J. Dairy Sci. 101:1–11
https://doi.org/10.3168/jds.2017-13615

Effects of methionine plus cysteine inclusion on performance and body composition of liquid-fed crossbred calves fed a commercial milk replacer and no starter feed

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ABSTRACT

This experiment aimed to evaluate the effects of supplying 4 different inclusion levels of Met + Cys to crossbred liquid-fed calves on animal performance and body composition. Thirty-six Holstein-Gyr male calves were separated into 2 age groups: 16 calves, slaughtered at an age of 30 d, representing the physiological phase from 8 to 30 d, and 20 calves, slaughtered at an age of 60 d, representing the physiological phase from 30 to 60 d. At 8 d of age, the animals were randomly distributed among the experimental treatments: 4 Met + Cys inclusion levels (Met + Cys: 8.0, 8.7, 9.4, and 10.2 g/d), provided by an AA supplement added to 1.0 kg (as fed) of commercial milk replacer containing soy protein concentrate and wheat protein isolate reconstituted at 13.8% (dry matter basis). The diet was supplied without allowing leftovers and no starter feed was provided. The experimental diets were supplied without allowing orts, so that the dry matter, crude protein, and ether extract intakes were the same for all animals, independent of Met + Cys level. Total weight gain, average daily gain, gain composition, and body composition were evaluated for both age groups separately. Digestibility of organic matter, crude protein, and ether extract was lower for 8 to 30 d than for 30 to 60 d. The effect of Met + Cys levels on the digestibility of nutrients was not observed; there also was no significant interaction between physiological phase and Met + Cys levels. For the 8 to 30 d group, no responses in performance were observed according to the different Met + Cys levels, which indicates that 8.0 g/d of Met + Cys met the requirements for this physiological phase. The 30 to 60 d group responded positively to higher Met + Cys inclusion in the diet. In conclusion, an optimal Met + Cys dietary level to ensure best performance and protein gain ranges from 8.41 to 9.81 g/d.
Key words: sulfur amino acid, lysine, protein gain, calf performance

INTRODUCTION

Milk is considered the best protein source for young calves due to its high digestibility and balanced AA profile (Huang et al., 2015; Castro et al., 2016). However, only few studies have suggested modifications of the AA profile of liquid diets for dairy calves to promote greater performance (Hill et al., 2008; Wang et al., 2012; Hill et al., 2016). The AFRC (1993), NRC (2001), and CSIRO (2007), which are the main systems used for prediction of nutrient requirements of dairy animals, do not have AA requirements for calves. However, some studies have suggested optimal inclusion levels of essential AA in calf diets (Hill et al., 2008; Wang et al., 2012) and highlighted Met as the main growth-limiting AA for neonates (Erickson et al., 1989; Abe et al., 1997; Wu et al., 2014).

Methionine plays an important metabolic role; about 52% of the consumed Met is metabolized by intestinal lumen cells and can be converted to Cys (Wu et al. 1998). Cysteine is a conditionally essential AA for neonates (D'Mello, 2003), which is involved in metabolic pathways that promote animal health and performance (Jankowski, et al., 2014). Thus, Met supply in calves' diets could meet Cys requirements as well.

Thus, we hypothesized that it is possible to find an optimal inclusion level of Met + Cys for crossbreed liquid-fed calves that allows maximum performance from DL-Met supplementation. We also hypothesized that animals up to 4 wk old respond differently to non-milk protein exclusive milk replacers and an AA supple-

Received July 31, 2017.
Accepted February 19, 2018.
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ment, as exclusive diet, than animals aged between 4 and 8 wk. The overall goal of our study was, therefore, to evaluate the effects of supplying 4 different Met + Cys levels in the diets of liquid-fed crossbreed calves of 2 age groups in terms of animal performance and body composition.

MATERIALS AND METHODS

Ethics Statement

The experiment was approved by the Institutional Animal Care and Use Committee of the Animal Science Department at the Federal University of Viçosa, registered under protocol number 27/2013.

The experiment was conducted at the Embrapa Dairy Cattle Experimental Farm, located in Coronel Pacheco, Minas Gerais, Brazil. The samples were processed at the Animal Nutrition Laboratory of the Animal Science Department, which belongs to the Federal University of Viçosa, Minas Gerais, Brazil.

Animals and Feeding Management

Forty-three male calves, whose genetic composition ranged from 1/2 to 15/16 Holstein-Gyr, with a birth weight (**BRW**) of 36.43 ± 5.09 kg, were used in the experiment. Immediately after birth, calves were separated from their dams, weighed, and the umbilical cord was immersed in iodine solution (10%). Calves were allocated in individual stalls of bedded sand, with free access to water. Colostrum (10% BRW, >50 g/L of IgG) was fed within the first 6 h after birth; the animals continued to receive colostrum until they were 3 d old at 10% BRW; between d 4 and 7, the calves were fed with 8 L/d of raw milk served in aluminum buckets in 2 equal meals (0800 and 1600 h).

The serum total protein test (Deelen et al., 2014) was performed between 24 and 48 h of life using a Brix refractometer (Serum protein REF-301, Biocotek, Beilun, Ningbo, China) to ensure the inclusion of calves in the experiment with minimum levels of immunity transferred from the colostrum (7 g of total protein per dL of blood serum; data not shown).

At 8 d and with an average BW of 42.06 ± 4.7 kg, calves with a genetic composition ranging from 1/2 to 15/16 Holstein-Gyr were divided into 2 age groups: group 1: 8 to 30 d calves, composed of 16 calves slaughtered at an age of 30 d, representing a physiological phase from 8 to 30 d; group 2: 30 to 60 d calves, composed of 20 calves slaughtered at 60 d of age, representing a physiological phase from 30 to 60 d. The 36 calves were distributed in a completely randomized block design (8 to 30 d, n = 16 and 4 replications; 30 to 60 d, n = 20 and 5 replications) among the experimental treatments that consisted of 4 Met + Cys inclusion levels (Met + Cys: 8.0, 8.7, 9.4, and 10.2 g/d; Table 1). The animals were randomly assigned across Met + Cys levels, thus initial BW did not vary among Met + Cys for both age groups and genotypes ($P > 0.05$, data not shown).

The 7 remaining animals were slaughtered at d 8 and used as the reference group, with a genetic composition ranging from 1/2 to 15/16 Holstein-Gyr; they were slaughtered at an average BW of 40.14 ± 4.4 kg. Body composition data of these animals were used to estimate initial body composition of the animals that remained in the experiment.

The calves were fed 1.0 kg/d of a milk replacer containing soy protein concentrate and wheat protein isolate (**MR**; Lacthor, DSM Company, Heerlen, the Netherlands), as fed (Table 1), reconstituted to 13.8% solids with warm water, prepared individually in aluminum buckets. The diet was supplied without allowing leftovers and no starter feed was provided. Values of Met + Cys were determined through a supply of AA supplement (Ajinomoto Co. Inc., Tokyo, Japan) with increasing levels of DL-Met and decreasing levels of crystalline glutamic acid, providing protein equivalence for experimental diets, where the addition of L-Lys was static (Table 1). Ten grams (DM basis) per meal of amino acidic supplement was diluted in 400 mL of warm water and offered in plastic bottles to avoid sedimentation of the material in the buckets and to guarantee the complete consumption of the MR; the supplement was given immediately before the MR supply, at 0800 and 1600 h.

The AA were included in the diets based on the milk protein amino acidic profile suggested by Rutherfurd and Moughan (1998) and adapted to the AA profile in the commercial MR used in this study (Table 1). The Lys used was adjusted to a suboptimal level (Conde-Aguilera et al., 2010), assuming that the optimal level of Lys supplied by the milk protein (Rutherfurd and Moughan, 1998) was 19.75 g/d. Lysine was provided at a suboptimal level to increase the sensitivity of the responses to the rising levels of Met (Conde-Aguilera et al., 2010). The MR and AA supplement was the only source of nutrients fed to the calves to ensure the expected ingestion of AA and that all responses were due to the formulated diet.

Digestibility Trial

The animals were weighed at birth and at 8, 30, and 60 d for performance monitoring. Feed intake was not evaluated because the amount of MR offered from d 8