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Evaluation of camelina meal as a feedstuff for growing dairy heifers

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ABSTRACT

The objective of this research was to compare the growth performance, metabolic profile, and nutrient utilization of dairy heifers fed camelina meal (CAM), linseed meal (LIN), or distillers dried grains with solubles (DDGS). A 12-wk randomized complete block design study was conducted using 33 Holstein and 9 Brown Swiss heifers (144.8 ± 22 d of age) with 3 treatments. Treatments were 10% of the diet as CAM, LIN, or DDGS (dry matter basis). All diets contained 60% grass hay and 40% concentrate mix. Diets were balanced with corn and soybean meal to be isonitrogenous and comparable in energy content. Diets were individually limit-fed to 2.65% of body weight using a Calan gate feeding system. Frame sizes, body weights, and body condition scores were measured on 2 consecutive days during wk 0, 2, 4, 6, 8, 10, and 12. Jugular blood samples were taken at the beginning of the study and then every 4 wk throughout at 3.5 h postfeeding for analysis of blood metabolites and metabolic hormones. Rumen fluid samples were taken at the same time as blood sampling via an esophageal tube during wk 8 and 12. Over the duration of the study, dry matter intake and average daily gain were similar among treatments. Body weights tended to be less for heifers fed CAM and greatest for LIN. Gain to feed was similar for the CAM and DDGS and greatest for the LIN. Overall, most frame measurements were similar among treatments. Body length had a tendency to be greater for CAM compared with LIN with DDGS similar to both. Body condition scores were greater for CAM and DDGS compared with LIN. Rumen total volatile fatty acids, acetate:propionate, and pH were similar among treatments. Butyrate was less in the CAM treatment, intermediate for LIN, and greatest for DDGS. Rumen ammonia was less in DDGS compared with CAM and LIN, which were similar. Blood concentrations of glucose, triglycerides, plasma urea N, and cholesterol were similar among treatments. Metabolic hormones, including insulin-like growth factor-1 and thyroid hormones triiodothyronine and free thyroxine, were similar among treatments. Heifers fed CAM had lesser insulin concentration than other treatments. Total-tract digestion of nutrients were similar among treatments, but CAM tended to have greater digestion of organic matter compared with LIN, with DDGS similar to both. Feeding CAM maintained growth performance compared with DDGS and LIN. This study demonstrates that CAM can be used as a protein source for growing dairy heifers.

Key words: dairy heifer, growth performance, camelina meal

INTRODUCTION

A relatively novel cruciferous oilseed crop, *Camelina sativa*, is being introduced to South Dakota, Minnesota, North Dakota, and Montana (Atyeo, 2015). This nonfood oilseed is a part of the *Brassica* family, which includes more common food crops such as cabbage, brussel sprouts, cauliflower, kale, rapeseed, canola, and broccoli (Moser, 2010). The renewed interest in camelina is in relation to demand for new feedstocks for biofuel production (Zubr, 1997; Frohlich and Rice, 2005). The oil content of camelina seeds is approximately 40%, with 90% of the total oil as PUFA and 50% of the PUFA is linoleic acid (C18:2) and α-linoleic acid (C18:3; Zubr, 1997; Moser, 2010). Therefore, camelina is desirable as a biodiesel feed stock because it is renewable, has a high oil content, and has relatively low agronomic inputs (Frolich and Rice, 2005; Moser, 2010; Waraich et al., 2013). The resulting meal after oil extraction contains 30 to 40% CP with 12% fiber (Zubr, 1997; Benz, 2010). It has been demonstrated using rumen in situ and in vitro intestinal digestibility methods that camelina meal (**CAM**) contains greater proportions of rumen degradable protein (**RDP**) than canola, linseed meal (**LIN**), distillers dried grains with solubles (**DDGS**), and soybean meal (Lawrence and Anderson, 2015). We also found that camelina had a comparable percentage of total digestible protein to

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LIN and soybean meal, making it potentially valuable as an alternative protein source for dairy cattle (Lawrence and Anderson, 2015). The main concern with feeding CAM is the anti-nutritional compounds found in all *Brassica* species (Tripathi and Mishra, 2007). Camelina contains glucosinolates, tannins, and erucic acid (C22:1; Zubr, 1997). Glucosinolates and erucic acid are the major concerns when feeding camelina because of their effect on the thyroid and the cardiovascular system (Tripathi and Mishra, 2007). Camelina contains 3 main glucosinolates: glucoarabin (9-methyl-sulfinyl-nonyl glucosinolate; **GS9**), glucocamelinin (10-methyl-sulfinyl-decyl glucosinolate; **GS10**), and 11-methyl-sulfinyl-undecyl glucosinolate (**GS11**; Schuster and Friedt, 1998). Ruminants are more tolerant to glucosinolates compared with monogastric animals; however, it is not recommended to feed meals containing glucosinolates in excess of 10% inclusion in the diet, which is currently the federal regulation (Benz, 2010).

Camelina meal has been fed to beef steers with no detrimental effects on growth performance or thyroid function (Moriel et al., 2011; Cappellozza et al., 2012). Feeding camelina seeds and meal to lactating dairy cattle tended to decrease DMI, but did not significantly affect milk production (Hurtaud and Peyraud, 2007). Camelina meal was found to decrease milk fat yield and content, with changes in fatty acid composition that resulted in modification of butter spreadability (Hurtaud and Peyraud, 2007). The effects of camelina oil versus extruded CAM were also examined and researchers found that milk yield or composition were not affected (Halmemies-Beauchet-Filleau et al., 2011). To our knowledge, the effects of feeding CAM in growing dairy heifer rations has not yet been evaluated. This age group of animals would be well suited for CAM supplementation because of less concern on effects on milk composition and the potential for glucosinolates to be transferred into milk, which may make it less suitable for lactating cows. The main objectives of this study were to determine the effects of CAM on the growth performance, metabolic profile, and total-tract digestibility of nutrients of dairy heifers. We hypothesized that because of the high overall total digestible protein content in CAM, it would improve growth performance when compared with LIN and DDGS.

Table 1. Ingredient composition of the camelina meal (CAM), distillers dried grains with solubles (DDGS), and linseed meal (LIN) diets fed to growing dairy heifers[1]

	Diet		
Ingredient, % of DM	CAM	DDGS	LIN
Grass hay	60.0	60.0	60.0
Camelina meal	10.0	—	—
DDGS	—	10.0	—
Linseed meal	—	—	10.0
Corn grain, ground	24.0	22.1	22.5
Soybean meal, 44% CP	4.5	6.4	6.0
Limestone	0.3	0.3	0.3
Vitamin and mineral premix[2]	1.0	1.0	1.0
Salt	0.2	0.2	0.2

[1]Formulated (NRC, 2001).

[2]Contained: 3.2 g/kg of lasolocid sodium, 18.9% Ca, 24.3% NaCl, 1.6% Mg, 0.5% K, 3,880 mg/kg of Zn, 880 mg/kg of Cu, 50 mg/kg of I, 25 mg/kg of Se, 550,000 IU/kg of vitamin A, 110,000 IU/kg of vitamin D_3, and 4,180 IU/kg of vitamin E (HeiferSmart No Phos B2909 Medicated, Purina Animal Nutrition LLC, Shoreview, MN).

MATERIALS AND METHODS

All animal procedures and uses were approved by the South Dakota State University Institutional Animal Care and Use Committee.

Experimental Design

A 12-wk randomized complete block design study was conducted using 33 Holstein and 9 Brown Swiss heifers (144.8 ± 22 d of age; BW 171.8 ± 24.3 kg) with 3 treatment diets. Heifers were blocked in groups of 3 based on birthdate and breed. Heifers were randomly assigned to treatment after assignment to block. Heifers were started on the study in groups of 6 at different times based on age. The entire feeding trial was completed in 9 mo from July 2014 to March 2015 at the South Dakota State University Dairy Research and Training Facility (Brookings, SD). Heifers were adapted to the research barns and feeding system for approximately 2 wk, followed by an experimental feeding period of 12 wk.

Three treatment diets were limit-fed at 2.65% of BW with 10% of the concentrate mix as the test feed. Treatments were (1) CAM, (2) DDGS, and (3) LIN. Diet ingredient compositions are presented in Table 1. Ground corn and soybean meal were used to make diets isonitrogenous and of comparable energy densities. The dietary inclusion of 10% as CAM has been found to be the optimum and safe inclusion amount for cattle due to the glucosinolates present, it is also the limit established by the FDA (Benz, 2010). Inclusion rate of the test feeds was the same across all treatments. Linseed meal was used because it does not contain glucosinolates and was comparable in protein digestibility to CAM. The DDGS treatment was considered the control diet because of previous research having found that it can be effectively used in heifer diets to maintain growth performance in replacement of corn and soybean meal (Anderson et al., 2015a).