Maintenance energy requirements of gestating beef cows and plasma concentrations of thyroxine and triiodothyronine

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STORY IN BRIEF

Spring calving, Angus cows, (n=32) were used to determine the effects of maintenance energy requirement **(MR)** on concentrations of thyroxine and triiodothyronine in plasma. Cows were fed individually a complete ration for 17 wk. After 2 wk the diet was adjusted until a constant BW was achieved and BW was maintained for 31 d for 25 cows. Cows were classified based on MR as low (> 0.5 SD less than mean, LMR), mod (± 0.5 SD of the mean, MMR) and high (> 0.5 SD greater than mean, HMR). When exposed to cooler temperatures (-5°C), LMR cows had greater plasma thyroxine compared with HMR. When exposed to warmer temperatures, HMR cows had greater plasma triiodothyronine compared with LMR. Thyroid hormone may be involved in the regulation of MR of beef cows during late gestation. Identification of cows with lower MR and greater efficiency could improve the profitability of beef production.

Key Words: beef cows, maintenance, rumen temperature, thyroxine

INTRODUCTION

Profitability of cattle production could be increased by reducing MR and feed costs of cows. Feed required to maintain beef cows accounts for approximately 50% of the total energy required for beef production (Ferrell and Jenkins, 1984) and is moderately heritable (Hotovy et al., 1991). Our laboratory determined a 30% difference in the amount of feed required to maintain body weight **(BW)** when the least and most efficient mature Angus cows were compared (Prado-Cooper et al., 2007; Bailey et al., 2009). The amount of feed to maintain body weight is influenced by thyroid hormones. Plasma concentrations of thyroxine are related to nutrient intake in cattle (Ciccioli et al., 2003). The long-term goal of this research is to identify biomarkers that can be used to identify animals that are more efficient and require less energy for maintenance of BW.

MATERIALS AND METHODS

Spring calving, Angus cows, (n=32) were used to determine the effects of MR on concentrations of thyroxine (T_4) and triiodothyronine (T_3) in plasma. Cows (4 to 7 yr of age) with an initial BCS of 4.4 ± 0.1 and BW of 556 ±6 kg were individually fed a complete ration for 17 wk during 4-8 mo of gestation. After 2 wk on a diet calculated to supply MR (Model 1, NRC 1996) the diet was adjusted weekly until constant BW was achieved (regression analyses). BW was maintained for 31 d for 25 cows and the amount of feed consumed was actual MR. Blood samples were collected on January 5 when ambient temperatures ranged between -5°C and -3°C, and on January 18 when temperatures ranged between 1°C and 15°C, before and after consumption of feed when cows consumed MR. Concentrations of T_3 and T_4 in plasma were quantified by radioimmunoassay. Cows were classified based on MR as low (> 0.5 SD less than mean, LMR), mod (± 0.5 SD of the mean, MMR) and high (> 0.5 SD greater than mean, HMR). Data were

analyzed using a mixed model (PROC MIXED, SAS Institute Inc., Cary, NC); the model included treatment, day, sample and the interactions.

RESULTS AND DISCUSSION

Average MR was 94.4 (SD=7.13) Kcal•kg$^{-0.75}$•day^{-1}. The difference in MR between the least efficient and the most efficient cow was 32% (Figure 1). Plasma concentrations of T_4 were influenced by MR. When exposed to cooler temperatures (-5°C), LMR cows had greater *(P = 0.01)* plasma T_4 concentrations compared with HMR, however when cows were exposed to warmer temperatures (15°C), T_4 concentrations were not influenced by MR *(P = 0.92;* Figure 2). Plasma concentrations of T_3 were influenced by MR when cows were exposed to warmer ambient temperatures *(P = 0.01)*; HMR cows had greater plasma concentrations of T_3 compared with LMR. However when exposed to cooler ambient temperatures (-5°C), MR did not affect concentrations of T_3 *(P = 0.64;* Figure 3). When steers were exposed to an ambient temperature of 32°C, concentrations of T_4 and T_3 were reduced, compared to an ambient temperature of 4°C (Pratt and Wettemann, 1986). Plasma concentrations of T_3 and T_4 are influenced by MR and may impact feed required to maintain BW of beef cows during late gestation. Identification of cows with lower MR and greater efficiency could improve the profitability of beef production.

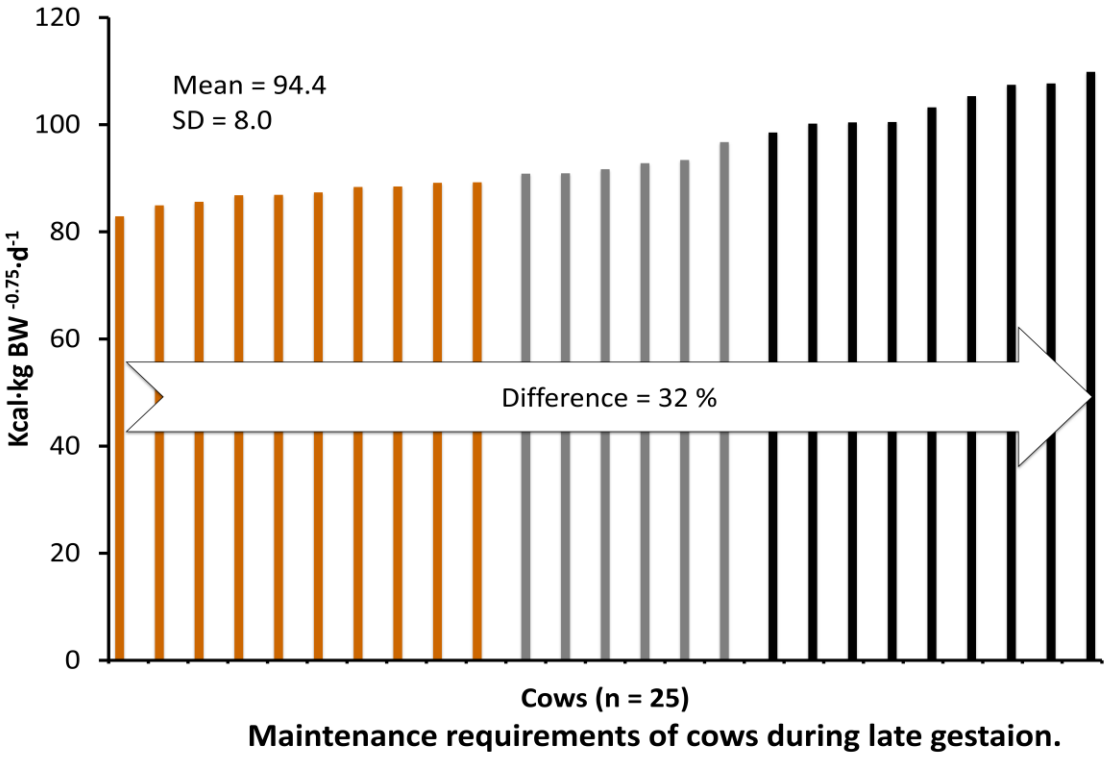
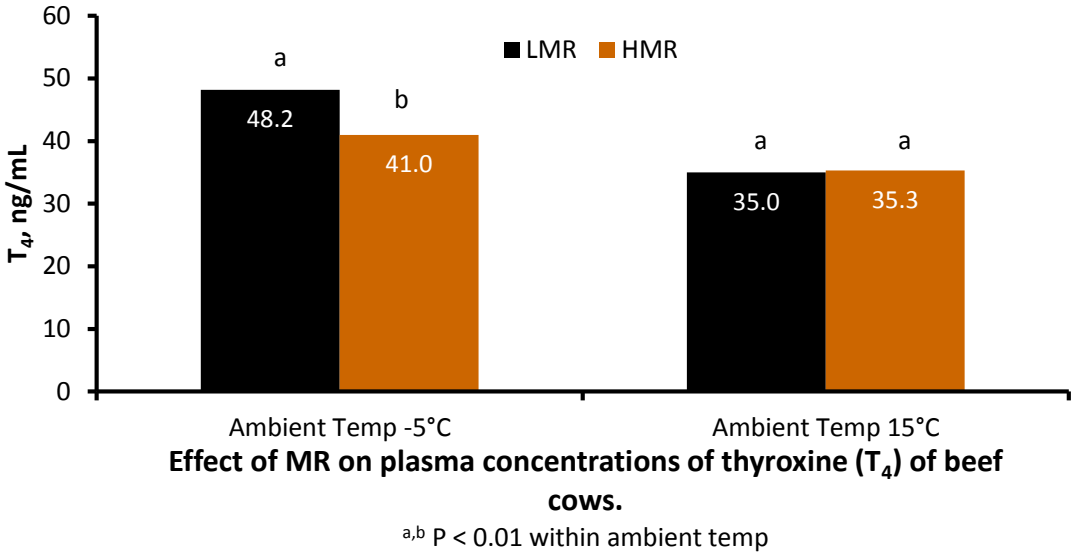


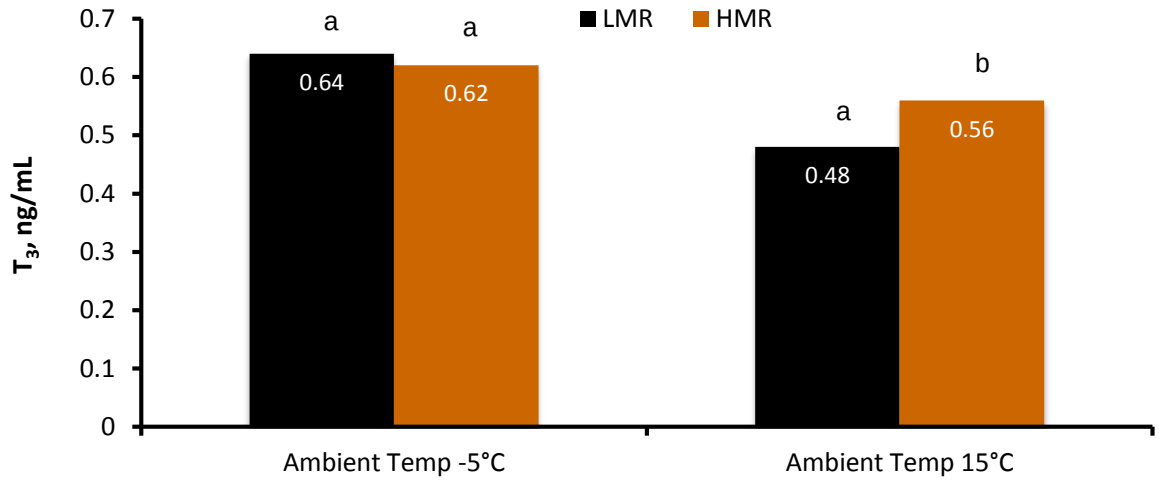
Figure 1. Maintenance requirements of cows during late gestation.



Effect of MR on plasma concentrations of thyroxine (T_4) of beef cows.

[a,b] P < 0.01 within ambient temp

Figure 2. Mean plasma concentrations of thyroxine of LMR and HMR cows in ambient temperatures of -5 and 15.



Effect of MR on plasma concentrations of triiodothyronine (T_3) in beef cows.

[a,b] P < 0.01 within ambient temp

Figure 3. Mean plasma concentrations of triiodothyronine of LMR and HMR cows in ambient temperatures of -5 and 15°F.

LITERATURE CITED

Bailey, C. L., M. J. Prado-Cooper, E. C. Wright, R. P. Wettemann, G. W. Horn, L. J. Spicer, and C. R. Krehbiel. 2009. Maintenance energy requirements of gestating beef cows and rumen temperature, plasma concentrations of IGF-I, glucose, thyroxine, and calf performance. J. Anim. Sci. (E-Suppl. 3) 87:28.

Ciccioli, N. H., R. P. Wettemann, L. J. Spicer, C. A. Lents, F. J. White, and D. H. Keisler. 2003. Influence of body condition at calving and postpartum nutrition on endocrine function and reproductive performance of primiparous beef cows. J. Anim. Sci. 81:3107- 3120.

Ferrell, C. L., and T. G. Jenkins. 1984. Energy utilization by mature, nonpregnant, nonlactating cows of different types. J. Anim. Sci. 58:234-243.

Hotovy, S. K., K. A. Johnson, D. E. Johnson, G. E. Carstens, R. M. Bourdon, and G. E. Seidel, Jr. 1991. Variation among twin beef cattle in maintenance energy requirements. J. Anim. Sci. 69:940-946.

NRC. 1996. Nutrient requirements of beef cattle. 7th rev. ed. Natl. Acad. Press, Washington, DC.

Prado-Cooper, M. J., N. M. Long, R. P. Wettemann, G. W. Horn, L. J. Spicer, and C. R. Krehbiel. 2007. Variation in maintenance energy requirements of gestating beef cows and relationship with calf performance and plasma IGF-I. J. Anim. Sci. Suppl. 1. 85:446.

Pratt, B. R., and R. P. Wettemann. 1986. The effect of environmental temperature on concentrations of thyroxine and triiodothyronine after thyrotropin releasing hormone in steers. J. Anim. Sci. 62:1346-1352.

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