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EFFECT OF RATE AND TIME OF GAIN ON DEVELOPING HEIFERS AND THE EFFECT OF ENERGY INTAKE ON LH LEVELS

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EFFECT OF RATE AND TIME OF GAIN ON DEVELOPING HEIFERS AND THE EFFECT OF ENERGY INTAKE ON LH LEVELS

by

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Effect of rate and time of gain on developing heifers and the effect of energy intake on LH levels

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INTRODUCTION

The beef industry is faced with increased production costs resulting in the need to get more rapid return on investments. Increasing the efficiency of production is a major challenge for management.

To the beef industry, developing replacement heifers to calve first at 2 years of age, rebreed and wean a live calve is a necessary challenge. There is varying opinion as to the best nutritional program for heifer development. From an economic standpoint, the developmental period is costly and returns per investment are not immediately measurable.

The research presented relates to three methods of developing replacement heifers from weaning to the beginning of the breeding season. Feeding heifers increased levels of dietary energy and protein on pasture following puberty and during the first 21 days of the breeding season was also studied. Postpuberal heifers were used to evaluate the effect of increased digestible energy on luteinizing hormone levels.

LITERATURE REVIEW

HEIFER DEVELOPMENT AND NUTRITION

First Half of the 20th Century

In the first half of the 20th century, beef herds were generally classified into farm or range herds. Recommendations for nutritional programs were poorly defined. For the most part, nutritional programs for heifer development were based primarily on whether the heifer calved first at 2 or 3 years of age, and varied in farm and range herds.

Smith (1906), a Nebraska author and investigator, reported, ". . . it is now generally admitted that anywhere outside the so-called grazing territory, or range, a grade cow to be profitable must be a good milker, as it does not pay to keep a cow one year for the calf she produces, unless it be in a locality where farming land is best suited for pasturing purposes". Henry (1900) suggested a provender of 24 to 25 lbs of dry matter per 1000 lbs of live weight of heifers weighing 330 to 355 pounds. Recommendations were made for time of first breeding the heifer that would provide for her to be over 2 years of age at time of first calving. A sampling of the early recommendations were: 18 months (Seulke, 1918); 18 to 24 months (Etz and Mann, 1920); about 20 months (Sheets,1920) and Snapp (1925) indicated that the safe rule to follow was breed heifers at the first breeding season after they are 20 months old.

The continuation of the early recommendations may have been predicted by the research of McCampbell (1920) at the Ft. Hays, Kansas Experiment Station. He reported that: (1) heifers which had been wintered on roughage alone and calved at 2 years of age, failed to reach normal size; (2) are apt not to have calves the following year; and (3)

more apt to become permanently sterile. He also indicated that feeding heifers a liberal allowance of grain in winter largely prevented the ill-effects of early breeding, but to do so was expensive under range conditions.

Withycombe et al., 1930, concluded from experiments conducted in Oregon that it was most profitable to breed range heifers to calve at 2 years of age, even when they were not fed liberally during the winter up to calving. These researchers reported that calving at 2 years of age resulted in: (1) a somewhat reduced percentage of calves dropped by the same cows when 3 or 4 years old; (2) cows that averaged about 100 lbs less in weight by 4 years of age; and (3) cows at the age of 6.5 years that had produced .7 more calf for the entire period than those calving first as 3-yr-olds.

Black (1939) discussed heifer development.

> "Emphasis should be placed on the wintering of young heifers as calves and yearlings. After the second winter they are usually turned in with the breeding herd and handled as mature cows. As calves, they should be given the opportunity for proper growth and development through liberal feeding during the winter season which follows weaning. There are few localities where it would be advisable to attempt to winter calves on the range. In the warmer climates, improved ranges or pastures that have been reserved for winter grazing may be used, but even then supplemental feed such as grain, protein concentrates or legume hay should be provided. Heifer calves intended for breeders should be fed so as to gain from .67 to 1.0 pound per head daily during the winter."

Pope et al. (1955) observed that heifers calving first at 2 years of age did not develop into as large a cows as those calving first as 3-year-olds, but produced just as many calves later with comparable weights at weaning. The cow cost per calf weaned was less for cows calving first at 2 years of age.

Lesmeister et al. (1973) studied the effect of first calving date in beef heifers on lifetime production. Early calving heifers had higher average annual lifetime calf production than late calving heifers. Calves born in earlier groups grew significantly faster from birth to weaning and weighed more at weaning than calves born in later groups.

Protein and Energy Requirements

Protein and energy requirements of beef females are dependent upon their age and stage of production (Clanton and Zimmerman, 1970). These researchers recognized that the crux of meeting requirements under range conditions was primarily associated with estimating how nearly range forage meets nutrient requirements. Recommendations for developing Hereford heifers for replacement purposes were that the heifer should weigh at least 180 kg at weaning and should be fed to gain .35 to .45 kg per day during the winter. This would allow a heifer to begin grazing pasture in the spring weighing 250 to 270 kg and weighing 340 to 370 kg in the fall carrying her first calf. At this point she should be fed to gain .2 kg per day for adequate continued growth during the winter period before calving.

To accomplish adequate gain the first winter these researchers recommended that the heifer calf be fed .3 kg of digestible protein (DP) and 11 to 12 megcal of digestible energy (DE) daily. To insure that the

heifer calving at 2 years of age would rebreed it was further recommended that she be fed 13 to 14 megcal DE and .27 to .32 kg of DP the winter preceeding first parturition. These recommendations were below NRC (1963) suggested recommendations. Following calving it was suggested that the heifer be fed all the feed she would consume and if grass hay were fed concentrate should be supplemented. Church (1977) commented that these recommendations for wintering heifers calves were too low.

The Effect of Nutrition on Growth

Eckles (1915) conducted trials with dairy heifers that were either "heavy fed" of "light fed". The heavy fed heifers received the maximum ration (composed largely of grain) that could be consumed from birth to first calving. The light fed group was fed skim-milk and roughage but no grain. The heavy ration resulted in a more rapid growth of skeleton, especially during the period of most rapid development, and later the animals became much fatter. Heifers receiving the light ration grew less rapidly but continued to grow longer, and never reached the size of those receiving the heavy ration when young. It was concluded that the difference between the two rations for growing heifers reflected more gain in condition that rate of skeletal growth.

The effects of delayed growth in identical twins was studied by Winchester and Ellis (1956). One member of each twin pair was fed a limited caloric allowance believed to be deficient only in energy while the other member of the twin pair was fed rations between maintenance and liberal levels. The age of the animals were either 3 to 6 months or 4 to 8 months. After the period of restricted intake all animals

were fed about as much as they were able to ingest without digestive disturbances. These researchers concluded that calves can be maintained without weight gain on rations that meet their nutritional needs, except for energy, without a later loss in efficiency of feed utilization. This economy in feed utilization was explained by the fact that the retarded animals made more economical gains on full feed from the end of the period of low caloric intake to slaughter than their twin made during the same period. This phenomenon has become known throughout the industry as compensatory gain.

In developing Holstein heifers, Sorensen et al. (1959) fed three levels of feed intake consisting of 62, 93 and 129 percent of Morrison's (1956) total digestible nutrients (TDN) recommendations. The hypothesis was made that the skeletal development of underfed heifers would continue at the expense of the development of other tissues. This was based on the premise that as animals of most species mature, the maximum growth rate occurs first in the skeleton, later in the muscles and still later in fat deposition. Results indicated that skeletal development was severely retarded in the underfed heifers. Heifers fed the high plane of nutrition did show some tendency to store the extra nutrients as fat, rather than for continued rapid skeletal growth. Ages at first estrus were 37.4, 49.1 and 72 weeks for the high, medium and low levels, respectively. At the end of 80 weeks weight (lb), height at withers (cm) and body length (cm) were: 566, 115.5, 126; 919, 125.6, 156; 1125, 129.1 and 159.4, respectively, for the low, medium and high levels of TDN intake. These differences indicate the extent to which growth, including skeletal size, can be regulated by varying the plane of nutrition. The

efficiency with which the feed was converted to body weight, expressed as pounds gained per pounds of TDN consumed was practically identical among the three feeding levels after 32 weeks of age. Estrous cycles occurred with about equal regularity in all three groups. There was little evidence to indicate ovarian function was adversely affected by either under- or over-feeding once puberty was reached.

Supplemental Protein and Energy

Pinney et al. (1972) reported on the lifetime effect of winter supplemental feeding and age at first parturition on range beef cows. This study concluded the research initiated by Pope et al. (1955). Approximately 60, 120 or 200 percent of the recommended DP allowances were fed between early November and mid-April each year beginning with heifers born in 1948. Half of the heifers were bred to calve first as 2-year-olds and the other half to calve first as 3-year-olds. Treatments were .45 kg (low), 1.13 kg (medium) and 1.13 kg of cottonseed meal plus 1.31 kg of whole oats (high). Conclusions reported were:

(1) Winter supplemental feed level affected winter and summer weight gains in the early years. Heifers that gained the least during the winter gained the most the following summer and the same effect was observed for weight changes of cows.

(2) Mature cow size and body weight, at approximately 7 years of age were not affected by winter feed level or age at first parturition. Body weight and height were greater for the later calving cows receiving the high level of winter supplemental feed and least for cows calving first at 2 years of age on the low winter supplemental feed level.

(3) No difference in birth or weaning weights of calves were observed but average calving date was delayed approximately 7 to 12 days

by the low winter supplemental feed level.

(4) Percent calf crop born and weaned was higher (P<.1) for cows receiving the low winter feed level.

(5) Total weight of calf weaned per cow during their lifetime was higher (P<.025) for cows fed on the low winter level of nutrition. This was 340 and 478 kg more calf than cows fed medium or high levels, respectively.

(6) The average cow calving first at 2 years of age weaned 154 kg more calf than the average cow calving first at 3 years of age.

(7) Average lifespan of cows calving first at 2 years of age was 14.65, 13.07 and 10.88 years, respectively, for low, medium and high winter feed levels. The average lifespan for cows calving first at 3 years of age was 13.51, 12.73 and 13.06 years, respectively, for the low, medium and high winter levels.

Throughout the study, all cows grazed native tall grasses yearlong with a stocking rate of approximately 10 acres per cow. Both the breeding and treatment groups were rotated at monthly intervals to reduce this environmental influence.

Bond and Wiltbank (1970) fed nine rations (three levels of protein superimposed over three levels of energy) to evaluate continuous vs compensatory growth and to compare all-concentrate vs a conventional diet. Angus heifers approximately 7 months of age weighing 178 kg were used in the 196 day experiment. Heifers on the high energy level diets were fed free choice while those on the medium level diet were fed approximately 66% of the high level diet and those on the low energy level diet were fed to maintain the body weight. The amount of DP fed was .22, .16 and .07 kg per 100 kg of body weight for the high, medium and low

levels, respectively. Half the heifers were fed an all-concentrate diet; the other half were fed a diet consisting of 30% hay, 50% corn, 10% soybean meal, 8% molasses and 2% mineral on a dry matter basis.

Conclusions were: (1) heifers fed low energy or low protein weighed less ($P<.01$) and gave less ($P<.01$) milk than heifers fed higher levels during first lactation; (2) the first calves born to heifers fed a low level of energy weighed less ($P<.01$) at birth and gained less ($P<.01$) than calves from heifers fed higher levels even when creep feed was available at 74 days of age; (3) the level of protein fed had no effect on birth weight and (4) There was no effect on estrous cycle and conception rate when heifers were fed for a compensatory or continuous growth rate on either all-concentrate or a more conventional diet.

Short and Bellows (1971) fed Angus-Hereford crossbred heifers to gain .23, .45 and .68 kg per day for 153 days during the winter prior to being placed on summer pasture. Increasing the winter feed level increased body weight, pelvic area and condition score by the end of the winter feeding period. Heifers fed to gain the least during the winter gained the most during the summer on pasture but this compensatory gain was not sufficient for them to attain the same body weight by the end of summer as the heifers wintered to gain the most during the winter. Increasing the winter feed level decreased age at puberty and increased weight at puberty. Pregnancy rate was 63% for heifers fed to gain .23 kg per day compared to 90% for heifers fed to gain .45 or .68 kg per day.

Kress et al. (1971) observed about 100 kg less weight gain in identical and fraternal twin beef heifers between 7 and 24 months of age when fed rations containing 80% the TDN their twin received. Increases