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Effects of Feeding Level on Energy Expenditure and Methane Emission in Crossbred (Holstein x Gyr) Steers

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There is a scarcity of published literature regarding the energy expenditure and methane emission by crossbred cattle in the tropics. In mammals, most of the measured oxygen consumption is transferred to the tissues through the heart; therefore, the use of heart rate (HR) for daily energy expenditure estimation is mainly based on the multiplication of daily HR recording by the calibrated ratio of oxygen consumption per beat (Brosh, 2007). This trial aimed to evaluate the effects of feeding level on energy expenditure and methane emission in crossbred Holstein-Gyr steers using the face-mask method. Eighteen crossbred (Holstein x Gyr) steers (body weight, 232 ± 52 kg; age, 12.5 ± 0.8 months) were housed in tie-stall barn at Embrapa Dairy Cattle experimental station. Animals were randomly assigned to 3 treatments: fed at 1.3% of body weight (BW, dry matter basis), fed at 2.2% of BW or fed *ad libitum*. The same diet was offered during 28 days (60% corn silage and 40% concentrate, dry matter basis; 140 g of crude protein per Kg of DM). The concentrate contained 24.8% soybean meal, 67.9% ground corn grain, 2.4% urea, 1.4% limestone and 3.5% premix. Heart rate (HR) was recorded during 72-h with Polar equine transmitter and monitor (Model RS800CX G3, Polar Electro Inc., Kempele, Finland). Oxygen consumption and methane emission data were recorded with Sable System (Sable Systems, Henderson, NV) attached to a facemask over a 3 d period, 4 h after feeding, during 20 min, simultaneously with HR measurement. Three oxygen pulse (O2P) measurements (ml O2/ heart beat) were collected. Total daily oxygen consumption (L/d) was calculated from the product of the average of O2P and average daily HR (Brosh, 2007). Daily energy expenditure was calculated as the product of total daily oxygen consumption and the constant 20.47 kilojoules per liter of oxygen (Nicol and Young 1990). Daily methane emission was calculated from the average rate of CH4 production (L/min) measured during 20 min, over 3 d. Data were analysed using ANOVA and means between treatments were compared using Tukey's test ($P < 0.05$).

Table 1. Main effect means ± SE to energy expenditure and methane emission measurements from crossbred (Holstein x Gyr) steers on different feeding level. Means within rows followed by the same letter are not significantly different ($P \geq 0.05$).

Parameter	*Ad libitum*	2.2% BW	1.3% BW	*P*-value
Dry matter intake, Kg/d	10.02 ± 0.57 a	5.05 ± 0.52 b	2.55 ± 0.52 c	<0.001
Average daily gain, Kg/d	1.25 ± 0.06 a	0.67 ± 0.06 b	0.17 ± 0.06 c	<0.001
Rate of consumption of O2, L/min	1.87 ± 0.12 a	1.42 ± 0.12 b	0.82 ± 0.12 c	<0.001
Rate of production of CH4, L/min	0.15 ± 0.01 a	0.10 ± 0.01 b	0.05 ± 0.01 c	<0.001
Daily heart rate, beats/min	102.89 ± 3.10 a	97.86 ± 2.83 a	99.08 ± 2.83 a	n.s.
Oxygen pulse, mL/min	18.26 ± 1.36 a	14.67 ± 1.24 a	8.30 ± 1.24 b	<0.001
Body Weight, Kg	286.25 ± 16.12 a	229.56 ± 14.71 ab	188.75 ± 14.71 b	0.002
Energy expenditure, Kcal/Kg of MBW	188.00 ±7.83 a	170.06 ± 7.15 a	114.09 ± 7.15 b	<0.001
Methane emission, L/d	216.11±19.62 a	142.48 ± 17.91 b	67.71 ± 17.91 c	<0.001

As expected, dry matter intake and body weight gain differed among animals fed *ad libitum*, at 2.2% of BW and at 1.3% of BW. Animals fed *ad libitum* presented higher rates of consumption of O2 and production of CH4 (L/min). There was no effect of feeding level on heart rate. As a result, energy expenditure (EE) or heat production was estimated to be lower in animals fed at 1.3% of BW. Therefore, changes in EE determined by facemask method serve as good indicators of general energy status of animal, as well, have potential for determination of energy requirements of cattle without the need of slaughtering. As expected, methane emission differed among feeding levels. The facemask method has a great potential for enteric methane emission measurement for ruminants in grazing systems and could be a good alternative for the conventional measurements in respiration chambers.

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