BEEF CATTLE RESEARCH UPDATE

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Effects of Dietary Energy Density and Intake Restriction on Maintenance Energy Requirements of Beef Cows

In recent years, due to reduced forage supplies (due to drought, conversion of pasture land to crops, etc.), semi-confined feeding of beef cows has been a hot research area. The major advantage of semi-confinement feeding is that cow feed requirements are reduced by approximately 10-20%.[1] Feeding cows in confinement allows one to feed a balanced mixed diet and program feed it on a restricted basis to the level of the cow's stage of production requirements. Feed requirements are reduced because cow movement is reduced which reduces maintenance energy requirements. In addition, feed digestibility is increased because one can program (limit) feed high-energy diets.

Recent Texas A&M University research used 32 beef crossbred cows individually fed 56 days using Calan gates to examine the effects of dietary energy concentration and intake level on energy metabolism and requirements.[2,3] The cows were fed either a high-energy (H: 1.11 Mcal ME/lb or ~67.9% TDN) or low-energy (L: 0.88 Mcal ME/lb or ~53.8% TDN) ration at two levels of intake to achieve 80 or 120% of estimated Beef NRC maintenance requirements. The high-energy ration contained 34.5% wheat straw, 29.5% corn, 27.5% distillers grains, and 8.6% other ingredients (molasses, urea, and minerals), costing $157.33/ton. The low-energy ration contained 64.1% wheat straw, 27.4% distillers grains, and 8.6% other ingredients, costing $129.52/ton. In order to provide equal nutrient consumption, the low-energy ration required feeding approximately 50% more feed per day per cow than the high-energy ration.

As was expected organic matter (OM) digestibility was greater (P = 0.03) for the high-energy ration as compared to the low-energy ration (64.6 vs. 60.82%). In addition, restricting intake appeared to increase OM digestibility across both diets (P = 0.01) by a mean of 4.5 percentage units (67.1, 62.8, 62.8, and 58.9%, respectively, for H80, H120, L80, and L120 diets). These researchers noted that this increased digestibly effectively increases energy intake, reducing the cost per calorie of a given diet by approximately 7.5% when feed intake is restricted. They also noted the feeding the high-energy ration results in a 23.5% reduction in the estimated daily maintenance energy requirement for the cows. These researchers concluded that their results suggest that increasing dietary energy density and restricting intake reduces the maintenance requirements of beef cows, and that these effects are additive. Thus, "substantial gains in efficiency of maintaining beef cows in intensive systems can be achieved by limit feeding an energy dense ration".

Effect of Nutritional Regimen on the Onset of Puberty in Beef Heifers

Replacement heifer development can significantly impact the profitability of a beef cattle operation. Thus, developing strategies that optimize the timing of sexual maturation of heifers to allow maximum lifetime productivity is a major goal of the beef industry. It is recommended that replacement heifers be developed to reach puberty and allow for at least one estrous cycle prior to the breeding season to optimize heifer pregnancy rates.[4] Age at puberty in heifers is controlled largely by genetic and environmental factors, among which nutrition has a major influence. Recent Texas A&M University research examined the ability of a stair-step compensatory gain nutritional regimen to program the onset of puberty in beef heifers at approximately 11 to 12 months of age.[5] In this study, crossbred heifers were weaned at an average age of 109 days and assigned randomly to 1 of 4 dietary treatments:

1) Low control (LC), restricted feed intake of forage-based diet to gain 1.1 lb/day until 14 months of age

2) High control (HC), controlled feed intake of a high-concentrate diets to gain of 2.2 lb/day until 14 months of age
3) Stair-step 1 (SS-1), ad libitum feed intake of a high-concentrate diet until 6.5 months of age followed by restricted access to a high-forage diet to gain 0.77 lb/day until 9 months of age, ad-libitum access to a high-concentrate diet until 11.5 months of age, and restricted intake of a forage diet to gain 0.77 lb/day until 14 months of age
4) Stair-step 2 (SS2), reverse sequence of SS-1, with the dietary treatment beginning with restricted access to a forage-based diet.

The heifers were weighed every 2 weeks and blood samples were collected twice weekly beginning at 8 months of age to measure progesterone concentrations to determine pubertal status.

These researchers reported that body weight gain in all groups followed a pattern similar to that they proposed in their experimental design with ADG over the entire 40 week feeding period differing significantly ($P < 0.05$) between all groups (1.98, 1.85, 1.67, and 1.21 lb/day, respectively, for HC, SS-1, SS-2, and LC). Analysis indicated that the percentage of pubertal heifers in the LC group was lower ($P < 0.05$) than all other groups throughout the experiment (Figure 1). At 12 months of age, the proportion of pubertal heifers did not differ ($P = 0.36$) between the SS-1 (80%) and HC groups (70%). Whereas, the proportion of heifers pubertal by 12 months of age in SS-2 (40%) and LC (30%) was considerably lower ($P < 0.05$) than in both HC and SS-1. However, by 14 months of age, 90% of heifers in the SS-2 group had also attained puberty compared to only 40% of the LC group.

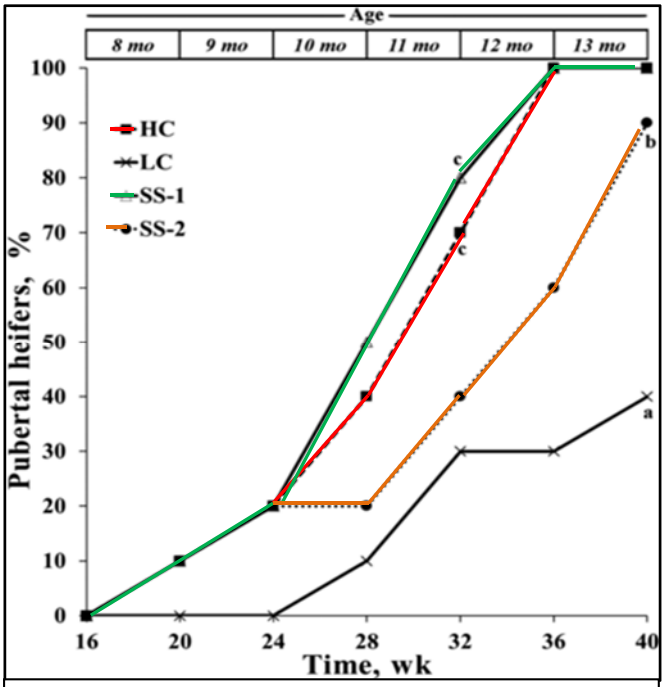

Figure 1: Cumulative percentage of heifers that attained puberty after weaning at 3.5 months of age and receiving 1 of 4 nutritional treatments: high control (HC), low control (LC), stair-step 1 (SS-1), or stair-step 2 (SS-2). $^{a\text{-}c}$Lines without a common superscript differ ($P \leq 0.057$).
Adapted from Cardoso et al., 2014.

These authors concluded that the age at onset of puberty can be nutritionally programed by exposing heifers to a stair-step nutritional regimen during development. They suggested that managerial approaches that focus on increasing availability of nutrients around 6 to 9 months of age (SS-2) can potentially time reproductive maturation consistently so that the majority of replacement beef heifers have reached puberty at 11 to 14 months of age while avoiding a high incidence of precocious puberty.

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[2] Trubenbach, L. A.,T. A. Wickersham, and J. E. Sawyer. 2014. The effects of dietary energy density and intake restriction on apparent maintenance energy requirements of beef cows. In: Plains Nutrition Council Spring Conference, San Antonio, TX. p. 166 (Abstr.).

[3] Trubenbach, L. A.,T. A. Wickersham,G. E. Carstens, and J. E. Sawyer. 2014. Managing energy requirements in confined cows. In: Dr. Kenneth and Caroline McDonald Eng Foundation Symposium: Innovative Intensification in Cow-Calf Systems, San Antonio, TX. p. 19-25. Available: http://aglifesciences.tamu.edu/animalscience/wp-content/uploads/sites/14/2014/09/Proceedings_for_web_compressed.pdf.

[4] Vraspir, R. A., A. F. Summers, A. J. Roberts, and R. N. Funston. 2014. Effect of Pubertal Status and Number of Estrous Cycles Prior to the Breeding Season on Pregnancy Rate in Beef Heifers. Nebraska Beef Cattle Report MP99: 5-7. Available: http://beef.unl.edu/c/document_library/get_file?uuid=def3bf57-1d31-4893-a1bf-4210bbd158f1&groupId=4178167&.pdf.

[5] Cardoso, R. C.,B. R. C. Alves,L. D. Prezotto,J. F. Thorson,L. O. Tedeschi,D. H. Keisler,C. S. Park,M. Amstalden, and G. L. Williams. 2014. Use of a stair-step compensatory gain nutritional regimen to program the onset of puberty in beef heifers. J. Anim. Sci. 92: 2942-2949.