MID-TERM REPORT, January 29, 2021

PRODUCTION EFFECTS OF EXTRUDED SOYBEAN MEAL IN COMPARISON WITH CANOLA MEAL IN LACTATING DAIRY COWS

Alex Hristov and Daniel Kniffen
Department of Animal Science, Pennsylvania State University

INTRODUCTION

A series of experiments in Canada and the U.S., funded through the Canola Council of Canada, resulted in a number of publications showing a higher rumen escape protein and lactational performance of dairy cows fed canola vs. solvent-extracted soybean meal. Rumen escape protein is critical for supplying amino acids for milk production, particularly for high-producing dairy cows. Comparison of canola meal to solvent-extracted soybean meal, however, puts soybean meal in a disadvantage because the canola seeds are already mechanically processed to decrease their oil content down to around 18%, before the remaining oil can be solvent extracted. Thus, animal production effects of canola meal cannot be compared to solvent-extracted soybean meal; the proper comparison is with extruded soybean meal, which is also undergoing mechanical oil extraction, thus increasing its escape protein. Therefore, we hypothesized that, when supplemented to the diet on an equal protein basis, extruded soybean meal will be equivalent or better than canola meal in terms of lactational performance of dairy cows.

Care of experimental animals: The animals involved in this experiment were cared for according to the guidelines of the Institutional ACUC at PSU (IACUC# PROTO202001392).

MATERIALS AND METHODS

Experimental design: The experiment was a randomized complete block design with 48 cows between 60 and 120 days-in-milk at the beginning of the experiment and was conducted in the free-stall barn of Penn State's Dairy Center. Cows were fed and DMI was monitored using the Calan gates system. At the beginning of the experiment, cows were blocked based on their parity and days-in-milk. The experiments included a 2-wk covariate and an 8-wk experimental periods. The first 2 wks of the experimental period were for adaptation to the treatments and the last 6 wks for data collection. The following treatments/diets were studied:

a. **Canola meal diet (CONTROL)** – the diet contained around 16% canola meal.
b. **Extruded SBM meal (ESBM) diet** – the diet contained around 13% ESBM (i.e., inclusion rate was on equivalent protein basis with canola meal from the CONTROL diet).

The canola meal was purchased through our regular feed suppliers and the ESBM was produced and supplied by Fabin Bros. The extrusion temperature of the meal was 325^{o}F**.** The diets were based on corn silage/alfalfa haylage, ground corn, whole cottonseed, molasses, minerals and

vitamins, and other feeds routinely fed at the Penn State dairy. With the exception of canola meal/ESBM, all other feed ingredients were identical between the two diets.

Sampling and Data Collection: Feed intake and milk production data were collected daily throughout the entire experiment. Body weight was recorded daily as cows exited the milking parlor. Cody condition score of cows was evaluated during the second week of the covariate period and during week 6 of the experimental period. Feeding was ad libitum (aiming at around 10% refusals) and feed offered and refusal weights were recorded daily. Feed and diet samples were collected and processed throughout the experiment following standard protocols.

Milk samples for composition analyses (fat, true protein, MUN, lactose) were collected on 2 consecutive days (i.e., 4 milkings) during the 2nd wk of the covariate period and experimental wks 3, 4, 5, and 6.

(Analyses not completed by the time of submission of this report): Grab fecal samples were collected from the rectum or after stimulating defecation at 0, 4, 8, and 12 h after feeding in 2 days during experimental wk 6. These samples are being analyzed for nutrients (crude protein, starch, fiber fractions) and data will be used to estimate total-tract, apparent digestibility of dietary nutrients. Indigestible NDF is used as an internal digestibility marker. Spot urine samples were also collected at the same time-points as for the fecal samples and are being analyzed for total N, purine derivatives (allantoin and uric acid), urea, and creatinine. These data will be used to determine urinary N losses and microbial protein formation in the rumen.

Rumen samples were collected from selected cows (10 total, 5 on each treatment) using the stomach tubing technique. Samples are currently being analyzed for fermentation variables (pH, VFA, ammonia) and microbial profiles.

Whole blood was collected from the tail vein or artery at the same time points as for the fecal samples. Blood samples are being analyzed for amino acid profile, BHB, NEFA, BUN, insulin, and glucose.

RESULTS

Data from the experiment that are currently available are shown in Table 1 below. Dry matter intake, milk and energy-corrected milk yields, and feed efficiency were not affected by treatment. Milk fat content and yield, however, were increased ($P \leq 0.01$) by ESBM compared with canola meal. Milk true protein concentration and yield were not affected by treatment, but lactose concentration tended to be increased ($P = 0.09$) by ESBM, compared with canola meal. Total milk energy was also tended to be greater ($P = 0.07$) for ESBM vs. canola meal. Milk urea N concentration was greater ($P = 0.01$) for ESBM than for the canola meal diet. There were no other production effects of diet in this experiment.

CONCLUSIONS

Based on the data currently available, it can be concluded that ESBM is equivalent to canola meal in terms of feed intake and milk production of dairy cows. The ESBM diet, however, increased milk fat content and yield, which is a significant advantage over canola meal as dairy farmers are paid on components and fat is always included in the milk pricing formula.

Table 1. Milk composition and production in dairy cows fed diets containing canola meal (CM) and extruded soybean meal (ESBM) on an equal protein basis

Item	Treatment[1]		SEM[2]	*P*-value[3]
	CM	ESBM		
DMI, kg/d	26.2	26.0	0.50	0.73
Milk yield, kg/d	39.4	38.6	0.66	0.28
Feed efficiency[4], kg/kg	1.49	1.50	0.026	0.70
Milk fat, %	3.52	4.00	0.102	0.002
Yield, kg/d	1.34	1.50	0.052	0.01
ECM[5], kg/d	36.0	37.1	0.910	0.20
ECM feed efficiency[6], kg/kg	1.38	1.42	0.036	0.32
Milk true protein, %	3.15	3.21	0.055	0.30
Yield, kg/d	1.19	1.19	0.051	0.90
Milk lactose, %	4.81	4.86	0.020	0.09
Yield, kg/d	1.85	1.85	0.42	0.99
MUN, mg/dL	11.2	12.0	0.21	0.01
SCC[9], × 10^7 cells/mL	114.2	75.6	28.93	0.23
Milk NE_L[8], Mcal/d	26.2	27.7	0.73	0.07
BCS[9]	3.0	3.0	0.08	0.79
BW, kg	629.7	626.1	3.83	0.38
BW change[10], g/d	551.2	713.0	131.83	0.40

[1]Treatments were CM (canola meal 16% and canola oil 0.6% inclusion rate on DM basis, respectively) and ESBM (extruded soybean meal 13% and soy hulls at 3.3% inclusion rate on DM basis, respectively).

[2]Largest SEM published in table; n = 292 for DMI, milk yield and BW; n = 290 for feed efficiency; n = 207 for milk composition data; n = 36 for BCS and BW change (n represents number of observations used in the statistical analysis).

[3]Main effect of treatment.

[4]Milk yield ÷ DMI.

[5]Energy-corrected milk.

[6]ECM yield ÷ DMI.

[7]Somatic cell count. Statistical analysis was performed on log-transformed data.

[8]Milk NE_L (Mcal/d) = kg of milk × (0.0929 × % fat + 0.0563 × % true protein + 0.0395 × % lactose) (NRC, 2001).

[9]BCS (body condition scoring) was measured on experimental week 7.

[10]BW change: (experimental BW wk 1 – experimental BW wk 7) ÷ days on study.