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Prediction of dry matter intake in dairy calves

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Introduction

Dry matter intake (DMI) directly affects animal performance; it is the main determinant of nutrients used to meet the requirements for maintenance and production. Therefore, accurate models of dry matter intake in calves is fundamental to formulating diets to meet requirements and the efficient use of the nutrients by the animals (NRC, 2001; Chizzotti *et al.*, 2007). The objective was to establish a model to determine dry matter intake (DMI) and free water intake (WI) for crossbred Holstein-Zebu calves aged between 0 and 60 days.

Material and methods

The experiment was conducted in the Department of Animal Science, Universidade Federal de Viçosa, Brazil. Eighteen male calves, crossbreed Holstein-Zebu, with an initial body weight of 36±5.5 kg, were used. The animals were distributed, according to a completely randomized design, into 3 treatments with 6 replications, and these treatments consisted of three different levels of milk intake, which were 2 (2L), 4 (4L) and 8 (8L) liters per day. The animals had free access to water and concentrate (starter), which was formulated in accordance with the requirements presented in NRC (2001). The animals were fed twice a day at 6:00 and 15:00, and water and starter intake were measured every day at 6:00h. There were performed digestibility assays, at 15 and 45 days of life. During those periods, there were collected samples of feeds offered. Milk samples were dried by lyophilization (Method INCT-CA G-002/1). All samples were analyzed for dry matter, according to the method (INCT-CA G-003/1), describe by Detmann *et al.*, (2012). Environmental variables were also considered: relative humidity (RH), temperature and humidity index (THI) and black globe temperature and humidity index (BGTHI). These estimates were made from daily uptakes of black globe temperature, dry bulb temperature, wet bulb temperature, and maximum and minimum temperatures. Environmental effects, milk intake and age were used in a multiple regression model, considering both linear and quadratic effects, to estimate calves DMI and WI. The test was conducted using the MIXED procedure of the SAS, at the level of significance of 5%.

Results and discussion

The DMI was affected by milk intake ($P<0.001$), THI ($P=0.0453$) and age of the animals ($P<0.001$). However, no significant quadratic effects were observed ($P>0.05$), thus the final regression can be expressed:

$$DMI = 0.4272 + 0.6741 \times M - 0.0059 \times THI + 0.0122 \times day \quad (1)$$

where DMI= dry matter intake (kg/day), M= milk intake (kg/day of DM), THI= temperature and humidity index (without dimension), Day= Age of animal (days). The DMI observed between treatments varied and increased with increasing the milk intake, as expected. On the other hand, starter intake (SI), followed the opposite behavior, and decreased as the milk intake was increased (Table 1). The reduction in solids intake by calves drinking more milk was due to the fact that these animals have reached satiety by chemical-physiological mechanisms (higher blood glucose) and b physical factors (continuous gut-filling because of curd formation, Khan *et al.*, 2011). The SI can b estimated by the difference between the total DMI and the DMI from milk.

Table 1. Dry matter (kg/day), starter (kg/day DM) and water intakes (l/day.) and prediction equations for dry matter and water intakes.

	L 2[1]	L 4	L 8	Regression
DMI	0.650	0.795	1.114	$DMI = 0.4272 + 0.6741 \times M - 0.0059 \times THI + 0.0122 \times Day$
SI	0.348	0.249	0.123	$SI = DM\ I_{total} - DMI_{milk}$
WI	2.274	1.979	1.273	$WI = -2.9648 + 0.187 \times T_{db} + 0.02756 \times Day + 0.7257 \times SI$

[1] L2: 2 l/day; L4: 4 l/day; L8: 8 l/day; DMI: dry matter intake, SI: starter intake, WI: free water intake.

All the environmental variables (dry bulb temperature, THI, BGHI) affected water intake ($P<0.0001$). However, as the dry bulb temperature had the greater correlation with WI ($r^2=0.185$), the other variables were not included in the model to estimate WI. It was verified significant effects of dry bulb temperature ($P<0.0001$), age in days ($P<0.0001$), and starter intake ($P=0.0028$) on WI. The same way as occurred to DMI, it wasn't observed quadratic effects for any of the variables tested ($P>0.05$) and the multiple linear regression to estimate WI in calves can be expressed:

$$WI = -2.9648 + 0.187 \times T_{db} + 0.02756 \times day + 0.7257 \times SI \qquad (2)$$

where WI = free water intake (liters /day), T_{db} = dry bulb temperature (°C), Day= age of animal (days), SI = starter intake (kg/day). The water intake presented a direct relationship with the starter intake (Table 1), and with the percentage of dry matter on the diet, and these were 25.2; 17.7 and 13.9% of the natural matter for the treatments 2L, 4L and 8L, respectively. NRC (2001) mention that among the many factors that can change the free water intake, the percentage of the dry matter on the diet is the main factor. Therefore, higher solid feed intake tends to be followed of the higher water intake, as observed in this study.

It can be concluded that the dry matter intake in calves can be estimated using parameters as milk intake, THI and age of animals. Furthermore, the free water intake can be estimated using parameters as dry bulb temperature, age of animals and starter intake.

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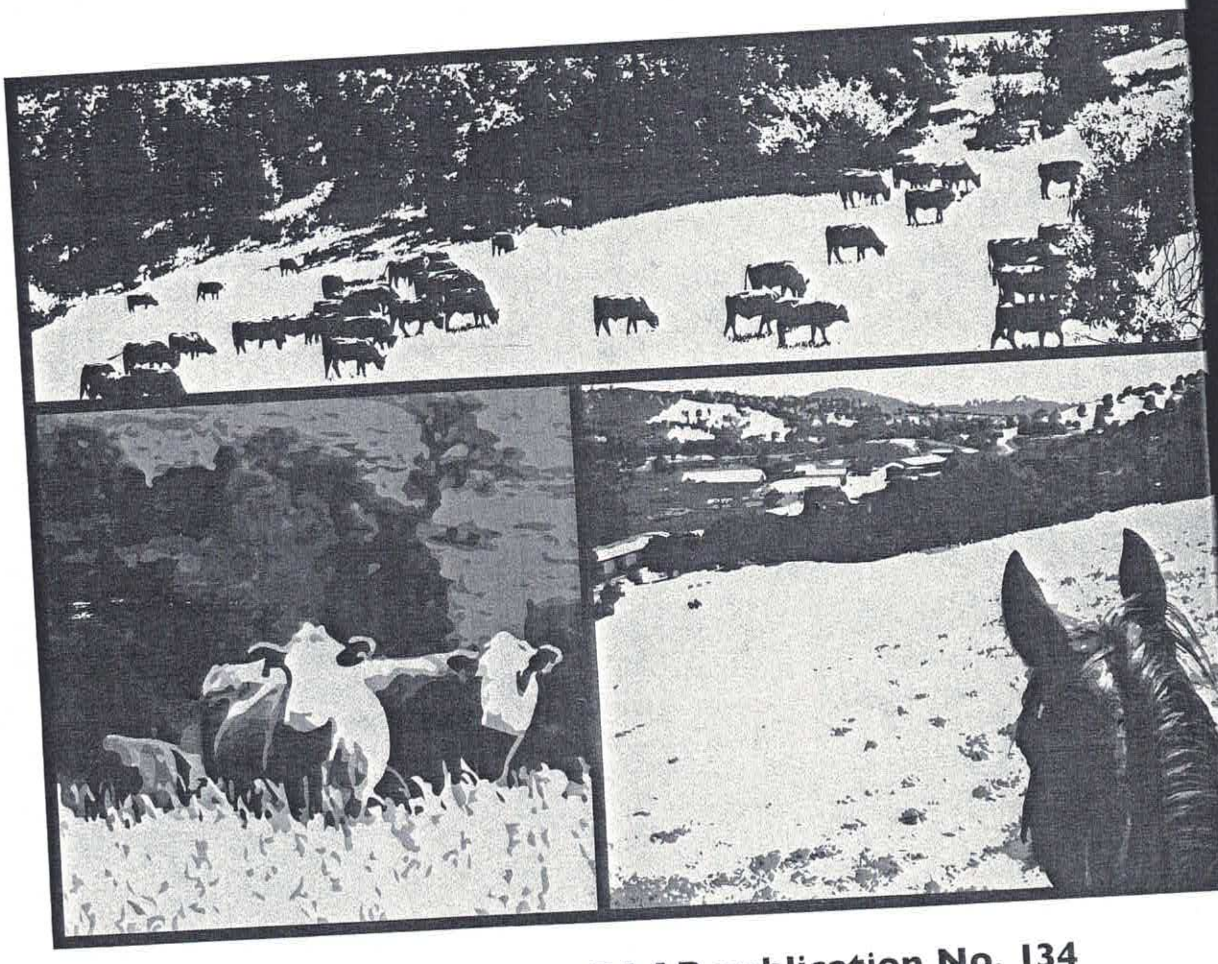

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