure of leanness in living meat animals would be a valuable aid in the selection of breeding as well in market animals as the livestock industry moves generally toward the production of animals that will provide a leaner meat product at the retail counter.

Recent interest in an evaluation technique utilizing the electronic properties of lean and fat as a basis for predicting leanness has provided such a possibility in the EMME (Electronic Meat Measuring Equipment). This method employs the principle that lean conducts electrical energy more readily than fat. In this instrument, an electronic transducer is so designed as to produce as electromagnetic field surrounding the chamber through which the animal is passed for evaluation. Differences in the amount of electromagnetism absorbed form the basis for the interpretation of results.

Forty-one market weight hogs, representing 3 breed crosses produced at the Fort Reno Livestock Research Station, were used in this follow-up study. The hogs were taken off-feed for 24 hours and washed prior to EMME evaluation. Each barrow was randomly counted five times for 2 purposes: (1) to provide data from which a determination of the repeatability of the device can be made, and (2) to determine the relationships between mean EMME count and pounds of fat-free lean from the carcass right half as determined by physical separation and chemical analyses.

Routine carcass data were obtained prior to cutting the right sides of each carcass into standard wholesale cuts. Untrimmed and closely trimmed cut weights were recorded from the four major wholesale cuts. The ham, loin, shoulder and thin cuts (belly and feet) were physically separated into lean, fat and bone. Ether-extract analyses were conducted on blended samples from the separable lean and pounds of fat-free lean were calculated by difference.

The analysis of the data is incomplete to date. However, the raw data appears to be no more promising than those of a previous study involving the EMME as a predictor of leanness in market hogs. The repeatability of the instrument and the relationship of the mean EMME count to different measures of leanness both appear to be somewhat inadequate for use in a meaningful prediction equation. A graphic plot

EMME count and fat-free lean. A more detailed report of the findings will be presented upon completion of the analysis of the data.

Net K^{40} Count as an Estimator of Lean in Two Types of Cattle Evaluated at Four Different Weights

Lowell E. Walters, Dennis M. Stiffler and R.F. Queener

Studies dealing with the relation between net K^{40} count and pounds of fat-free lean from steers of 2 different types slaughtered at 500, 700, 900 and 1100 pounds described in Oklahoma Agricultural Experiment Station Publication Number MP-92 (1974) continue in progress. The work is currently in the third and final replication. While the data to this point suggest certain trends, a report on this, the basic objective of the study, will not be made until all of the data are collected and analyzed.

Of added interest and as a "spin off" of the primary study are trends in the data relative to differences in muscling between the 2 types of cattle used in the work, namely "intermediate" or conventional type beef cattle and "growthy", large scale type. Table 1 presents the fat-free lean yields by type and slaughter weight. While the numbers of cattle involve to date are small, the advantage in yield of muscle in the "growthy" cattle used in the study appears to be quite pronounced. In addition to total muscle, certain muscles and muscle systems in the carcasses were removed individually from the carcass and weighed.

It appears from a preliminary review of the data that the "Growthy" type carcasses were especially meatier in such muscles as biceps femoris (outside of bottom round), semimembranosus and adductor (inside or top round), quadraceps (sirloin tip), longissimus dorsi (rib eye), psoas major (tenderloin) and semitendinosus (eye of round). With such variation in these and other economically important traits in our herds, it becomes important to the producer to combine in one production unit the best

combination of reproductive performance, rate and efficiency of growth and fattening to market weight and of carcass merit.

So long as there is variation in these economically important traits we can make progress toward achieving these herds or individuals that will allow for the maximizing of beef production, and best fitted for one of a variety of environmental conditions under which beef production is accomplished.

Table 1. Mean Slaughter Weights and Yields of Fat-free Lean from Cattle of Different Types[1]

Conventional Beef Type			Growthy (Large Scale) Beef Type		
Slaughter Wt. Lbs.	Fat-free Lean Lbs.	Fat-free Lean % (Sl. Wt.)	Slaughter Wt. Lbs.	Fat-free Lean Lbs.	Fat-free Lean % (Sl. Wt.)
502	167	33.3	520	197	37.8
698	214	30.6	701	252	35.9
904	272	30.0	902	291	32.3
1095	302	27.6	1100	345	31.4

[1] 8 animals per weight group.

Serum Alkaline Phosphatase Levels in Small Scale and Large Scale Steer Calves

T.R. Kramer, J.R. Escoubas, J.J. Guenther and K.K. Novotny

The role of alkaline phosphatase in the production and growth of bone has been extensively investigated in humans and experimental animals but not in beef cattle. Alkaline phosphatase is particularly abundant in bone forming cells (osteoblasts) and in the formation and development of bone (osteogenesis). During recent years the beef industry has moved towards increased use of large scale beef cattle as sources of red meat. Limited information is available concerning the physiological growth patterns of bone, muscle and fat in these large scale or "exotic" breeds. This study is aimed at determining the relationship between serum alkaline phosphatase levels and bone maturity.

The experimental units for this study were eight grade Angus steer calves and eight crossbred Charolais (7/8 Charolais x 1/8 Angus) steer calves. Blood samples were collected from the calves at about one month of age and 56 day intervals thereafter, for a total of eight periods. The calves averaged 116 pounds in live weight at the first period. The Bessey, Lowry and Brock assay for the rapid determination of alkaline phosphatase or "alkaline phosphatase activity" of serum, was used. Results were expressed as micromoles of p-nitrophenol liberated per hour per milliliter of serum, which is the same as Sigma Units or Bessey-Lowry-Brock Units.

The mean values for the serum alkaline phosphatase results are given in Table 1. Results showed that the small scale Angus calves averaged 4.5 micromoles of alkaline phosphatase activity for the eight test periods, whereas that of the large scale Charolais was 5.3 micromoles. It may be perceived from the values in Table 1 that considerable variation existed in alkaline phosphatase activity among animals and periods. It is believed that much of the variation observed in alkaline phosphatase activity was due to stress of the animals during sampling.

From physiological growth patterns it would be expected that the large scale, late maturing Charolais would be expected to have a greater alkaline phosphatase level than the small scale, early maturing Angus. Also, the alkaline phosphatase levels should decrease with age. The data in Table 1 tend to support these expectations, but only from a general standpoint. However, it is believed that if the animal stress during sampling could be minimized, thus reducing variation, then alkaline phosphatase activity could be used as a measurement of the rate of bone growth and/or maturity.

Table 1. Alkaline Phosphatase Activity in Small Scale and Large Scale Calves.[1]

	Periods								
	1	2	3	4	5	6	7	8	Average
Angus	5.4[2]	7.1	3.7	2.7	5.4	4.7	4.1	3.1	4.5
Charolais	5.5	5.6	5.8	5.1	5.0	4.8	5.3	5.3	5.3

[1] All values are in a micromoles per hour per milliliter of serum.
[2] Each value represents the average of eight animals (determinations were in triplicates).

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Beef Carcass Composition Studies Among Crossbred Cattle

Dennis M. Stiffler, Lowell E. Walters and Richard R. Frahm

Crossbreeding in beef cattle has attracted a great deal of interest during recent years as producers search for methods of improving the production potential of their herds in terms of those traits of greatest economic importance. Many so-called "exotic" breeds are becoming more widely used in such attempts without the knowledge of the extent to which this new genetic material will contribute to such a program of maximizing quality beef production.

As a part of the recently initiated beef crossbreeding project at the Oklahoma Agricultural Experiment Station, studies are being initiated which deal with such beef carcass characteristics as quality grade, cutability, conformation grade, yield of total closely trimmed lean, fat and bone as well as the yield of certain selected individual muscles and muscle systems. In addition, Warner-Bratzler Shear values for tenderness determination will be obtained.

These studies are in the initial stages and the first group of cattle has been slaughtered, the carcasses evaluated and the data collected. Further reports will be made as sufficient data accumulate to warrant a detailed account of the findings.

The Effects of Freezing and Thawing on Lactate Dehydrogenase Isoenzymes from Bovine Muscle

J.R. Escoubas, J.J. Guenther and K. K. Novotny

Defining meat animal growth potential and muscle deposition efficiency has been the objective of meat scientists for several years. Many methods of ascribing muscling potential are being utilized today, however none of these takes into consideration metabolism at the fiber level, on

the state of cellular metabolism, the state of cellular differentiation and the way these two parameters affect overall muscle synthesis and deposition would certainly assist in making finite determinations of muscling potential, a bovine growth and development investigation at the cellular and subcellular levels was initiated.

At the advent of such an extensive investigation, procedural format was developed. Of specific consideration was in what physical state should enzymic preparations be made so that *in vivo* functioning might be most accurately approximated? In order to define the state in which the tissue should be used, Lactate Dehydrogenase (LHD), a tetrameric, glycolytic enzyme was used. LHD catalyzes the reduction of pyruvate to lactate in order to generate reducing equivalents (NAD) for glycolysis during anaerobiosis. This enzyme is composed of two pure forms, the muscle type and the heart type which have a greater specificity for pyruvate and lactate, respectively. LHD-pyruvate specific has been observed primarily in tissues obtaining their energy mostly from glycolysis whereas LDH-lactate specific has been observed primarily in tissues obtaining their energy from aerobic pathways. Hybrids of these two pure forms occur in varying numbers and concentrations depending upon the energy substrates present. Quantitation of these forms of LDH and their relative concentrations would aid in defining the metabolic condition of the muscle tissue in question.

For this work muscle tissue was collected from bovine longissimus dorsi and portions were either frozen in liquid nitrogen or utilized as fresh tissue. The muscle sample was extracted, centrifuged and the resulting supernatant dialyzed and electrophoresed on polyacrylamide gels. These gels then were stained via dehydrogenase staining techniques. Bands were sectioned from unstained gels and enzyme and protein assays performed on each of the isolated band solutions. Enzyme activity was measured as the average optical density change per minute and expressed as units of enzyme activity per gram of muscle protein. These units were then expressed as a percentage of the summed activities of the sectioned bands.

The results as noted in Table 1 indicate a "hybridization" after freezing and thawing of the two original bands isolated in the fresh extract. These results are similar to those results of Blonde *et al* (1967) in their freeze-thawing experiments with Malate Dehydrogenase. Similar studies have been reported on LDH by Chilson *et al* (1965a), Chilson *et al* (1965b) and Chilson *et al* (1966). Investigations by Markert (1963) suggest that freeze-thawing two electrophoretically distince forms of LDH caused formation of multiple forms to appear in a binomial type of distribution. This author disclosed that such hybridization occurred via complete dis-

Table 1. Number and Percent of Lactate Dehydrogenase Bands at Various Extraction Periods.

Extraction Time		Fresh	Days Frozen						
			1	7	14	21	28	35	42
Number of Bands		2	2	3	4	4	4	4	4
Percent Activity:	Band 1	35[1,2]	40.0[2]	35	28[2]	24[2]	14[2]	36[2]	50[2]
	Band 2	65[3]	59.9	27	19	34	33	10	18
	Band 3		60.0[3]	38[3]	31	25	32	28	22
	Band 4				22[3]	17[3]	21[3]	26[3]	10[3]

[1] All values expressed as a percent of the summed specific activities of the gel sections.
[2] The band electrophoresing to the anode least rapidly labeled band 1 referred to as the muscle type.
[3] The band electrophoresing to the anode most rapidly was referred to as the heart type.

sociation and random recombination of subunits during the freezing and thawing process but offered no mechanistic explanation.

As indicated by the data in Table 1, electrophoretic separation and subsequent enzyme assays on the fresh muscle extract showed evidence of two isoenzyme bands. Yet after 7 days of storage at –20° C, three bands appeared indicating a possible hybridization of the two primary bands. By the 14th day of storage at –20° C, four isozymic bands appeared, possibly due to the same hybridization phenomenon. This information suggests that isoenzymic analysis on previously frozen muscle tissue might be subject to procedural artefacts and conclusions on such data would prove extremely hazardous. Thus, it was concluded that fresh muscle tissue must be utilized in all protein and enzymic assays in order to obtain results more indicative of the *in vivo* metabolic state.

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