ESTIMATES OF ENERGY REQUIREMENTS FOR MAINTENANCE AND GAIN OF HOLSTEIN × GYR CROSSBRED YEARLING BULLS USING COMPARATIVE SLAUGHTER AND RESPIRATION CHAMBERS TECHNIQUES

D. B. Oss[1], M. I. Marcondes[1], F. S. Machado[2], T. R. Tomich[2], L. G. R. Pereira[2], M. M. Campos[2], M. M. D. Castro[1], T. E. Silva[1], A. S. Trece[1], A. S. Trece[1], R. F. O. Guerra[1], E. C. Godinho Jr[1], G. P. Costa[1], A. F. Machado[1], C. F. Lobo[1], F. P. Provazi[1]

[1]Departamento de Zootecnia, Universidade Federal de Viçosa, Viçosa-MG, Brasil
[2]Empresa Brasileira de Pesquisa Agropecuária, Embrapa Gado de Leite, Juiz de Fora-MG, Brasil

INTRODUCTION

Brazil has its own nutrient requirement system for cattle; however, information about crossbred cattle is little due to the database being constituted of zebu cattle in general. Regarding energy requirements, different techniques are available to measure the retained energy (RE) of animals and then estimate the requirements. Comparative slaughter (CS) and respiration chambers (RC) are two of them. Each one has its specific advantages and disadvantages. The CS is able to measure RE directly, but it is very laborious and precludes the use of animals of high commercial value. On the other hand, RC prevents the slaughter of animals but it precludes the use of grazing ruminants and it is very expensive. The objective of this study was to compare the estimates of energy requirements for maintenance and gain of Holstein × Gyr crossbred yearling bulls using CS and RC techniques.

MATERIAL AND METHODS

This study was carried out at Embrapa Dairy Cattle, in Coronel Pacheco, MG, Brazil, from August 2013 to February 2014. The study was approved by Ethics Committee in Animal Use of the Animal Science Department of the Universidade Federal de Viçosa (UFV). The reference group consisted of six animals that were slaughtered at the beginning of the experiment to estimate the initial body energy content of the animals. The eighteen remaining yearling crossbred bulls averaging 10 months old (initial live weight = 155.2 ± 5.6) were randomly subdivided into 3 groups of 6 animals. The groups consisted of levels of dry matter (DM) intake: (1) 1.2% of body weight (BW); (2) 1.9% of BW and (3) unrestricted. Bulls were housed in a tie stall system. One animal from the unrestricted group had to be removed from the experiment due to health complications that was not caused by the treatment. They were fed a total mixed ration (TMR) consisting of corn silage and concentrate (59.6:40.4 DM basis) once daily. The estimated metabolizable energy content of the diet was 2.4 Mcal/kg DM. Feed intake was recorded daily and BW was measured at 15 days intervals. After 3 months the beginning of the experiment bulls were evaluated in indirect open-circuit respiration chambers where each bull spent a two days period. Heat production (HP) was calculated according to Brouwer (1965) and RE by difference between HP and metabolizable energy intake (MEI). Bulls were slaughtered at the end of the trial, when they had their final body energy content directly determined. The experiment lasted 173 days. The body energy determination was obtained from the body protein and fat levels and their caloric equivalent (ARC, 1980). The net energy for maintenance (NE_m), metabolizable energy for maintenance (ME_m), efficiency of use of metabolizable energy for maintenance (k_m), net energy for gain (NE_g), metabolizable energy for gain (ME_g), and efficiency of use of metabolizable energy for gain (k_g) were estimated as described in BR-Corte (Valadares Filho et al., 2010) using the NLIN and NLMIXED procedure of SAS software (SAS Institute Inc., Cary, NC).

RESULTS AND DISCUSSION

To describe the relationship between HP and MEI a non-linear exponential model was used: $HP = \beta0 \times e^{\beta1 \times MEI}$, where β0 and β1 are regression parameters and β0 represents the NE_m. The β0 for CS and RC were 0.0794 and 0.0691, respectively; and the β1 for CS and RC were 3.7345 and 3.9900, respectively. No difference was found between techniques for the parameters β0 (P=0.1158) or β1 (P=0.4621). Thus, only one equation was adjusted to estimate the NE_m (Figure 1A). The NE_m in this study was 73.9 Kcal/$BW^{0.75}$ day^{-1}, whereas ME_m was 116 Kcal/$BW^{0.75}$ day^{-1}. The ME_m was determined by the iterative method when MEI equals to HP. The k_m, obtained from the relation between the requirements of NE_m and ME_m was 0.64 in this study for both techniques. The model used in this study to describe the relation between RE and MEI and then to calculate NE_g was: $RE = NE_g = a \times BW^{0.75} \times ADG^{b}$; where ADG is average daily gain. There were no differences between techniques for *a* (P=0.1274) or *b* (P=0.7706) parameters and only one equation to estimate NE_g was suggested in this study (Figure 1B). The exponent of ADG (*b*=0.5516) obtained in this study is lower than others reported in the literature (Valadares Filho et al., 2010) what suggests that there was a lower energy concentration in the gain of the bulls evaluated in our study because their growth stage provided a higher protein proportion in the ADG. The k_g estimated as the slope of the regression of RE on the MEI (RE = $a + b \times$ MEI) was 0.30. The parameter a was -0.0279. The EM_g can be obtained by the relation EL_g/K_g. We conclude there is agreement between the estimates of energy requirements using CS and RC.

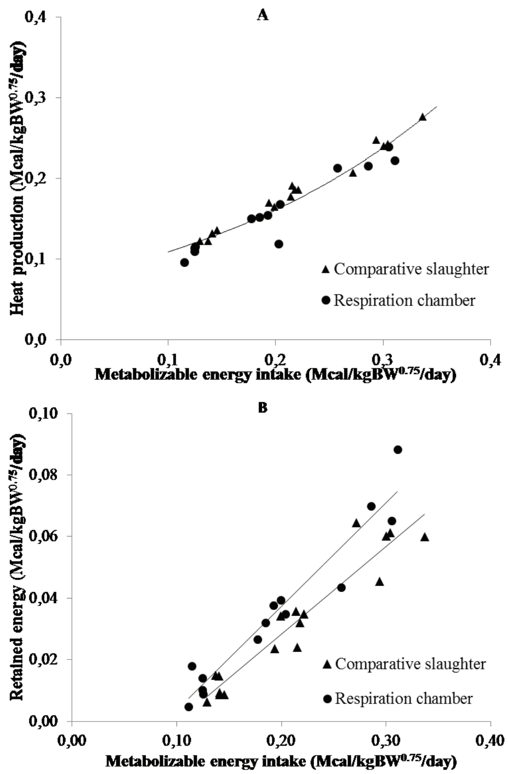

Figure 1 - (A) Exponential relationship between heat production (HP) and metabolizable energy intake (MEI); HP = $0.0739 \times e^{3.8983 \times MEI}$ and (B) Relation between retained energy (RE) and metabolizable energy intake (MEI) of Holstein × Gyr crossbred yearling bulls using comparative slaughter (n=17) and respiration chamber (n=14) methods; RE = NEg = $0.0533 \times BW^{0.75} \times ADG^{0.5516}$.

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