AG-BU-2310
Agricultural Extension Service
University of Minnesota

1985 Minnesota Beef Cow—Calf Report

AGRICULTURAL EXTENSION SERVICE
in cooperation with
Department of Animal Science and
Agricultural Experiment Station

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Animal Science
120 Peters Hall
1404 Gortner Avenue
St. Paul, Minnesota 55108

Dear Beef Producer:

Greetings from the Department of Animal Science, University of Minnesota. We hope that you find this Beef Cow-Calf report informative and that the information herein is useful in your enterprise. It is our desire to provide you with the latest research results and to present technical information that may assist you in your beef operation.

As you recall, the Department of Animal Science requested the 1984 Legislature to appropriate funds for renovation of livestock facilities on the St. Paul Campus and at Rosemount and for the construction of some new animal facilities. A portion of those funds were appropriated. We are now in the process of designing a new unit on the St. Paul Campus that will house individually-fed cattle and cattle that will be used in nutrient balance studies. Plans for renovation of the campus beef barn as a teaching facility are progressing well and renovation should start next summer. The beef teaching unit will house beef cows and feedlot cattle. Students will manage the unit and gain valuable experience as they apply management information learned in their courses.

We need you assistance in telling the 1985 Legislature that the remainder of the Animal Science building request is urgently needed to complete the construction and renovation of livestock facilities. Give your legislator a call or drop a note that indicates you support for our building request. Thank you for your support.

Sincerely yours,

Richard Goodrich
Professor and Head

RDG:lda

TABLE OF CONTENTS

BEEF COW EFFICIENCY - AN OVERVIEW**

R.L. Arthaud* and J.C. Meiske*

Efficiency as related to beef cattle has become a frequent -- and often controversial -- topic of discussion. Many factors have contributed to this upsurge of interest. The influx of cattle from continental Europe has been a factor as has the near obsession among breeders on "ever bigger", "ever more milk".

Economic conditions have contributed to increased emphasis on economic efficiency; on more optimum use of land, cattle, labor and capital. Producers are becoming more concerned with matching production levels to the resources that are available or can economically be made available.

Two Kinds of Efficiency

Beef cow efficiency is generally expressed in two ways: 1) as biological efficiency, or 2) as economic efficiency. Biological efficiency is useful as a base for decisions because of its relative stability. It does not account for differences in inputs such as feed costs nor for price differentials relating to grade, weight and other factors that may vary greatly. There is no incentive for improving biological efficiency unless some economic benefit can be realized.

Biological Efficiency

Biological efficiency is usually expressed as a ratio of output over input or of input over output. Many of the measures of biological efficiency are not feasible for use by producers, but are important research tools. A few examples of measures of biological efficiency are:

1. Calf's Weaning Weight. Weaning weight often is highly correlated with cow efficiency. It is a practical measure for both commercial and seed stock producers.

2. Dam's Milk Production. Milk production is closely related to weaning weight of the calf. Most producers will depend on the indirect measure of milk production; i.e., weaning weight. Maximum milk production may not be desirable; cows producing milk in excess of what the environment will support may respond with lowered fertility.

3. Calf's Weight/Dam's Weight. In this measure of efficiency, it is assumed that the dam's weight is related to her annual feed requirements. Actual body weight as the denominator may not be as appropriate as metabolic

---

* Animal Scientists, University of Minnesota

**Portions of this report have been taken or adapted from a paper by Harlan D. Ritchie, Michigan State University, prepared for Beef Cow Efficiency Forum, East Lansing, MI and Fort Collins, CO, May 1984.

body weight (body weight to the 0.75 power). Some people might assume that a 1400 pound cow would require twice as much energy for maintenance as a 700 pound cow, which is not true; the 1400 pound cow needs about 1.6 times as much energy (about 9.7 Mcal of net energy vs about 6.1 Mcal).

4. Calf Weight Weaned/Cow Exposed to Breeding. This is one "index" of productivity. It is a function of cow fertility, calf survival rate, milking ability and the calf's genotype for pre-weaning growth. The components are not weighted according to economic importance; i.e., what is 1 percent more calves alive at weaning worth relative to a 10 pound increase in weaning weight?

   A major deficiency in this ratio as a measure of efficiency is that it does not account for the major cost input in a cow-calf enterprise -- feed consumed, which accounts for about 40 to 70 percent of all costs.

5. Calf Weight Weaned/Energy (TDN) Consumed. This is a function of milking ability, calf's genotype for growth, and total digestible nutrients consumed by the cow and her calf (if creep-fed) up to weaning time. Most producers would not have the individual feed consumption information to use this measure. This measure does not account for differences in fertility or survivability.

6. Calf Weight Weaned/Cow Exposed/TDN Consumed. This is the preferred measure of biological efficiency up to weaning time because it accounts for differences in reproductive rate, milking ability, calf's growth rate and feed consumed. However, if small numbers are involved, a few open cows or a few dead calves may exert an undue influence on biological efficiency. As mentioned above, cull cow weight may be added to weaned calf weight to account for total output. In so doing, however, an adjustment for difference in value of weight sold should be applied.

7. Final Product Weight/TDN Consumed. In this measure of efficiency, the output (final product) may be expressed in several ways: 1) slaughter weight; 2) empty body weight; 3) carcass weight; 4) retail cut, lean cut, or edible product weight; 5) energy in the calf at time of slaughter; 6) edible energy in the calf at slaughter. In some studies, the data are adjusted for differences in reproductive rate; in others, reproduction is not considered. If differences in reproductive rate are large, they can have a dramatic impact on biological efficiency, as noted above. It is one measure of efficiency in the total system, but is not specific to the cow-calf portion.

8. Other Measurements. There are many other measurements or factors that directly or indirectly are related to biological efficiency and often to economic efficiency. These include: birth weight, pelvic area, yearling weight, mature weight, calving ease, gestation length and longevity. Some of these will be discussed later in this paper.

Measures of Economic Efficiency

Economic efficiency has not been studied to the same extent as biological efficiency. Nevertheless, most animal scientists today agree on its importance and that it should be considered in research projects whenever possible. Economic efficiency is certainly critical to survival of the beef cow-calf producer. Following are a few measures of economic efficiency that have been used by researchers.

Cost of Production/Weight of Live Animal Marketed. In this case, all production costs are accounted for and divided by weight of live animal marketed. Live animal weight may consist of weaned calf weight, or final slaughter weight, plus cull cow weight adjusted for value differences between cow weight and progeny weight. Historically, cull cow weight has sold for approximately 55 to 60% of the value of feeder calf weight. When calves are sold at weaning time, 40 to 45% of the live weight marketed annually may come from the sale of cull cows. This means that 25 to 30% of gross income could be derived from the sale of cows, and 70 to 75% from the calves. If calves are fed out to slaughter, cull cows account for about 20% and calves 80% of gross income.

Cost of Production/Weight of Retail Yield Marketed. From the standpoint of total life cycle beef production, this is an excellent measure of efficiency because it attempts to assess the cost of producing the final product -- saleable retail beef. However, it does not account for potential value differences between quality grades of beef (choice, good, etc.).

Net Return per Cow-Calf Unit. Everyone is (and ought to be) interested in net profit. However, it is not always the most useful concept because it means different things to different people. The basic problem is: what costs are included upon which to base net return? For example, land, livestock and labor charges may or may not be included in the total cost of production, depending upon the nature of the operation. This can have a major impact on net profit.

Net Return to the Beef Cattle Enterprise. This is a more useful measure of economic efficiency than one based on a per animal unit. It is really the whole enterprise that determines the economic fate of the beef producer. Nevertheless, the question of which costs are to be included remains a problem, as suggested above.

Return on Investment. This measure is not often cited in beef cow efficiency research. However, it may be one of the most useful barometers of economic efficiency.

Factors Affecting Beef Cow Efficiency

Numerous factors have been identified as possibly having an impact on beef cow efficiency. They are listed in the sections that follow.

Genetic/Biological Factors

1. Size (Weight, Frame, etc.). Much of the research conducted recently has dealt either directly or indirectly with physical size.

2. Milk Production. Next to size, milk production has received the most attention from cow efficiency researchers.

3. Level of Feed (Energy) Intake. Dietary energy intake has been shown to affect body maintenance requirements which can, in turn, influence efficiency of production.

4. Body Condition. Degree of body fatness has also been shown to exert some influence on maintenance requirements.

5. Breed Differences. There is some evidence to indicate that breeds do differ in efficiency, depending upon how it is defined and measured.

6. Heterosis. The dramatic impact of heterosis on increasing output per cow exposed is well documented in the scientific literature; pounds of calf weaned per cow exposed to breeding may increase by 20 to 25 percent because of heterosis. Its effect on efficiency is perhaps less clear.

7. Crossbreeding Systems. The crossbreeding system chosen can have a significant effect on efficiency. Crossbreeding systems were discussed in the 1984 Minnesota Beef Cow-Calf Report.

8. Age at Puberty. The age when heifers reach puberty and when they subsequently give birth to their first calves will affect life cycle efficiency.

9. Longevity. Length of life in the herd can affect efficiency in several different ways: 1) more progeny are sold when cows produce longer and the culling (replacement) rate is lower; 2) up to a point, mature cows wean heavier calves than 2 to 4-year-old cows; 3) maintenance requirements for mature cows are somewhat higher than for replacement heifers.

10. Functional Defects. Unsoundnesses of the feet, eyes, udder, and reproductive tract can impair productivity, increase costs, and reduce longevity.

11. Dystocia and Related Problems. Calving difficulty and its associated problems can result in reduced output and increased costs, thereby reducing efficiency.

Environmental/Management Factors

1. Climate. Research has shown that climate can have a profound effect on maintenance costs as well as on output (progeny performance).

2. Soils and Vegetation. Fertility of the soil and quality of the vegetation that it will support can aid in determining the type of cattle that will be most efficient.

3. Topography/Terrain. As indicated above for soils and vegetation, type of terrain and distances required to travel for feed and water can influence the type of cattle best adapted to the conditions.

4. Supplemental Feed Resources. The availability, cost and quality of supplemental feed can also influence decisions regarding the most efficient biological types.

5. Labor and Facility Resources. If labor and facilities are limited or expensive, the type of cattle selected must be relatively trouble-free and easily managed in order to maximize efficiency.

6. Pathogens, Parasites and Predators can reduce output and thereby lower efficiency.

7. Growth Implants and Feed Additives. Growth implants can stimulate pre- and post-weaning gains by 5 to 15%. Ionophores can improve post-weaning feed efficiency by 6 to 10%. The overall biological efficiency of beef production is generally enhanced through the use of these materials.

Marketing/Economic Factors

1. Carcass Weight Preferences. The boxed beef trade accounts for about 80% of the beef marketed in the U.S. To meet specifications for this market, carcasses should generally weigh within a range of 550 to 850 lbs. This can have a major impact on cow size and efficiency.

2. Carcass Cutability Preferences. In order to earn top economic returns, beef carcasses must have a yield grade of 3 or better. A yield grade of 2 would seem to be a reasonable goal.

3. Quality Grade Preferences. At the present time in the U.S., beef carcasses must have a quality grade of low choice or higher in order to achieve top price. In the future, a grade equivalent to the present quality grade of high good may be sufficient.

4. Breed and/or Color Preferences. There is no doubt that cattle feeders in various regions of the country will pay more for calves of certain breedtypes than they will for others. This was well documented in a recent study by Lambert et al. (1983). Meat packers also have preferences, but they do not necessarily coincide with those of cattle feeders.

5. Slaughter Age Preferences. It is perceived that U.S. consumers prefer the flavor of yearling to 2-year-old beef over that from cattle less than 12 months of age. Moving in the direction of younger slaughter ages could have some impact on economic efficiency.

1985 Minnesota Cow-Calf Report C-63

FACTORS INFLUENCING MAINTENANCE ENERGY REQUIREMENTS OF BEEF COWS

D.A. Larson, R.D. Goodrich and J.C. Meiske
Department of Animal Science, St. Paul

Summary

Due to increased economic pressure in the beef industry and the trend toward larger mature cow sizes in commercial herds, beef producers have shown an increased concern for cow efficiency. To achieve efficient beef calf production, cattlemen must meet energy needs of beef cows for optimum performance attainable under given environmental conditions and feed resources. This paper reviewed energy requirements as estimated by NRC (1984) and discussed major factors that influence maintenance energy requirements of beef cows. The major factors were body weight, body condition, stage of reproduction, lactation, breed, thermal environment and use of ionophores. Additional research is needed to quantify more precisely the effects of these factors on energy requirements so that cattlemen may better meet the nutrient requirements of beef cows under specific production conditions.

Introduction

Cow efficiency is currently a popular topic in the beef industry. The feed requirement for maintaining beef cows, which is a major expense in beef calf production, is a primary concern of beef producers. One reason for this increased concern about efficiency and ultimately about energy requirements for maintaining beef cows is the increased economic pressure on the beef industry. If the beef industry is to thrive it must produce a quality product at a price that is acceptable to the consumer and competitive with other meat products. Because feed is the largest variable expense in beef production, it is logical to investigate means to reduce this expense while maintaining optimum production. Another reason for increased concern about energy requirements is the introduction of the continental breeds into the U.S. beef industry. These breeds represent cattle with large mature weights and high feed costs per herd. These costs must be offset by increased production per cow. However, many beef producers question whether there is an efficiency limit to cow size. To answer questions such as these, it is necessary to understand energy requirements of beef cows and the many factors that influence those requirements.

Energy Requirements

It has been estimated that about 70% of the energy required for a cow production year is attributable to maintenance of the cow (Jenkins and Ferrell, 1983). Any reduction in energy required for maintaining the cow herd will significantly increase efficiency of calf production. However, energy intake cannot be below required amounts for long periods without affecting performance of the herd. Inadequate energy intake prior to calving causes cows to lose condition and results in a lengthened interval from calving to first estrus (Wiltbank et al., 1962; Holloway et al., 1975; Holness et al., 1978; Reardon et al., 1978). Inadequate energy after calving lowers conception rates (Wiltbank et al., 1962, 1964; Somerville et al., 1979). These results are dependent on initial condition of the cows and on the severity of energy restriction. Mature cows in good condition can lose weight and condition due to inadequate energy intake and not have their performance affected because their final condition is yet adequate. This fact aids in explaining why some researchers have found no relationship between cow weight changes and reproductive performance (Hight, 1966; Phillips and Vavra, 1981; Bartle et al., 1984). The ultimate nutritional goal in efficient beef calf production is to supply nutrients to meet the needs of the beef cow for optimum performance under given environmental conditions without overfeeding.

Energy requirements for gestating and lactating beef cows, as estimated by NRC (1984), are presented in tables 1 and 2, respectively. The energy requirement for pregnancy was determined from a regression of energy required on calf birth weight. It was assumed that dry pregnant mature cows need to gain 0.9 lb/d during the third trimester to account for products of conception. From that regression equation it was determined that 2.8 Mcal more metabolizable energy (ME) is required per day during the last third of pregnancy for a pregnant cow bearing an 80 lb calf. No energy requirement for pregnancy during the second trimester was assumed; therefore, energy values for that period represent maintenance requirements of the cow.

Because determined values for energy requirements of lactating beef cows are not available, they were assumed by NRC (1984) to be similar to those determined for dairy cows. Requirements listed in table 2 for lactating beef cows were based on ME requirements for 10 or 20 lb of milk given in Nutrient Requirements of Dairy Cattle (NRC, 1978). Major factors that influence maintenance energy requirements include body weight, body condition, lactation, breed, environment and use of ionophores. Some of these factors undoubtedly differ between beef and dairy cows; therefore, further research is needed to determine energy requirements for lactation in beef cows rather than to estimate them by extrapolations from measured energy requirements of dairy cows. The remainder of this paper is devoted to reviewing major factors that influence maintenance energy requirements of beef cows.

Factors Influencing Maintenance Energy Requirements

Body weight

Energy requirements for maintenance of beef cows are primarily dependent on body weight. Researchers frequently use metabolic body weight ($W^{.75}$) as a scaling coefficient for comparing energy requirement data obtained on animals differing in body weight. Use of this scaling coefficient resulted from studies by Brody (1945) and Kleiber (1961) which showed that fasting heat production was closely related to $W^{.73}$ and $W^{.75}$, respectively, when means of species of mature animals, which varied greatly in W, were used to evaluate this relationship. A more recent analysis by Thonney et al. (1976) reconfirms $W^{.75}$ as an appropriate estimator of fasting heat production of mature animals for interspecies comparisons but indicates that W would serve adequately as a scaling coefficient when making comparisons within a species. Regardless of the specific scaling coefficient used, weight influences fasting heat production and, therefore, maintenance energy requirements. Thus, energy requirements for gestating and lactating beef cows are established within weight classes (tables 1 and 2).

Body condition

Experiments by Klosterman et al. (1968) and Lemenager et al. (1980) indicate that body weight alone cannot be used to describe accurately energy requirements of cows differing considerably in size. Klosterman et al. (1968) reported significant negative correlation coefficients between condition score and energy requirement, suggesting that fatter cows had lower energy requirements. When fed equivalent amounts of feed per unit of body weight, cows that had a high condition score tended to gain weight while cows in thin condition lost weight. This suggests that increases in weight due to increases in condition may not result in increased maintenance requirements. Lemenager et al. (1980) reported that visual body condition score combined with weight appeared to predict relative energy requirements of pregnant cows during late gestation more accurately than did weight alone.

Thompson et al. (1983) studied the influence of body condition on winter energy requirements of spring-calving beef cows. Twenty Angus-Hereford and 20 Angus-Holstein cows were individually fed 12.9 or 18.0 Mcal ME/hd daily throughout the feeding period. Energy retentions during this period were calculated by determining body composition at initiation and at termination of the feeding period. Maintenance energy requirements (kcal/d) were estimated from linear regressions of energy retentions on ME intakes per unit metabolic body weight ($W^{.75}$). Average winter body compositions and maintenance requirements for thin and fat cows within each breed group are given in table 3. Percentage empty body fat during the winter feeding period was the criterion for dividing cows into thin and fat groups. Maintenance energy required/$W^{.75}$ tended to be less for fat Angus-Hereford cows than for thin Angus-Hereford cows. This agrees with the previously mentioned results of Klosterman et al. (1968) and Lemenager et al. (1980). In contrast, maintenance energy requirements of Angus-Holstein cows were slightly higher for fat cows than for thin cows. A possible explanation for the observation that increased body fat did not reduce maintenance energy requirements for Angus-Holstein cows may be the difference in fat distribution between Holstein and beef cattle. Holstein cattle deposit a greater proportion of their fat internally and therefore have less subcutaneous fat than typical beef cattle. Less subcutaneous fat results in less insulation and consequently increases maintenance energy requirements for animals to keep warm during cold weather.

Because increased fat deposition reduces winter maintenance energy requirements of Angus-Hereford cows, manipulation of body condition during appropriate periods of the year may serve as a means to reduce total maintenance needs for the year. Thompson et al. (1983), using efficiency estimates derived in their study, made a theoretical comparison of the energetic efficiency of having Angus-Hereford cows in a thin to average body condition during the winter vs feeding cows more in the fall to have them in a fatter condition during the winter (table 4). Their calculations indicated that there would be no advantage, relative to ME fed, for fattening beef cows in the fall unless the cows were maintained in that fatter condition throughout the year for at least 10 years. Fattening beef cows in the fall may be a logical alternative if feed supplies are more readily available in fall than in winter and, consequently, feed cost per unit ME is less in the fall.

Lactation

Energy requirements increase during lactation due to energy required to produce milk. However, several studies have shown that maintenance requirements for energy are also greater for lactating cows than for non-lactating cows. Neville and McCullogh (1969) used 40 lactating, nonpregnant and 16 nonlactating, nonpregnant, mature Hereford cows in an energy study and concluded that maintenance requirements for lactating cows were 31% higher than those for nonlactating cows. Brody (1945), Hutton (1962), Moe et al. (1970) and Neville (1974) also reported that maintenance requirements were higher for lactating cows than for nonlactating cows. Energy fed to lactating cows in excess of that required for maintenance during their nonlactating, nonpregnant state can be assumed to be the energy cost of producing milk. A primary question to be answered is whether the increase in maintenance energy requirement due to lactation is the same for beef cows as for dairy cows and the same for different breeds of beef cows. A difference in the increase in maintenance energy requirement due to lactation would result in different energy requirements for milk production and thus bar any extrapolation from dairy cattle requirements.

Breed

Another factor that may influence energy requirements of beef cows and that has received insufficient research thus far is breed. Thompson et al. (1983) determined winter maintenance energy requirements of Angus-Hereford and Angus-Holstein cows. Maintenance energy requirements were approximately 10% higher for Angus-Holstein than for Angus-Hereford cows (77.5 and 70.5 kcal/$W_{lb}^{.75}$, respectively). This difference in maintenance energy requirements between Angus-Holstein and Angus-Hereford cows indicates that one or more of the maintenance components differed. These maintenance components may include energy needs for protein and fat synthesis and turnover, ion transport across cell walls, thermogenesis, and vital organ and nervous tissue function. Results of others (Tyrrell et al., 1974; Haaland et al., 1980) also indicate that Holsteins have higher maintenance requirements than cattle of beef breeding. Plegge and Meiske (1983) in a review of dietary considerations for Holstein steers concluded that Holsteins require greater amounts of ME for maintenance than beef cattle do.

A question of primary importance is whether these differences between cattle of typical beef breeding and cattle with Holstein breeding are also present among beef breeds and, if so, whether these differences are economically significant. Solis et al. (1984) determined maintenance energy requirements and efficiency of energy use for gain in 60 dry, nonpregnant, mature cows of five breeds and their crosses. The five breeds were Angus, Brahman, Hereford, Holstein and Jersey. Cows were individually fed daily for four consecutive periods (127, 105, 97 and 99 d) at each of four levels (50, 83, 117 and 150% of a cow's estimated maintenance level). One cow of each four per breed group was assigned to each feeding level within a period. Feeding levels were rotated during consecutive periods. Maintenance energy requirements for weight equilibrium and efficiency of weight change were determined for each cow from the regression of weight change on ME intake across all four periods. Breed means are presented in table 5. Maintenance energy requirements and efficiency of energy use for gain differed ($P<.01$) among breeds. Maintenance energy requirements were highest for dairy breeds (Holstein and Jersey) while little variation was noted among beef breeds (Angus, Brahman and Hereford). Efficiency of energy use for gain was lowest for Jersey and highest for Brahman. Jenkins and Ferrell (1983) also determined energy required to maintain weights of mature, nonlactating, nonpregnant cows. Four breed types, Angus-Hereford crossbreds and Angus and Hereford crosses with Jersey, Charolais and Simmental, were evaluated. Estimated dry matter intakes for zero daily weight change did not differ ($P>.10$) among breed types. Certainly, further research with larger numbers of cows is needed to determine if differences exist among beef breeds and to identify underlying factors for those differences.

Environment

Beef cattle are raised under a variety of environmental conditions; therefore, it is important to understand how their nutrient requirements are affected by environment. Maintenance energy requirements of beef cows are influenced by thermal environment. Thermal environment is primarily affected by air temperature but may be altered by wind, precipitation, humidity and radiation. Because sufficient information is not presently available to permit complex climatic factors to be expressed in a composite unit, mean air temperature is normally used with the understanding that while it is not an ideal description of environmental conditions, it is usually available and does provide a reasonable index.

Young (1975) studied effects of winter acclimatization on resting metabolism of beef cows. Twelve pregnant beef cows were maintained during winter in either heated housing (64 F) or outside. Those outside were exposed to naturally occurring cold winter conditions (41 to 14 F during early winter and 32 to -54 F during mid-winter). Metabolic measurements were made on each cow (22 h postfeeding) while exposed to test temperatures of -22, 32 and 86 F. Metabolic acclimatization occurred in cows kept outside resulting in an increased resting metabolism. Resting metabolic rates of cows kept outside were 18% and 37% higher during early winter and mid-winter, respectively, than those for the housed cows. In addition, metabolic acclimatization resulted in a downward shift in their thermoneutral zone. Metabolic acclimatization has significant practical importance because the elevated resting metabolism and lowered critical temperature mean that environmental temperature must reach a lower point before the animal needs to increase its rate of heat production to maintain body temperature. Without metabolic acclimatization an animal exposed to an acute, severe cold stress may not be able to produce heat at a sufficient rate to maintain its body temperature. Although this metabolic acclimatization does provide cows with some protection against the stresses of winter, the elevated resting metabolic rate results in a higher maintenance energy requirement. Results of a study by Anderson et al. (1983) support the concept of higher maintenance requirements in colder environments. Their data indicate that energy requirements for beef cows maintained in South Dakota may be above NRC (1976) estimates due to environmental influences.

Hot temperatures can also influence energy requirements of beef cows. If cows are acclimatized to hot temperatures, maintenance energy requirements are lowered due to a decrease in resting metabolism (NRC, 1981). However, during an acute, severe heat stress maintenance energy requirements increase as a result of the increased energy cost of panting and alterations in tissue metabolism caused by elevated tissue temperatures. Further research is needed to determine effects of the previously mentioned climatic factors on energy requirements of beef cows and to determine if those effects differ among beef breeds. Nutrient recommendations cannot be published to fit all environmental conditions, but increased knowledge in this area will permit cattlemen to adjust diets for specific environmental conditions.

Ionophores

Use of ionophores in beef cow rations has not been federally approved; however, many researchers have evaluated the potential of ionophores to reduce energy requirements of beef cows. Ionophores are polyether antibiotics that participate in the transport and exchange of cations for protons or other cations across a variety of biological membranes. Ionophores improve feed conversion in feedlot cattle and increase daily gain in pasture-fed cattle. These effects are the result of altered growth and metabolism of rumen microflora that ultimately affect production, digestion and absorption of nutrients. Byers (1980) suggested that ionophores may modify the amount of cellular energy required for maintenance of osmotic gradients because of the effect of ionophores on ion transport. This would result in lowered maintenance energy requirements for the animal.

Although there is no consensus on whether ionophores decrease maintenance energy requirements and(or) increase efficiency of diet energy use for maintenance, a number of studies have shown decreased feed needs for maintaining beef cows through the use of ionophores. Turner et al. (1980) studied effects of four levels of monensin (0, 50, 200 and 300 mg/hd daily) on beef cow performance. Cows were fed 1.0 lb of barley/hd daily to serve as a monensin carrier plus meadow hay fed in amounts to maintain equal weight gain among cows in different treatment groups. Consumption of meadow hay was 92, 88 and 90% of the control for the 50-, 200- and 300-mg treatments, respectively. There were no significant differences among treatments for prepartum average daily gain, days to first estrus, conception rates and adjusted calf weaning weights. Clanton et al. (1981) also reported that cows fed 200 or 300 mg of monensin/hd daily and 90% of the forage intake of control cows did not differ significantly from control cows in daily weight gains, calf weight gains, days to first estrus or pregnancy rates. Other researchers have reported similar reductions in feed requirements due to feeding monensin (Meiske et al., 1978; Walker et al., 1980).

Hixon et al. (1982), however, reported no benefit from monensin supplementation (200 mg/hd daily). Their experiment consisted of a 2-year drylot study involving 80 multiparous beef cows. Cows received 85% of the NRC total digestible nutrient (TDN) requirement for the first 56 d and were fed ad lib during the remainder of the 140-d trial. Cow weight change, calf gains and milk yield estimates at 56 d and 140 d were not affected by monensin supplementation. Monensin also had no effect on conception rate or services per conception. Smith et al. (1980) also reported that monensin supplementation (125 mg/hd daily) had no effect on pregnancy rate, pregnancy rate at first service, and percentage of conceptions per estrus when cows in either moderate or poor body condition at the start of the experiment were fed either 9 or 18 Mcal of supplemental ME/hd daily in addition to grazing Bermudagrass pastures. The trial began 21 d before breeding season and continued throughout the 45-d breeding season. The high amounts of energy supplementation used in this study may be responsible for lack of response to monensin supplementation. The effect of ionophores on energy requirements of beef cows needs further study to identify factors that may influence the response to ionophores and thereby supply cattlemen with knowledge to make effective use of ionophores once they become cleared for use in beef cow rations.

Table 1. Daily energy requirements of dry pregnant mature beef cows.[a]

	Second trimester[b]		Third trimester[c]	
Weight, lb	ME, Mcal	TDN, lb	ME, Mcal	TDN, lb
800	12.3	7.5	15.0	9.2
900	13.4	8.2	16.2	9.8
1000	14.5	8.8	17.3	10.5
1100	15.6	9.5	18.3	11.2
1200	16.6	10.1	19.4	11.8
1300	17.7	10.8	20.4	12.5
1400	18.7	11.4	21.5	13.1

[a] NRC (1984).

[b] Assumes weight gain of 0.0 lb/d.

[c] Assumes weight gain of approximately 0.9 lb/d to account for products of conception.

Table 2. Daily energy requirements of beef cows nursing calves during the first 3 to 4 months postpartum.[a]

Weight, lb	Average milking ability[b] ME, Mcal	Average milking ability[b] TDN, lb	Superior milking ability[c] ME, Mcal	Superior milking ability[c] TDN, lb
800	16.6	10.1	19.9	12.1
900	17.7	10.8	21.5	13.1
1000	18.8	11.5	22.7	13.8
1100	19.9	12.1	23.8	14.5
1200	21.0	12.8	24.9	15.2
1300	22.0	13.4	26.0	15.9
1400	23.0	14.0	27.1	16.5

[a] NRC (1984).

[b] 10 lb milk/d.

[c] 20 lb milk/d.

Table 3. Average winter body composition and maintenance energy requirements as affected by body composition within each breed group.[a]

Item	Angus-Hereford Thin	Angus-Hereford Fat	Angus-Holstein Thin	Angus-Holstein Fat
Average body composition, lb				
Protein	179.3	172.9	184.0	170.7
Fat	108.5	191.5	86.2	133.8
Maintenance energy requirement/d				
ME, kcal/$W_{lb}^{.75}$	72.7	68.3	76.7	78.7

[a] Thompson et al. (1983).

Table 4. Theoretical calculations of efficiency of having beef cows in fat or thin body conditions during the winter.[a]

Item	Condition of beef cow		
	Thin, all year	Fatten in fall	Fat, all year
Fat content in early fall, lb	88	88	176
Fat gained in fall, lb	0	88	0
Fat content at start of winter, lb	88	176	176
Fat content at end of winter, lb	88	88	176
Winter maintenance requirements for 120 d, Mcal ME			
Protein	1,670	1,670	1,670
Fat	-62	-93	-124
Total	1,608	1,577	1,546
ME spared due to fat loss, Mcal	0	276	0
Feed ME required for winter, Mcal	1,608	1,301	1,546
Feed ME required for fat gain in fall, Mcal	0	499	0
Total feed ME required, Mcal	1,608	1,800	1,546

[a] Thompson et al. (1983).

Table 5. Maintenance energy requirements and efficiency of energy use for gain in dry, nonpregnant, mature cows of five breeds.[a]

Breed	Maintenance energy requirement, kcal ME/$W_{lb}^{.75}$/d	Efficiency of gain, g/kcal ME intake
Angus	55	116
Brahman	54	134
Hereford	60	80
Holstein	66	116
Jersey	84	58

[a] Solis et al. (1984).

Literature Cited

Anderson, V.L., Lorna Jost, C.A. Dinkel and M.A. Brown. 1983. Prediction of daily total digestible nutrient requirement of beef cows in northern climates. J. Anim. Sci. 56:271.

Bartle, S.J., J.R. Males and R.L. Preston. 1984. Effect of energy intake on the postpartum interval in beef cows and the adequacy of the cow's milk production for calf growth. J. Anim. Sci. 58:1068.

Brody, S. 1945. Bioenergetics and Growth. Rheinhold Publishing Company. New York, NY.

Byers, F.M. 1980. Determining effects of monensin on energy value of corn silage diets for beef cattle by linear or semi-log methods. J. Anim. Sci. 51:158.

Clanton, D.C., M.E. England and J.C. Parrott III. 1981. Effect of monensin on efficiency of production in beef cows. J. Anim. Sci. 53:873.

Haaland, G.L., H.F. Tyrrell and P.W. Moe. 1980. The effect of dietary protein and cattle breed on energy utilization for growth. J. Anim. Sci. 51(Suppl.1):365.

Hight, G.K. 1966. The effects of undernutrition in late pregnancy on beef cattle production. New Zealand J. Agr. Res. 9:479.

Hixon, D.L., G.C. Fahey, Jr., D.J. Kesler and A.L. Neumann. 1982. Effects of energy level and monensin on reproductive performance and lactation of beef cows. Theriogenology 17:515.

Holloway, J.W., D.F. Stephens, J.V. Whiteman and Robert Totusek. 1975. Performance of 3-year-old Hereford, Hereford x Holstein and Holstein cows on range and in drylot. J. Anim. Sci. 40:114.

Holness, D.H., J.D.H. Hopley and D.H. Hale. 1978. The effects of plane of nutrition, live weight, temporary weaning and breed on the occurrence of oestrus in beef cows during the postpartum period. Anim. Prod. 26:47.

Hutton, J.B. 1962. The maintenance requirements of New Zealand dairy cattle. New Zealand Soc. Anim. Prod. Proc. 22:12.

Jenkins, T.G. and C.L. Ferrell. 1983. Nutrient requirements to maintain weight of mature, nonlactating, nonpregnant cows of four diverse breed types. J. Anim. Sci. 56:761.

Kleiber, M. 1961. The Fire of Life. John Wiley and Sons, Inc., New York.

Klosterman, E.W., L.G. Sanford and C.F. Parker. 1968. Effect of cow size and condition and ration protein content upon maintenance requirements of mature beef cows. J. Anim. Sci. 27:242.

Lemenager, R.P., L.A. Nelson and K.S. Hendrix. 1980. Influence of cow size and breed type on energy requirements. J. Anim. Sci. 51:566.

Meiske, J.C., D.W. Crawford and R.D. Goodrich. 1978. Monensin for beef cows. Minnesota Cow-Calf Rep. C-35.

Moe, P.W., H.F. Tyrrell and W.P. Flatt. 1970. Partial efficiency of energy use for maintenance, lactation, body gain and gestation in the dairy cow. European Assoc. Anim. Prod. Pub. No. 13:65.

Neville, W.E. 1974. Comparison of energy requirements of non-lactating and lactating Hereford cows and estimates of energetic efficiency of milk production. J. Anim. Sci. 38:681.

Neville, W.E., Jr. and M.E. McCullough. 1969. Calculated energy requirements of lactating and non-lactating Hereford cows. J. Anim. Sci. 29:823.

NRC. 1976. Nutrient Requirements of Domestic Animals, No. 4. Nutrient Requirements of Beef Cattle. Fifth Revised Ed. National Academy of Sciences - National Research Council, Washington, DC.

NRC. 1978. Nutrient Requirements of Domestic Animals, No. 3. Nutrient Requirements of Dairy Cattle. Fifth Revised Ed. National Academy of Sciences - National Research Council, Washington, DC.

NRC. 1981. Effect of Environment on Nutrient Requirements of Domestic Animals. National Academy of Sciences - National Research Council, Washington, DC.

NRC. 1984. Nutrient Requirements of Domestic Animals, No. 4. Nutrient Requirements of Beef Cattle. Sixth Revised Ed. National Academy of Sciences - National Research Council, Washington, DC.

Phillips, R.L. and M. Vavra. 1981. The effect of pre-calving energy levels on cow performance. Proc. West. Sec., Amer. Soc. Anim. Sci. 32:117.

Plegge, S.D. and J.C. Meiske. 1983. Dietary considerations for feeding Holstein steers. Proc. Minnesota Nutr. Conf. p. 42.

Reardon, T.F., R.A.S. Welch, D.E. Wright and M.W. Brinsmead. 1978. Pre-calving nutrition of beef cows. Proc. New Zealand Soc. Anim. Prod. 38:202.

Smith, M.F., L.D. Shipp, W.N. Songster, J.N. Wiltbank and L.H. Carroll. 1980. Effect of monensin, energy level, and cow body condition on pregnancy rate in nonlactating beef cows. Theriogenology 14:91.

Solis, J.C., F.M. Byers, C.R. Long, L.W. Greene, and G.T. Schelling. 1984. Maintenance requirements and efficiency of energy use for gain in dry, non-pregnant, mature cows of five breeds and their crosses. J. Animal Sci. 59(Suppl. 1):424.

Sommerville, S.H., B.G. Lowman and D.W. Deas. 1979. The effect of plane of nutrition during lactation on the reproductive performance of beef cows. Vet. Rec. 104:95.

Thompson, W.R., J.C. Meiske, R.D. Goodrich, J.R. Rust and F.M. Byers. 1983. Influence of body composition on energy requirements of beef cows during winter. J. Anim. Sci. 56:1241.

Thonney, M.L., R.W. Touchberry, R.D. Goodrich and J.C. Meiske. 1976. Intraspecies relationship between fasting heat production and body weight: A reevaluation of $W^{.75}$. J. Anim. Sci. 43:692.

Turner, H.A., D.C. Young, R.J. Raleigh and Dale Zobell. 1980. Effect of various levels of monensin on efficiency and production of beef cows. J. Anim. Sci. 50:385.

Tyrrell, H.F., P.W. Moe and R.R. Oltjen. 1974. Energetics of growth and fattening compared to lactation in cattle. European Assoc. Anim. Prod. Pub. No. 14:205.

Walker, P.M., B.A. Weichenthal and G.F. Cmarik. 1980. Efficacy of monensin for beef cows. J. Anim. Sci. 51:532.

Wiltbank, J.N., W.W. Rowden, J.E. Ingalls and D.R. Zimmerman. 1964. Influence of post-partum energy level on reproductive performance of Hereford cows restricted in energy intake prior to calving. J. Anim. Sci. 23:1049.

Wiltbank, J.N., W.W. Rowden, J.E. Ingalls, K.E. Gregory and R.M. Koch. 1962. Effect of energy level on reproductive phenomena of mature Hereford cows. J. Anim. Sci. 21:219.

Young, B.A. 1975. Effect of winter acclimatization on resting metabolism of beef cows. Can. J. Anim. Sci. 55:619.

1985 Minnesota Cow-Calf Report C-64

ENERGY REQUIREMENTS DURING GESTATION FOR SPRING-CALVING BEEF COWS

D. A. Larson, R. D. Goodrich and J. C. Meiske
Department of Animal Science, St. Paul
J. W. Rust, North Central Experiment Station, Grand Rapids

Summary

A 4-year experiment involving 69 cow-gestation periods was conducted to evaluate effects of three levels of energy during the last half of gestation on performance of spring-calving Hereford cows and their calves. Prior to each year's gestation trial, digestibilities of gross energy and crude protein in alfalfa-brome hay were determined by the lignin ratio method utilizing six yearling heifers. Cows were then individually fed either .07, .085 or .1 Mcal digestible energy (DE) per pound of metabolic weight ($W_{lb}^{.75}$) based on the DE values for the alfalfa-brome hay obtained from the heifer digestion trials. Following termination of each year's gestation trial, all cows were managed similarly until calves were weaned. Number of gestation periods per energy treatment were 24, 22 and 23 for low (L), medium (M) and high (H) energy intakes, respectively. Cows receiving the L, M and H energy treatments consumed 11.8, 13.3 and 15.2 lb dry matter/hd/d ($P<.05$) and 14.71, 16.56 and 18.98 Mcal DE/hd/d ($P<.05$), respectively. Energy intake during the last half of gestation did not influence ($P>.05$) cow weight at midgestation, pre-calving and post-calving but did have a negative linear effect ($P<.05$) on cow weight at weaning. Cows fed L energy gained slower ($P<.05$) from midgestation to pre-calving than those fed M or H energy (-.04 vs .21 and .33 lb/hd/d, respectively). Energy intake during the last half of gestation had a positive linear effect ($P<.05$) on adjusted 205-d weaning weights (407.3, 421.1 and 442.0 lb for the L, M and H energy treatments, respectively). In each of the last 3 years of this study, digestibility of gross energy in alfalfa-brome hay was also determined by the lignin ratio method on a representative sample of cows from each energy treatment. Feed intake had no influence ($P>.05$) on digestibility of gross energy (65.37, 65.54 and 64.88% for the L, M and H energy treatments, respectively). Based on energy intake and performance data, a regression model was derived for use in predicting energy requirements of gestating beef cows wintered in Minnesota. Our predicted energy requirements are in close agreement with recommendations published by NRC (1976) but are lower than the revised recommendations of NRC (1984).

Introduction

The nutritional challenge to be met in efficient beef calf production is to supply nutrients to meet the needs of the beef cow for optimum performance under given genetic and environmental restraints without overfeeding. Energy constitutes the greatest proportion of a cow's feed requirements and the majority of the energy required for a cow production year is used to maintain the cow. The maintenance energy requirement of a beef cow is influenced by a number of factors including body weight, body condition, breed and environment. It is known that maintenance energy requirements are higher in cold environments; however, the energy requirements for maintaining pregnant beef cows in cold climates, such as are experienced during Minnesota winters, have not been well established. Therefore, this study was conducted to establish more precisely the energy requirements of gestating beef cows wintered in Minnesota. The development of more detailed energy requirements would allow beef cows to obtain optimum performance while fed at the most economical level.

Objectives of this study were three-fold. The first was to determine effects of three levels of energy fed during the last half of gestation on performance of Hereford cows and subsequent performance of their calves. It is known that level of feed intake will affect rate of passage of nutrients through the gastro-intestinal tract and, consequently, influence digestibility of those nutrients. Therefore, a second objective of this study was to determine effects of level of feed intake, as established in this experiment, on digestibilities of gross energy and crude protein. The third objective was to derive a regression model, based on energy intake and cow performance, that could be used to predict energy requirements of gestating beef cows wintered in Minnesota or any similar environment.

Procedure

This experiment was a 4-year study involving a total of 69 cow-gestation periods. Prior to each year's feeding trial, random samples of the alfalfa-brome hay supply were fed to six yearling heifers. Fecal samples were collected twice daily by rectal palpation for 10 consecutive days. Lignin contents of feed and feces were determined by the sulfuric acid procedure. Digestion coefficients for gross energy and crude protein were then determined by the lignin ratio method. The determined gross energy digestibility was used to calculate the digestible energy (DE) value of the alfalfa-brome hay. Each year pregnant Hereford cows were assigned to one of three energy levels. Based on the DE values obtained from the heifer digestion trials, alfalfa-brome hay was individually fed to each cow daily during the last half of gestation in amounts to furnish 0.07, 0.085 or 0.1 Mcal DE per pound of metabolic weight ($W_{lb}^{.75}$). Individual cows assigned to an energy treatment the first year remained on the same treatment during subsequent years, unless they were removed because of reproductive failure, injury or death. Additional cows were added to replace culled cows in subsequent years.

During each year's gestation trial, cows were housed in an open shed with freedom to go outside except during 5 to 7 hours each day when they were confined to individual stalls for feeding. In addition to alfalfa-brome hay, which was fed to each cow individually, a mixture of trace mineralized salt and dicalcium phosphate was available free-choice. Sawdust or wood shavings were used as bedding. The gestation trial started each year at approximately midgestation and continued until approximately 1 week prior to the start of the calving season in the spring. Following termination of each year's gestation trial, all cows were managed similarly until the calves were weaned. Cows were fed alfalfa-brome haylage free-choice from calving until the time cows and calves were placed on pasture.

Data collected in this study included shrunk cow weights at initiation (midgestation) and termination (1 week pre-calving) of each year's gestation trial, at 24 to 48 hr post-calving, at the time cows were placed on pasture and at the time calves were weaned in the fall. Calves were weighed at birth, at the time they were placed on pasture and at weaning. Data were collected from 24, 22 and 23 cows fed low, medium and high levels of energy, respectively, and tested for differences by analysis of variance using least squares procedures. In each of the last 3 years of this study, digestibilites of gross energy and crude protein were also determined by the lignin ratio method on a representative sample of gestating cows from each energy treatment. Digestibilities for each level of feed intake were tested for differences by analysis of variance.

Results and Discussion

Digestibilities of crude protein and gross energy in alfalfa-brome hay as determined from the heifer digestion trials are reported in Table 1. Lignin content varied from 6.1 to 9.6%, thus indicating a substantial year-to-year variation in quality of alfalfa-brome hay. This variation is also reflected in the range of crude protein contents (11.2 to 18.7%). Digestible crude protein contents ranged from 7.1% to 14.5%; however, it was adequate each year to meet requirements across all energy treatments. Digestible energy values for alfalfa-brome hay were 1.09, 1.32, 1.39 and 1.21 Mcal/lb for years 1, 2, 3 and 4, respectively. These digestible energy values were used to calculate the amount of hay that was individually fed to each gestating cow based on her metabolic weight and assigned energy treatment.

Performance data of cows and their calves, as affected by energy intake during the last half of gestation, are reported in Table 2. Cows assigned to low, medium and high energy treatments consumed 11.84, 13.30 and 15.21 lb dry matter/hd/d ($P<.05$) and 14.71, 16.56 and 18.98 Mcal DE/hd/d ($P<.05$), respectively. Daily intake of digestible protein was adequate for all energy treatments according to NRC (1976) requirements. It was estimated that cows assigned to the low, medium and high energy treatments consumed 7.36, 8.28 and 9.49 lb TDN/hd/d, respectively. Over the 4 years of this study and the three energy treatments, average body weight during the gestation trials was 1058 lb. For this average body weight NRC (1976) recommended 8.3 lb TDN/hd/d for dry pregnant mature cows in the middle third of pregnancy and 9.7 lb TDN/hd/d for dry pregnant mature cows in the last third of pregnancy. Therefore, because this energy study covered the last half of pregnancy rather than the last third, the energy requirement would be estimated to be between 8.3 and 9.7 lb TDN/hd/d.

Cow weight at midgestation, pre-calving and post-calving did not differ ($P>.05$) among energy treatments. However, cow weight at the time the calves were weaned exhibited a negative linear response ($P<.05$) to energy intake during the previous gestation (1086, 1049 and 1025 lb for cows receiving the low, medium and high energy treatments, respectively). This indicates that cows fed low energy during the last half of gestation gained the most weight during lactation. Energy intake during the last half of gestation had a positive linear effect ($P<.01$) on cow daily gain from midgestation to pre-calving (-.04, .21 and .33 lb for the low, medium and high energy treatments, respectively). Energy intake during the last half of gestation had no effect ($P>.05$) on cow daily gain from midgestation to post-calving, thus indicating that cows receiving the medium and high energy treatments had greater weight losses at calving than those cows receiving the low energy treatment. Although cow daily gains from post-calving to weaning suggest a negative linear response to level of energy intake during the last half of gestation, this response was not significant ($P>.05$). Energy intake during the last half of gestation had no effect ($P>.05$) on calf birth weight but had a positive linear effect ($P<.05$) on adjusted 205-d weaning weight (407.3, 421,1 and 442.0 lb for the low, medium and high energy treatments, respectively). Cows fed low energy lost weight during the last half of gestation while cows fed medium and high energy had similar positive weight gains. However, the positive linear response between energy intake during the last half of gestation and adjusted 205-d weaning weight suggests that the high energy level is the more appropriate requirement during the last half of gestation.

Digestibilites by gestating cows of crude protein and gross energy in alfalfa-brome hay as influenced by level of feed intake are reported in Table 3. In the last 3 years of this study a total of 16 cows per energy treatment were sampled for digestibility determinations. Cows receiving the low, medium and high energy treatments consumed 11.8, 13.3 and 15.2 lb of alfalfa-brome dry matter/hd/d. This range in level of feed intake had no effect ($P>.05$) on digestibilities of crude protein and gross energy.

Based on energy intake and performance data, a regression model was derived to predict energy requirements of spring-calving Hereford cows wintered in Minnesota. The resulting best-fit multiple linear regression included average body weight and average daily gain of cows during the last half of gestation as independent variables. The predicted energy requirements for second and third trimesters are reported in Table 4 for cows weighing 800 to 1400 lb. It was assumed that cows should have daily weight gains of 0.0 lb during the second trimester and 0.9 lb during the third trimester. The predicted energy requirements are in close agreement with recommendations published by NRC (1976) but are lower than the revised recommendations of NRC (1984). These results suggest that energy requirements of gestating cows wintered in Minnesota or any similar environment are not higher than estimated requirements despite the apparent cold environment. Predicted energy requirements are for mature cows in good condition at the onset of the winter feeding period. It is suggested that higher levels of energy should be fed to immature cows and to cows that are in thin condition. Published data suggest that differences in energy requirements among conventional beef breeds are small. Therefore, although these energy requirements were determined with Hereford cows and breed can influence maintenance energy requirements, these energy requirements may be used as guidelines for any breed of beef cows wintered in Minnesota. Because of the limited number of gestating cows (n=69) in this study, further research is needed with larger numbers of cows in order to define more accurately the energy requirements during both gestation and lactation and to determine how those requirements are influenced by various factors.

Table 1. Digestibilities of crude protein and gross energy in alfalfa-brome hay as determined from heifer digestion trials.[a]

Item	Year 1	Year 2	Year 3	Year 4
Dry matter, %	85.1	87.4	90.0	88.7
Lignin, %	9.60	6.32	6.10	7.90
Crude protein, %	11.2	18.7	12.4	14.2
Digestibility of crude protein, %	63.1	77.6	76.6	71.7
Digestible crude protein, %	7.1	14.5	9.5	10.2
Gross energy, Mcal/lb	1.97	2.02	1.99	2.06
Digestibility of gross energy, %	55.4	65.2	70.0	58.5
Digestible energy, Mcal/lb	1.09	1.32	1.39	1.21
Estimated TDN, %[b]	54.5	66.0	69.5	60.5

[a] All values expressed on dry matter basis.

[b] Assumes 1 lb TDN = 2 Mcal DE.

Table 2. Performance of cows as affected by energy intake during the last half of gestation.

Item	Energy intake: Low	Energy intake: Medium	Energy intake: High
No. of gestation periods	24	22	23
Daily intake			
Dry matter, lb/hd	11.84[a]	13.30[b]	15.21[c]
Digestible energy, Mcal/hd	14.71[a]	16.56[b]	18.98[c]
Digestible protein, lb/hd	1.17[a]	1.32[b]	1.53[c]
TDN, lb/hd	7.36[a]	8.28[b]	9.49[c]
Shrunk cow weights, lb			
Midgestation	1080	1046	1026
Pre-calving	1068	1065	1065
Post-calving	1049	1032	1018
At weaning[d]	1086	1049	1025
Cow daily gains, lb			
Midgestation to pre-calving[e]	-.04	.21	.33
Midgestation to post-calving	-.29	-.16	-.15
Post-calving to weaning	.35	.24	.17
Calf weights, lb			
Birth	78.1	75.4	76.8
Weaning, adjusted 205-d[d]	407.3	421.1	442.0

[a,b,c] Means within a row with no common superscripts differ (P<.05).

[d] Linear response (P<.05).

[e] Linear response (P<.01).

Table 3. Digestibilities by gestating cows of crude protein and gross energy in alfalfa-brome hay as influenced by intake (3-year summary).

Item	Intake level		
	Low	Medium	High
No. of cows	16	16	16
Daily dry matter, lb/hd	11.8[a]	13.3[b]	15.2[c]
Digestibility, %			
Crude protein	75.76	75.75	75.48
Gross energy	65.37	65.54	64.88

[a,b,c]Means within a row with no common superscripts differ ($P<.05$).

Table 4. Predicted energy requirements for spring-calving Hereford cows wintered in Minnesota.

Weight, lb	Second trimester[a]		Third trimester[b]	
	DE, Mcal/d	TDN[c], lb/d	DE, Mcal/d	TDN[c], lb/d
800	12.9	6.5	17.2	8.6
900	14.1	7.0	18.4	9.2
1000	15.2	7.6	19.5	9.8
1100	16.3	8.2	20.6	10.3
1200	17.5	8.7	21.8	10.9
1300	18.6	9.3	22.9	11.5
1400	19.7	9.9	24.0	12.0

[a]Assumes a daily weight gain of 0.0 lb.

[b]Assumes a daily weight gain of 0.9 lb.

[c]Assumes 2 Mcal DE = 1 lb TDN.

EFFECT OF STEER-OID ON PERFORMANCE OF SUCKLING CALVES

S.D. Plegge and J.M. Roach

Department of Animal Science, St. Paul
North Central Experiment Station, Grand Rapids

Summary

Thirty-nine suckling calves (24 heifers, 15 steers) were used in an experiment designed to determine the effect of a full dose of Steer-oid (20 mg estradiol benzoate, 200 mg progesterone) on calf performance. Half of the calves within each sex group were implanted and performance observed for 120 days. Average age of the calves at time of implanting was 64 days. Steer calves implanted with Steer-oid gained 28 lbs more during this period than non-implanted steers (2.63 vs 2.39 lb/day for implanted and non-implanted steers, respectively). Heifer calves implanted with Steer-oid gained 26 lbs more during this period than non-implanted heifers (2.44 vs 2.23 lb/day for implanted and non-implanted heifers, respectively).

Introduction

Implants are an extremely effective management tool for increasing weight gains of suckling calves. Several implants are approved for use in suckling calves. Recently, Steer-oid (20 mg estradiol benzoate, 200 mg progesterone) was approved for use in feedlot cattle. Steer-oid has the same chemical composition as Synovex-S. Steer-oid is manufactured by Philips Roxane, Inc., St. Joseph, Missouri; Synovex-S by Syntex Laboratories, Inc., Denver, Colorado.

Synovex-C (10 mg estradiol benzoate, 100 mg progesterone) was recently approved for use in suckling calves 45 days of age or older. This trial was conducted to determine the effect of a full dose of Steer-oid on performance of suckling calves. As of January 1, 1985, Steer-oid has not been approved for use in suckling calves.

Procedure

Twenty-four crossbred heifer calves (average initial wt, 200 lb; average initial age, 66 days) and fifteen crossbred steer calves (average initial wt, 213 lb; average initial age, 62 days) were grouped according to sex and breed group of dam and either implanted or not implanted with a full dose of Steer-oid (20 mg estradiol benzoate, 200 mg progesterone) on May 25, 1983. Cows were predominately Hereford X Angus and Holstein X Angus and were mated to Hereford bulls. Male calves were surgically castrated at approximately 30 days of age. All calves and dams were allowed to graze improved pasture and were managed as a single group during this trial.

Calf weights were obtained every 30 days during the trial. Weights were taken within 1 hour after cows and calves were removed from pasture. Calves were observed daily for signs of unusual sexual activity or development. One non-implanted steer calf was removed from the trial for reasons not related to treatment.

Results

Performance data for both steers and heifers are reported in Table 1. Within sex group, implanted calves gained faster ($P < .05$) than calves not receiving an implant. Implanted steers gained 2.63 lb/day compared to 2.39 lb/day for non-implanted steers, or an additional 28 lbs during the 120 days following administration of the implant. Implanted heifers gained 2.44 lb/day compared to 2.23 lb/day for non-implanted heifers, or an additional 26 lbs during the 120 days following administration of the implant. The percentage increase in weight gain for both sexes was relatively constant during the 30 day periods within the 120 days following administration of the implant.

Table 1. Performance Of Suckling Calves Implanted With Steer-oid[a]

Item	Heifers Control	Heifers Implant	Steers Control	Steers Implant
No. of calves	12	12	7	8
Initial wt, lb	197	203	209	217
Final wt, lb	464	495	495	532
Daily gain, lb[b]	2.23	2.44	2.39	2.63
Weight gain/head, lb				
0- 30 days	72	81	80	90
0- 60 days	122	141	138	151
0- 90 days	190	211	208	226
0-120 days	267	293	287	315

[a] Implanted calves received a full dose of Steer-oid (20 mg estradiol benzoate, 200 mg progesterone).

[b] Implanted heifers and steers gained faster ($P < .05$) than non-implanted heifers and steers ($SE = .06$, $n = 12$).

INFLUENCE OF ADDED Mn, Cu AND Zn ON REPRODUCTIVE PERFORMANCE OF BEEF COWS

A. Di Costanzo, J. C. Meiske and S. D. Plegge
Department of Animal Science, St. Paul

Summary

Ninety-three Angus females (64 cows, 29 first-calf heifers) were grouped by parity and assigned to three diets from calving to wk 19 postpartum to determine effects of Mn, Cu and Zn supplementation on reproductive performance and serum mineral concentrations. Diets consisted of 20.7 lb of corn silage dry matter (DM)/d and 1.3 lb of DM/d from one of three corn-urea supplements: 1) control, 2) added Mn (+Mn) or 3) added Mn, Cu and Zn (+MnCuZn). Changes in blood serum mineral contents and in body weights were recorded along with reproductive performance measurements (days to first estrus, days to conception, services per conception and conception rate). Addition of Mn reduced days to first estrus ($P<.05$) and days to conception ($P<.1$) for first-calf heifers (66 v 75 and 86 d, and 16 v 28 and 34 d for +Mn, +MnCuZn and control groups, respectively). Addition of Mn or Mn, Cu and Zn reduced ($P<.1$) days to conception for cows (21 and 21 v 32 d for +Mn, +MnCuZn and control groups, respectively), but did not influence ($P>.05$) days to first estrus. Addition of Mn or Mn, Cu and Zn reduced ($P<.005$) services per conception when data for first-calf heifers and cows were pooled (1.1 and 1.3 v 1.6 for +Mn, +MnCuZn and control groups, respectively). Addition of Mn or Mn, Cu and Zn did not influence ($P>.05$) conception rate. Addition of Mn or Mn, Cu and Zn had depressing effects on serum P, Ca, Mg and Zn in first-calf heifers. These data suggest that diets containing 40 ppm of Mn may not supply adequate Mn to first-calf heifers.

Introduction

Trace minerals such as manganese (Mn), copper (Cu) and zinc (Zn) play important roles in reproduction of cattle. However, little attention has been given to amounts of trace minerals provided by plants or plant products fed to breeding cattle. Furthermore, a review of literature concerning mineral contents of grasses and plant products revealed that Mn, Cu and Zn supplied by corn and other cereals may be below requirements of cattle. Thus, it was the purpose of this experiment to determine effects of Mn, Cu and Zn supplementation on reproductive performance and serum mineral concentrations of beef cows postpartum.

Procedure

Ninety-three Angus females (64 cows, 29 first-calf heifers) were grouped by parity and assigned to three diets from calving to wk 19 postpartum. Diets consisted of 20.7 lb of corn silage DM/d and 1.3 lb DM/d from one of three corn-urea supplements: 1) control, 2) added Mn (+Mn) or 3) added Mn, Cu and Zn (+MnCuZn). Compositions of supplements are given in Table 1. Trace minerals were complexed with Giant Brown kelp (an algae) in supplement premixes. These complexes are regarded as highly available to livestock. Dry matter, crude protein and mineral contents of diets are listed in Table 2. All females were blood sampled and weighed at the beginning and end of the trial. Blood serum was extracted and analyzed for mineral content. Changes in blood serum mineral contents and in body weights (difference between final and initial values) were analyzed by analysis of variance for completely randomized block design, blocking by age group.

Estrus was observed twice daily 3 wk after calving. All females were palpated by a veterinarian 3 wk before the start of the breeding season (June 1); cases of metritis were treated accordingly. Females were artificially inseminated 12 to 14 hr after observed in standing estrus with semen from primarily one Angus bull. Days to first estrus, days to conception, services per conception and conception rate were recorded from wk 3 to wk 19 postpartum. Because of a restricted breeding season, days to conception were calculated as the interval between the start of the breeding season and conception. Cows or first-calf heifers that remained open at the end of the trial were not included in statistical analysis of days to conception and services per conception. Days to first estrus and days to conception were analyzed by completely randomized block design, blocking by age group. Treatment by age group means were analyzed by least squares means procedures. Services per conception and conception rate data were analyzed by chi-square procedure.

Results and Discussion

Days to first estrus, days to conception, services per conception and conception rate are recorded in Tables 3 and 4 for first-calf heifers and cows, respectively. Addition of Mn reduced ($P<.05$) days to first estrus for first-calf heifers in +Mn group, but not for those in +MnCuZn group (66 v 75 and 86 d for +Mn, +MnCuZn and control groups, respectively). Addition of Mn or Mn, Cu and Zn did not influence ($P>.05$) days to first estrus of cows. Similar to treatment effects on days to first estrus of first-calf heifers, addition of Mn reduced ($P<.05$) days to conception for first-calf heifers in +Mn group, but not for those in +MnCuZn group(16 v 28 and 34 d for +Mn, +MnCuZn and control groups, respectively). In contrast, addition of Mn or Mn, Cu and Zn reduced ($P<.1$) days to conception for cows (21 and 21 v 32 d for +Mn, +MnCuZn and control groups, respectively).

Age group had no statistically significant effect on services per conception; hence, services per conception were pooled regardless of age. Addition of Mn or Mn, Cu and Zn reduced ($P<.005$) services per conception for both first-calf heifers and cows (1.1 and 1.3 v 1.6 for +Mn, +MnCuZn and control groups, respectively). Conversely, addition of Mn or Mn, Cu and Zn did not influence ($P>.05$) conception rate.

Addition of Mn lowered ($P<.05$) serum P, Ca and Mg in first-calf heifers, but did not influence ($P>.05$) concentrations of these minerals in cows. However, these decreases were not detrimental to reproduction or body weight changes. In fact, first calf-heifers in +Mn group tended ($P=.1018$) to gain more weight than those in the other groups (59 v 18 and 4 lb for +Mn, +MnCuZn and control groups, respectively). All cows lost weight regardless of treatment, probably because they calved later and were better milk producers than first-calf heifers. Results suggest that diets containing 40 ppm Mn may not supply adequate Mn to first-calf heifers.

TABLE 1. COMPOSITIONS OF SUPPLEMENTS.

Ingredient	Supplement[a] Control	 +Mn	 +MnCuZn
	--------	lb/ton	--------
Ground corn grain	1066.9	1063.4	1060.0
Dicalcium phosphate	360.0	360.0	360.0
Urea (283% CP)	261.2	261.2	261.2
Salt	240.0	240.0	240.0
Gypsum ($CaSO_4.2H_2O$)	36.0	36.0	36.0
Se premix (90 mg Se/lb)	13.4	13.4	13.4
Mg premix[b] (5.4% Mg)	10.1	10.1	10.1
Trace mineral premix[b]	8.0	8.0	8.0
Vitamin A+E premix[c]	4.4	4.4	4.4
Mn premix[b] (16% Mn)	- -	3.5	3.5
Zn premix[b] (22% Zn)	- -	- -	2.1
Cu premix[b] (12.7% Cu)	- -	- -	1.3

[a] Control, control diet supplement; +Mn, supplement with added Mn; +MnCuZn, supplement with added Mn, Cu and Zn.

[b] Magnesium and trace minerals in premixes were complexed with an algae--Giant brown kelp--by Stauffer Chemical Co.

[c] Provided 30 000 IU vitamin A and 300 IU vitamin E/g premix.

TABLE 2. CHEMICAL COMPOSITIONS OF DIETS.

Component	Diet Control[a]	 +Mn	 +MnCuZn
	--------	% of DM	--------
Crude Protein	10.70	10.40	10.50
P	.43	.36	.38
Ca	.58	.47	.50
Mg	.27	.27	.27
	--------	ppm of DM	--------
Mn	40.50	52.50	54.20
Zn	46.10	43.20	57.60
Cu	4.00	3.70	9.10

[a] NRC (1984) suggested values for Mn, Zn and Cu are 40, 30 and 8 ppm, respectively.

TABLE 3. REPRODUCTIVE PERFORMANCE OF FIRST-CALF HEIFERS.

Item	Treatment			$S\bar{x}$[a]
	Control	+Mn	+MnCuZn	
No. of heifers	10	9	10	
Initial wt, lb	1118	1025	1113	
Final wt, lb	1122	1084	1131	
Weight change, lb	4	59	18	
Days to 1st estrus	86^{b}	66^{c}	75^{bc}	6.0
Days to conception[d]	34^{e}	16^{f}	28^{ef}	6.1
No. of services/conception	1.6	1.1	1.6	
Pregnant at 1st service, %	56	88	67	
Conception rate, %	90.0	88.9	90.0	

[a] Standard error calculated for n=10.
[b,c] Means with different superscripts within the same row differ ($P<.05$).
[d] Calculated as interval between day 0 of breeding season and conception.
[e,f] Means with different superscripts within the same row differ ($P<.1$).

TABLE 4. REPRODUCTIVE PERFORMANCE OF COWS.

Item	Treatment			$S\bar{x}$[a]
	Control	+Mn	+MnCuZn	
No. of cows	24	20	20	
Initial wt, lb	1307	1252	1234	
Final wt, lb	1252	1210	1212	
Weight change, lb	-55	-42	-22	
Days to 1st estrus	60	52	61	4.3
Days to conception[d]	32^{b}	21^{c}	21^{c}	4.3
No. of services/conception	1.7	1.0	1.2	
Pregnant at 1st service, %	40	95	84	
Conception rate, %	83.3	95.0	95.0	

[a] Standard error calculated for n=20.
[b,c] Means with different superscripts within the same row differ ($P<.1$).
[d] Calculated as interval between day 0 of breeding season and conception.

COMPARISON OF TWO ESTRUS SYNCHRONIZING PROCEDURES FOR BREEDING HEIFERS ON APPOINTMENT

J. C. Meiske, Animal Science
H. W. Momont and B. E. Seguin, Theriogenology

Summary

Synchronizing 64 12- to 15-month-old heifers with either a prostaglandin (Estrumate) or a synthetic progesterone in combination with estradiol valerate (Synchro-Mate-B) prior to AI breeding on appointment produced nonsignificantly different results (59 vs 47% pregnant) over 2 years. Thus, the "breeding on appointment" procedures followed averaged 53% of the heifers pregnant.

Introduction

Two types of products are available for synchronization of estrus in cattle. They are: prostaglandin F_2 (PGF_2; Lutalyse, The Upjohn Co. and Estrumate, Bay Vet) and synthetic progesterone (norgestomet) in combination with estradiol valerate (Synchro-Mate-B, Ceva Labs).

Synchronization can be used to increase the number of artificial insemination (AI)-sired calves from genetically superior bulls available only in that manner, to increase numbers of cows and heifers conceiving early in the breeding season (shortening breeding and calving seasons), and to permit use of rotational crossbreeding without the need to maintain bulls of different breeds.

The purpose of the trials reported here was to compare the percentage of pregnancies resulting from "breeding on appointment" when prostaglandin-treated heifers and progestin (Snychro-Mate-B)-treated heifers were used.

Procedure

In each of 2 years, 12- to 15-month-old Angus and Charolais heifers, most of which were cycling, were divided into two groups on the basis of breed, age and weight. Synchro-Mate-B-treated heifers were inseminated between 49 to 52 hours after removing the implant. Prostaglandin (Estrumate)-treated heifers were inseminated between 60 and 63 hours after the second PGF_2 infection. Pregnancy was determined by rectal palpation about 40 days after insemination.

Results

Table 1 summarizes the results of these trials. In 1983, a greater percentage of PGF_2-treated heifers than of Synchro-mate-B-treated heifers were pregnant 40 d after insemination at an appointed time (69 vs 31%). However, in 1984, results in pregnancies favored the Synchro-Mate-B-treatment over the PGF_2-treatment (63 vs 50%). Numbers per treatment were small each year. By combining results of the 2 years, permitting more desirable numbers, there were not large enough differences to conclude advantages for either treatment.

The procedure followed in inseminating heifers at an appointed time resulted in 53% pregnancies. Other research shows that this percentage could be improved by inseminating following estrus detection, rather than a timed AI or "breeding on appointment" as was used here. However, expectations exceeding 50-55% pregnancies in timed AI of synchronized heifers are not realistic at this time.

Table 1. Results of Synchronization and Artificial Insemination of Yearling Heifers.

Year	Treatment	Number treated	In estrus		Pregnant	
			No.	%	No.	%
1983	Synchro-Mate-B	16	16	100	5	31
	Estrumate	16	15	94	11	69
1984	Synchro-Mate-B	16	NA	NA	10	63
	Estrumate	16	NA	NA	8	50
Both	Synchro-Mate-B	32	--	--	15	47
	Estrumate	32	--	--	19	59

1985 Minnesota Cow-Calf Report C-68

PROGENY PERFORMANCE EVALUATION OF ANGUS SIRES

J. C. Meiske, A. DiCostanzo and S. D. Plegge
Department of Animal Science, St. Paul

Summary

Four Angus sires were compared by evaluating performance of their progeny produced from random mating within dam groups (groups by age and sire) in a single herd. Within sex groups (steers and heifers), progeny were managed, housed and fed alike, permitting valid comparisons among sire groups within years. Two reference sires (widely used in the industry) and two test sires (nominated for evaluation by their owners) were used following protocol of the American Angus Association structured sire evaluation program. Differences among progeny groups of the sires used were not as large as those observed in previous comparisons. However, differences among groups of feeder cattle are likely to be three or four times more variable because the calves are sired by bulls that are more variable, and are from cows with a more diverse genetic background. Thus, profit potential of feeder cattle varies because of considerable variation that exists in the genetic makeup of feeder cattle. Commercial producers need to be aware of genetic status of their calves so that they may make sound choices among alternatives of either selling their calves as feeders or maintaining ownership through backgrounding and finishing periods.

Introduction

Most progressive breed associations publish sire summaries for their breed. These summaries permit comparisons among sires for several traits of their progeny. Traits for which sire comparisons are usually made include calving ease, 205-d weights, 365-d weights, carcass characteristics and maternal breeding values.

The Angus cow herd at the Rosemount Station has been used in a structured sire evaluation program for the last 6 years. Each year, cows within a sire and age group are randomly assigned to be bred to four sires. Two sires (test sires) had been nominated by their owners so that their progeny can be compared with progeny from two reference sires designated by the breed association. These reference sires are used in other herds and serve as bases by which all sires in a national program may be compared. Progeny of all sires in a given evaluation herd must be managed and fed alike (within sex groups) to permit valid comparisons. Cattle feeders should be aware of genetic variation among and within producer groups of cattle they purchase. Commercial producers need to be aware of genetic status of their calves so that they may make sound decisions among alternatives of either marketing their produce as feeder cattle or maintaining ownership through backgrounding and finishing periods.

Procedure

Cows were grouped according to sire and age and randomly assigned from within groups to be inseminated with semen from one of four sires (two reference sires and two test sires) during the breeding season. All cows and calves were managed the same to weaning. At weaning, steer calves and heifer calves were separated. All heifers were fed a high silage diet until culling and selection at about 13 months. All steers were fed a high silage diet for about 110 d and then fed a higher corn grain diet until slaughter. All diets after 205-d weights were supplemented with an appropriate urea-based supplement that contained salt, trace minerals, calcium, phosphorus, sulfur and vitamin A. Carcass data were collected from all steers at slaughter (12 to 14 mo).

Results

Performance data of heifer progeny of the four sires used during the 1982 breeding session (calves born in 1982) are presented in Table 1; performance and carcass data of steer progeny from the 1981 breeding season are summarized in Table 2.

Mean adjusted yearling weights of heifers differed due to sire by only 27 lb in 1983-84. Similarly, mean adjusted yearling weights of steers differed due to sire group by as much as 88 lb in 1983-84. Although differences among sire groups were not extremely large, there was evidence for differences in growth rates among them and, further, evidence for differences in carcass composition as indicated by fat thickness and rib eye area averages.

In these progeny performance comparisons made during each of the last 6 years, we have found differences among program group averages a great as almost 200 lb at 365 d of age. Differences of 125 lb among progeny group averages were also observed at weaning age.

These are indeed extremely wide differences, especially when it is realized that sires used were all thought to be outstanding performance sires and that all calves were produced in a single herd mated at random to such sires. When it is considered that there are considerable differences in performance potential among commercial cow herds and that considerable differences exist among sires selected for use in those herds, it is not surprising that performance of calves produced from different herds vary tremendously. Successful commercial producers will be aware of the comparative genetic potential of their produce and can easily justify the relatively little extra money required to purchase superior performance sires. These producers also critically cull and replace sires that do not contribute to enhancement of their herd's production potential.

TABLE 1. PERFORMANCE OF HEIFER PROGENY BY FOUR ANGUS SIRES (1983-84)

	Sire group			
Item	Reference sire 1	Reference sire 2	Test sire 1	Test sire 2
No. of heifers	5	8	10	13
Birth wt, lb	77	70	73	72
205-d wt, lb	410	434	431	413
Avg daily gain, lb[a]	1.62	1.78	1.75	1.66
365-d wt, lb	714	725	730	703
Avg daily gain, lb[b]	1.90	1.82	1.87	1.81

[a] From birth to 205 days.

[b] From 205 to 365 days.

TABLE 2. PERFORMANCE OF STEER PROGENY BY FOUR ANGUS SIRES (1983-84)

	Sire group			
Item	Reference sire 1	Reference sire 2	Test sire 1	Test sire 2
No. of steers	13	7	14	13
Birth wt, lb	76	80	80	75
205-d wt, lb	529	526	537	497
Avg daily gain, lb[a]	2.21	2.18	2.23	2.06
365-d wt, lb	1029	1065	1061	967
Avg daily gain, lb[b]	3.13	3.37	3.28	2.94
Avg age at slaughter, d	399	389	394	391
Carcass wt, lb	672	673	678	625
Fat thickness, in.	.57	.51	.53	.60
Ribeye area, sq. in.	12.5	12.6	12.4	12.1
Yield grade	3.0	2.8	2.9	3.1
Lean/day of age, lb	.84	.87	.86	.80
Marbling score	6.1	6.3	5.4	5.8
Quality grade	12.6	12.9	11.9	12.3

[a] From birth to 205 days.

[b] From 205 to 365 days.

1985 Minnesota Cow-Calf Report C-69

DETERMINATION OF THE EFFICACY OF A VACCINE FOR BOVINE RESPIRATORY SYNCYTIAL VIRUS

D. L. Haggard, E. Kilelu and T. R. Ames, Large Animal Clinical Sciences
and J. C. Meiske, Animal Science

Background

Bovine Respiratory Syncytial Virus (BRSV) was incriminated in a respiratory disease outbreak in early weaned calves in the fall of 1982 in the University of Minnesota beef herd. Rising titers were demonstrated in a number of calves and the clinical and pathologic findings were those of pulmonary adenomatosis associated with BRSV. The following summer another outbreak of BRSV occurred. Direct fluorescent antibody staining of the lungs revealed positive fluorescence for BRSV. Sero-conversion was demonstrated in nearly all of the calves using the serum neutralization test. It appeared that BRSV was a recurring problem in this herd and occurred in the calves after weaning when they may have lost their colostral antibody titers.

Objectives

To determine if vaccinating half of the calves born in 1984 could provide protection for these animals should another outbreak occur and to follow the serologic response to vaccination in the calves.

Procedure

One month prior to weaning all calves were bled to determine their titers to BRSV. Half of the heifers and steers were vaccinated at that time with BRSV modified live virus vaccine.

At time of weaning the calves were bled again to determine their BRSV titer and the vaccinated calves were boostered. The calves will be bled every month for 8 months following the second vaccination for determination of BRSV titers.

Respiratory Disease Outbreaks

Any respiratory outbreaks occurring in these calves will be investigated immediately according to the following criteria:

Clinical Examination -- calves will be given a complete physical exam and all abnormal findings will be recorded. Morbidity, mortality and case fatality rates will be determined.

Isolation of BRSV -- attempts will be made to isolate BRSV from all clinical cases of respiratory disease.

Direct Fluorescent Antibody Test -- will be conducted on nasal swabs of all calves showing respiratory disease and tissues of frozen sections of lung from any necropsies.

Serology for BRSV -- acute and convalescent blood samples will be examined for virus antibodies by serum neutralization and hemagglutination inhibition test.

Bacterial Culture -- nasal swabs from clinical cases and lung samples from animals necropsied will be cultured for bacteria.

Chlamydia Isolation -- nasal swabs from clinical cases and lung samples from animals necropsied will be cultured for chlamydia.

Post-Mortem Examination -- tissues from calves that die during the field investigation will be examined for gross pathology, histophathology and virus isolation.

Results

This investigation is now in progress. Results will be reported upon completion.

1985 Minnesota Cow-Calf Report C-70

EFFECT OF ORAL ANTIBIOTIC THERAPY ON FECAL FLORA OF CALVES

D. L. Haggard, Large Animal Clinical Sciences
G. E. Ward, Veterinary Pathobiology
and J. C. Meiske, Animal Science

Antibacterials are commonly used to treat diarrhea (scours) in calves. Little information is available on the effect of this treatment on the normal flora of calves. Because populations of intestinal bacterial flora are very large and complex, it is expected that antibacterial usage will lower the number of bacteria present. There is a possibility that reduction of normal as well as pathological intestinal bacteria might lead to proliferation and increases in numbers of yeasts. This work was conducted to determine the effect of oral antibiotic therapy on fecal flora of calves.

Experimental Design

Nursing calves, less than 1 month old, that had not received anitbacterials, were placed on the trial at the time diarrhea (<10% fecal solids) was noted. After being assigned to a treatment group, calves were given oral treatment A (control, placebo), B (chloramphenicol), or C (vetisulid). Treatment consisted of a bolus given orally twice a day for 4 days. There were 6 calves per group.

Fecal samples were obtained from each calf before beginning treatment (0-H) and 24 hours after last treatment (120-H). Quantitative microbiologic examination of fecal flora was done on samples from each calf. This included total 1) anaerobes, 2) lactobacilli, 3) aerobes, 4) streptococci, 5) coliforms and 6) yeasts per 5 g feces.

Fecal consistency and dehydration were scored at the time of each treatment according to the following scales:

Fecal consistency: 0 = normal
1 = no scours, feces may flatten or spread
2 = mild scours, feces liquid and solid
3 = severe scours, watery feces

Dehydration: 0 = normal
1 = mild; eyes sunken with space between eye and bony socket, 8- to 10-second skin pinch

Results

Mean (log base 10) counts of various microflora per 5 g of feces before treatment and 24 hr post-treatment are listed in Table 1. The only change of statistical significance was the increase in yeast counts of chloramphenicol-treated calves between pre-treatment and 24 hr post-treatment. This indicates that certain antibacterial treatments of calves for diarrhea can result in increased numbers of yeasts in the intestinal tract.

Mean fecal consistencies of calves at the time of treatments are listed in Table 2. There was improvement in all groups, with more improvement in group B, the chloramphenicol group, than in either the control or vetisulid-treated groups. No dehydration occurred in any of the calves.

Summary

Some antibacterials used to treat calves for diarrhea permit an increase in numbers of yeasts in the intestinal tract. Further studies will be necessary to evaluate the possible results of this occurring.

It should be noted that chloramphenicol is not approved for use in food animals.

Table 1. Mean Counts (Log Base 10) of Microflora Per 5 g Feces Before Treatment and 24 h Post-Treatment.

Treatment and time	Yeast	Aerobes	Strep	Coliform	Lactobacilli	Anaerobes
A, Control						
0 h	6.2	7.4	<4.2	7.1	8.4	8.6
120 h	6.4	7.7	<3.5	7.5	9.0	9.2
B, Chloramphenicol						
0 h	5.7[a]	7.3	<4.3	6.8	8.5	8.7
120 h	7.8[b]	8.3	<4.4	8.2	9.2	9.7
C, Vetisulid						
0 h	5.9	8.2	<3.6	7.8	8.3	8.8
120 h	7.0	7.9	<3.5	7.7	8.5	8.6

[a,b] Values within a treatment group with different superscripts differ ($P<.05$).

Table 2. Mean Consistencies of Feces From Calves at Various Treatment Times.[a]

Group	0 h	24 h	48 h	72 h
A, Control	2.7	2.0	1.9	1.6
B, Chloramphenicol	2.5	1.7	1.2	.8
C, Vetisulid	2.3	1.7	1.3	1.5

[a] See text for description of scoring feces' consistencies.

1985 Minnesota Cow-Calf Report C-71

EFFECT OF INJECTABLE IRON DEXTRAN AND B-VITAMINS ON NON-CYCLING FIRST CALF BEEF HEIFERS

D. L. Haggard, Large Animal Clinical Sciences
J. C. Meiske, Animal Science

Introduction

Previously researchers reported that breeding efficiency of non-cycling first calf heifers could be improved by administering injections of iron dextran and B-complex vitamins, including vitamin B-12. It was suggested that improvement occurred because of correction of anemia or low blood hemoglobin that existed. The purpose of the trial reported here was to compare breeding efficiencies of untreated first-calf heifers and first-calf heifers treated with injections of iron dextran and B-vitamins.

Procedure

At the time of prebreeding examination of the University Angus herd in the spring of 1983, all non-cycling first-calf heifers were injected with 20 ml (2 gm) of iron destran and 20 ml of B-complex vitamins containing vitamin B-12 (200 mcg/ml). All of the treated heifers became pregnant with no more than the anticipated repeat services.

Following prebreeding examination of the herd in the spring of 1984, 10 of the 19 non-cycling heifers were treated with iron dextran and B vitamins. This was done to determine if there would be differences due to treatment. Hemoglobin determinations were done at that time and 26 days later.

Results

Results of breeding efficiency of the treated and untreated groups are listed in Table 1. Hemoglobin levels before treatment and 26 days later are listed in Table 2. One heifer in the treated group failed to become pregnant following two AI services.

The only significant difference in breeding efficiency was average days between calving and conception, which was 102.7 days in the treated group and 121.8 days in the untreated group (Table 1). There were apparent differences in days calved to first service (100.3 to 110.9) and services per conception (1.1 to 1.5), but these were not statistically significant with the limited numbers of animals involved.

There was no difference in mean hemoglobin levels between groups before treatment or 26 days following treatment (Table 2). Hemoglobin levels in all of the first calf heifers were considered within the normal range, before and after treatment.

Summary

Because of the limited numbers of animals it is not possible to draw conclusions from results of this trial. However, the data suggest that there may be beneficial effects from the treatment. Benefits do not appear to occur as a result of correction of pre-existing low blood hemoglobin (anemia) because all were within the normal range initially.

Table 1. Breeding Efficiency Measures of Untreated Cows and Cows Treated with B-Vitamins and Iron.

Measurement	Untreated	Treated
Avg interval, days		
Calving to treatment	85.5	74.6
Calving to first AI	110.9	100.3
Calving to conception	121.8[a]	102.7[b]
Treatment to first AI	18.1	22.9
Treatment to conception	33.2	25.2
Services per conception	1.5	1.1

[a,b] Means in a row with uncommon superscripts differ ($P>.05$).

Table 2. Average Hemoglobin Levels of Treated and Untreated Cows.

Sampling date	Untreated	Treated
	g/dl	
Pretreatment, 5/23/84	12.5	13.3
26 d, 6/18/84	13.3	13.9