J. Dairy Sci. 97:363–371
http://dx.doi.org/10.3168/jds.2012-6356

The effect of 2 liquid feeds and 2 sources of protein in starter on performance and blood metabolites in Holstein neonatal calves

A. M. Tahmasbi, S. Heidari Jahan Abadi,[1] and A. A. Naserian
Department of Animal Science, Ferdowsi University of Mashhad, Mashhad 91779-48978, Iran

ABSTRACT

The aim of present study was to investigate the effect of 2 liquid feeds and 2 protein sources in starter on the performance and blood metabolite responses of Holstein neonatal calves from birth to 6 wk of age. Calves (20 males and 20 females) based on sex were randomly assigned to 4 treatments in a 2 × 2 × 2 factorial arrangement, including soybean meal (SBM) and meat and bone meal (MB) with either fermented colostrum (or fresh milk. Although sex and liquid feed had no significant effect on feed intake, calves consumed more feed intake on the diet containing SBM (15 ± 0.2 kg) than MB (13 ± 0.2 kg) during the experimental period; also, weight gain was affected by both liquid feed and starter. Liquid feed and starter had significant effects on calf body size, including pin width, hip width, withers height, hip height, and stomach size, but no significant effects were observed on calf body size between the sexes. Plasma glucose concentration was not affected by sex, liquid feed, or starter. Plasma urea nitrogen concentration decreased in the first 3 wk and then started to increase during the last 3 wk, but it was only affected by starter and calves receiving SBM (10.18 mg/dL) had a higher concentration of plasma urea nitrogen than calves receiving MB (9.6 mg/dL) at the end of the experiment. Plasma growth hormone and insulin-like growth factor I concentrations decreased in all treatment groups from d 0 to the end of the study. No significant effects were observed on plasma growth hormone and insulin-like growth factor I concentrations between the 2 sexes, but they were significantly affected by both liquid feed and starter. Results of the present study provide useful information to apply to Holstein neonatal calves during the first 6 wk of life when liquid feed and 2 sources of protein in starter are considered.
Key words: calf, performance, blood metabolites, body size

INTRODUCTION

Calf health, growth, and productivity rely heavily on nutrition and management practices. Colostrum is the first milk produced after a normal dry period and mammary involution, or the first milk secreted by a heifer, and it is an essential part of a newborn calf's survival. Colostrum produced by dairy cows during the first 3 to 4 d postpartum is much more than can be utilized by the calf. In large dairy herds, surplus colostrum can be utilized by feeding it to all calves in the herd. However, surplus colostrum can remain if calving is not dispersed uniformly throughout the year. Colostrum can be stored by freezing without nutrient loss during storage (Foley and Otterby, 1978) or can be stored by fermentation. However, several problems, such as undesirable fermentation, excessive acidity, reduced acceptability by calves, or increased nutrient losses, were reported when colostrum was stored at warm ambient temperatures (Muller et al., 1976; Rindsig and Bodoh, 1977). Chemical additives have been used to control fermentation, especially at warm ambient temperatures.

Several researchers reported that weight gains for calves fed colostrum treated with propionic acid (Otterby and Linn, 1981), acetic acid (Polzin et al., 1976), lactic acid (Foley and Otterby, 1978), and formaldehyde (Jenny et al., 1977) were similar to weight gains calves fed fresh milk (**FM**) or naturally fermented colostrum (**FC**). In addition, newborn calves require both of liquid and dry feed to improve their performance and digestive tract. Barley, corn, and soybean meal (**SBM**) are typical ingredients in ruminant diets (Sahlu et al., 1984). Calves fed SBM-based diets performed about as well as or better than those fed other sources of protein (Muller et al., 1976; Chiba, 2001). It would be interesting, however, to know if alternative regional protein sources, such as meat meal, could replace soybean meal without any adverse effects on performance or body composition. On the other hand, the possible use of the animal waste products is of major importance, both in terms of maintenance of the environment and of economic meat production (Miller and De Boer, 1988). The feeding value of meat meal as a protein supplement for ruminants has been studied in relation to milk yield

Received November 7, 2012.
Accepted August 22, 2013.
[1]Corresponding author: somaye.heidari119@gmail.com

(Mäntysaari et al., 1989), calf growth (Leibholz, 1967; Leibholz and Moss, 1967; Khorasani et al., 1989), and in feed lot performance of steers and lambs (Stock and Klopfenstein, 1979; Loerch and Berger, 1981). However, none of these studies involved the effects of supplying meat meal on growth factors and body size of growing calves. The objective of this study was to determine the effect of 2 liquid feeds and 2 protein sources in starter on the performance and blood metabolites in Holstein neonatal calves.

MATERIALS AND METHODS

Experimental Design, Treatments, and Calves

Before starting the experiment, the chemical composition of FM and FC acidified with formic acid was measured using a MilkoScan analyzer (Foss Electric A/S, Hillerød, Denmark) at the ruminant nutrition laboratory of Ferdowsi University of Mashhad (Mashhad, Iran). The chemical compositions of liquid feeds are shown in Table 1.

Forty neonatal Holstein calves (20 males and 20 females) with 43.3 ± 0.1 and 42.3 ± 0.1 kg of BW (male and female, respectively) were used in a 42-d experimental period (the experiment took from March to April, because the calves were born at different times). According to the environmental temperature, calves were monitored indoors up to 6 wk of age at the calf Housing Facilities of Ferdowsi Research station (Ferdowsi University of Mashhad). At the beginning of the experiment, calves were separated from their dams immediately after birth and then were placed in individual pens. They were hand-fed their dam's fresh colostrum twice daily (1.5 to 2 kg per meal) for the first 2 d of life. On the third day, calves were switched to their treatments, including the respective liquid diets and starters. Calves based on sex were assigned randomly to 1 of 4 treatments, including SBM and meat and bone meal (**MB**) with either FC or FM.

The experiment was conducted according to a factorial 2 × 2 × 2 design (2 sexes, 2 liquid feeds, and 2 sources of protein in their starters). The 8 treatments were male/female fed (1) FM and SBM, (2) FM and MB, (3) FC and SBM, and (4) FC and MB. The trials continued for 6 wk. Colostrum collected for the first 8 milkings postpartum from dams of calves assigned to the experiments was acidified with formic acid and stored separately in covered plastic containers of 60 or 120 L. For acidification of colostrum, pure formic acid (98–100%, Riedel-de Haën) was used. Briefly, formic acid was diluted 1:10 (1 part formic acid to 10 parts water) and then 25 mL of diluted formic acid was added per kilogram of liquid diets (1 part FC with formic acid was mixed with 2 parts water so that both FC and FM would have equal TS, fat, protein, and lactose contents). Thus, approximately 2.27 mL of pure formic acid was added per kilogram of liquid diet (approximately 0.23%, vol/wt). Calves received liquid diets twice daily (2 kg per meal) and water and starters were available for ad libitum intake until the end of the trial at 6 wk of age.

Table 1. Chemical composition of liquid feeds

Composition (% of DM)	Fermented colostrum acidified with formic acid	Fresh milk
TS	19.20	12.00
Protein	8.00	3.40
Fat	6.10	3.50
Lactose	3.60	4.80
Minerals	1.10	0.80

Body Size Measurements, Blood Sampling, and Analyses

Calves were measured for growth to determine performance throughout the trial. At birth and every 3 wk, the following measurements were taken: BW, feed intake, pin width, hip width, body length, stomach size, withers height, and hip height, by using a wooden height stick with horizontal crossbar and level, calibrated in 0.635-cm increments (actual calibrations were in English units). Body length (measured from point of shoulder to caudal projection of pin bone). Weights were determined with a digital scale. Starter intake was measured daily by weighing refusals. The amount of starter fed was increased by 50 g if daily orts were less than 25 g. Calves were limited to no more than 2.5 kg/d, but no calves reached this limit. Fresh, clean water was available ad libitum beginning 1 to 2 d after birth.

Blood samples were collected by jugular venipuncture into evacuated tubes containing 0.1 mL of 15% EDTA (Vacutainer; Becton Dickinson, Rutherford, NJ), placed on ice, and transported to the laboratory. Plasma was harvested by centrifugation at 5,000 × g for 15 min at 4°C and stored at −20°C until analyzed for glucose, urea, growth hormone (**GH**), and IGF-1 (Technicon Corp., Tarrytown, NY). Plasma glucose concentrations were measured by the glucose oxidase method using a commercial kit (No. 115; Sigma Diagnostics, St. Louis, MO). Plasma urea nitrogen (**PUN**) concentration was determined using urease and the indophenol reaction (Chaney and Marbach, 1962). Urea standards were prepared by dissolving 0.2142 g of urea in 100 mL of deionized water to form a stock solution and then further diluting the stock with deionized water to prepare a set of standards.