2002 Annual Report

Beef Section

Dickinson Research Extension Center
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Effect of Fat Source and Supplement Delivery Method on Beef Cow-Calf Performance and Reproductive Responses

Interim Progress Report

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Summary

This project was initiated third days before the 2002 calving season and is designed to evaluate beef cow response to differing fat sources (saturated = tallow or unsaturated = vegetable fat) with respect to colostrum quality, calf survival, postpartum interval, pregnancy rate, and weaning weight. The second objective is to determine the effect delivery system may have on cow and calf response. Results and discussion will be available in the next annual report.

Introduction

Fat, because of its energy concentration and physical form, has been used as an ingredient in beef cattle supplements for many years. However, large amounts of fats do not normally occur in forages consumed by ruminants. It has been demonstrated that the addition of polyunsaturated fat, originating from plant oils, can have a positive impact on reproductive performance including ovarian follicular growth, luteal function, and pregnancy rates independent of caloric effects (Williams and Stanko, 1999).

Additions of polyunsaturated fat to the diets of cattle have favorably modified several reproductive physiological processes. Fats are categorized as being saturated (e.g., animal tallow), polyunsaturated (e.g., canola, soybean and sunflower) and highly polyunsaturated

(e.g., linseed oil, fish oils) based on the number of double bonds. The use of fats in postpartum cow diets permits greater energy consumption than the ingredients they replace. When used in postpartum dairy diets, long-chain fatty acids are used with high efficiency for lactation because they are metabolized directly to milk fat (Coppock and Wilks, 1991). During lactation low density (LDL) and high density (HDL) lipoproteins undergo a unique adaptation such that pre-lactation serum lipoprotein-cholesterol concentrations of 100 - 150 mg/dL rise during peak lactation to concentrations nearing 300 mg/dL in dairy (Maynard et al., 1931; Noble, 1978) and beef cattle (Williams, 1989). Puppione (1978) reported the observed rise in lipoprotein concentration may be a consequence of mammary gland activity and the hepatic production of triglycerides for synthesis of milk fat. Coincidentally, fat supplementation stimulates synthesis and accumulation of lipoprotein-cholesterol and cholesterol esters in tissues, body fluids and the ovary (Williams, 1999). Circulating lipoproteins in ruminants are predominantly of the HDL type and are the only lipoprotein with access to the intrafollicular compartment (Caravaglios and Cilotti, 1957). Previous research at North Dakota State University has evaluated the concept that dietary-mediated increases in plasma cholesterol could modulate luteal function (Talavera et al., 1985). Dairy heifers receiving full-fat supplemention of whole sunflowers (15% of diet) experienced a dramatic increase in serum cholesterol concentration and mid- to late-luteal phase concentrations of progesterone were also elevated (Talavera et al., 1985). Fats derived from plant oils have yielded the most positive responses due mainly to the prevalence of linoleic acid. Polyunsaturated fats, compared to saturated and highly polyunsaturated fats, appear to be the most effective with respect to the onset of follicular activity. Thomas et al. (1997) demonstrated that polyunsaturated soybean oil increased the number of medium-sized follicles relative to other fat sources within 20 days after initiation of fat feeding. Increased liver gluconeogenesis, subsequent insulin rise and proliferation of granulosa cells resulting from enhanced production of propionate in the rumen when soybean oil is present (linoleic) is thought to be one possible explanation for the increase in follicular activity (Thomas et al., 1997).

In research conducted in eastern Montana, supplemental fat from crushed safflower seed was fed precalving to first calf heifers to evaluate the effect of cold tolerance on newborn calves, which is believed to increase the presence of "brown fat" in the new born calf, tended to improve calf survival and increased reproductive performance (Bellows et al., 2000). A second study with first calf heifers fed soybean, safflower, and sunflower seeds precalving resulted in a 14% increase in pregnancy rate (Bellows et al., 2001). Fat supplementation to mature cows was also studied. Mature 3 to 8 year old cows receiving fat supplementation delivered in free choice lick tubs or compressed blocks during late gestation were evaluated. Effect of delivery system and fat on dam precalving weights, condition score, calf birth weight, and calving ease did not differ. Cyclicity at begin breeding and final pregnancy were affected by a calving season x delivery group interaction, such that, cows calving in February followed by limited postpartum forage benefitted from fat supplementation whereas cows calving in April did not. Precalving fat increased weaning weight (Bellows et al., 2000). In a third investigation, Grings et al. (2001) in a 2 year study evaluated prepartum high (safflower seed and meal) and low (safflower meal and barley) fat supplementation effects on cow performance pre- and postpartum. Each year, 3 year old and 5-7 year old cows from February, April and May calving seasons were assigned to supplement types. Effects of supplement type were limited and only found in interactions. Three year old cows calving in February and 5-7 year old cows calving in April receiving high fat had greater pregnancy rates than cows fed low fat; the opposite was true for 3 year old cows calving in April. There was no effect of supplement type on cows calving in June. Varying conditions associated with season of calving affected cow performance and response to supplementation.

It is still unclear, however, under applied field conditions as to whether the source of fatty acids (tallow vs vegetable oil) in the fat is important in determining cow and calf response to oilseed supplementation. Secondly, delivery method under field conditions needs further

investigation to determine whether cow response differs between either hand-fed supplements or self-fed low-moisture cooked molasses products.

Objectives

- Determine whether or not beef cows respond differently when supplemented with either saturated or unsaturated fat with respect to colostrum quality, calf survival, post partum interval, pregnancy rate, and weaning weight.
- Determine if cow response differs between either hand-fed supplements or self-fed low-moisture cooked molasses products.

Materials and Methods

Two hundred fifty-six beef cows and heifers ranging in age from 2 to 10 years of age will be randomized in a complete-block design based on cow age, weight, breed, and MPPA value (CHAPS ® Most Probable Producing Ability). Blocks consist of first calf heifers, 2nd - 4^{th} calf cows, 5^{th} - 7^{th} calf cows, and 8^{th} calf cows and older. Sixteen (16) females are allotted to each pen, which serves as the experimental unit. Individual cow servers as the experimental unit for reproductive measurements.

Treatments:

1. Control - pelleted protein supplement hand-fed at 1 lb/hd/day
2. Saturated fat (choice white grease or tallow) pellet or cube hand-fed at 2 lb/hd/day.
3. Unsaturated fat (soy oil or whole soybeans) pellet or cube hand-fed at 2 lb/hd/day.
4. Unsaturated fat (same source as #3) fed free-choice in cooked molasses tub (30-35% CP, 10-13% NPN, 20% fat) with expected consumption of 1 lb/hd/day.

The supplement Feeding begins 30 days before calving begins and continues 45 days after the last cows calves. Considering this calving time frame of the cows in this study, supplement feeding will extend from the last week of January to approximately the first week of June.

Cows in the investigation will be bred naturally using fertility tested bulls. Ultrasound will be used to determine gestational age based on fetal cranial measurements.

Measurements to be taken include:

1. *Animal Weights -*

Cows will be weighed initially when supplementation begins, after calving, when cows and calves are processed the third week of April, in conjunction with each reproductive or fat depth ultrasound scan, and at weaning. Calves will be weighed at birth, during April processing, supplement termination, at each ultrasound scan, and at weaning.

2. *Cow Condition Evaluation -*

Visual condition score will be taken to coincide with each fat depth ultrasound scan. Ultrasound fat depth scans taken at the beginning of the study, as each cow calves, at the end of the supplementation/breeding, and at weaning.

3. *Colostrum Evaluation -*

Two heifers and two cows from each treatment will be selected as they calve midway through the calving season for colostrum analysis and evaluation. Samples will be collected from one unnursed quarter as soon as possible after calving and chemically preserved for proximate analysis and immunoglobulin content.

4. *Forage Analysis -*

Hay fed to cows in each treatment will be pre-evaluated by core sampling. Samples will be composited and a single weekly sample taken from each composite for proximate analysis.

5. *Effect of Supplementation -*

Effect of supplementation will be correlated to calf survival, post partum interval and reproductive efficiency (pregnancy rate corresponding to the 1^{st} and 2^{nd} cycles and at weaning determined using ultrasonography), cow condition score change, fat depth change, and calf weaning weight.

6. *Health and Death Loss -*

Health and Death Loss records will be kept on an individual cow/calf basis. Treatments, dates, and products used are to be recorded. When death loss occurs, dates and causes will be noted as well as weight at the time of death.

Statistical Analysis:

Data will be analyzed as a complete-block design using statistical analysis procedures of SAS (1996).

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Acknowledgment

Funding for this project has been provided by Cooperative Research Farms, Guelph, Ontario, Canada.

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