

Effect of replacing soy bean meal with brewers' spent grain pellets in dairy feed on feed intake, milk production and milk quality in dairy cows

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Abstract

The purpose of this research was to study the effect of replacing soy bean meal with brewers' spent grain pellets in dairy feed on feed intake, milk production and milk quality in 8 dairy cows with 75 percent Holstein-Friesian blood. The experimental design used was a 4x4 double Latin square and the intervention of experiment was concentrated feed mixed with brewers' spent grain pellets in place of soy bean meal at 4 levels; 0, 60, 80 and 100 percent (amount in concentrated feed were 0, 20, 30 and 40 percent). Every animal subject was fed with rice hay ad libitum and was given concentrated feed at 1.8 percent of body weight twice per day; in morning (06.00) and afternoon (16.00). The substitution of soy bean meal with brewers' spent grain pellets did not affect the intake volume of coarse feed, concentrated feed, total consumption and milk production yield ($P > 0.05$). However, replacing soy bean meal with brewers' spent grain pellets in dairy feed made the fat level in milk higher ($P < 0.01$). In this study, it was concluded that it was possible to replace soy bean meal with brewers' spent grain pellets up to 100 percent in the concentrated feed formula without affecting the feed intake and milk production and it was also beneficial in increasing fat component in milk.

Key words: brewers' spent grain pellets, soy bean meal, dairy cow, milk quality

Introduction

An important factor in dairy farming is feed as more than half of the production cost is from the feed. The common problem in farming dairy cows in the tropics is a shortage of feed with high protein sources as tropical forage has low levels of protein nutrients (Wanapat, 1995). When this forage is fed to the dairy cows, the cows then do not get enough nutrients required in the dairy production needs. Therefore, it is necessary to provide concentrated feed in order to increase nutritional intake to the dairy cows. The main protein source in the concentrated feed is soy bean meal, but this is expensive, resulting in high feed costs. The use of cheaper sources of protein but with nutritious qualities close to soy bean meal as a substitute can be a cost-cutting solution. By-products of the brewery such as drier brewers' spent grain have similar proteins to soy bean meal and also have high levels of protein flow (Merchen et al 1979, Rounds and Klopfenstien, 1975).

According to the previous studies, wet brewers' spent grain or drier brewers spent grain were used as a replacement for up to 15-16% of total feed (Dhiman et al., 2003; Cozzi and Polan, 1994). The form of feeding was to add it to the ready-mixed feed or mix it in concentrated feed to replace 23-30 percent of soy bean meal (Polan, 1994; Davis et al., 1983). However, there was not enough research on the use of brewers' spent grain pellets for dairy feed. Pelletizing may have a beneficial effect on the dairy farming, as it might help reduce losses, reduce chances of cows being picky about feed, and help keep the balance in the cows' ruminant stomach. As cows are a ruminant animal, it may cause cows to secrete more saliva which is good for their foregut fermentation digestion resulting in an increase in overall digestibility of nutrients. When the digestion is improved and the brewers' spent grain has a higher level of crude fiber than soy bean meal, when used as a raw material in concentrated feed and using a high level of concentrated feed for dairy feed, it might be beneficial in reducing the opportunity of high acidity in the ruminant stomach and may increase fat level in milk. The purpose of this research was to study the effect of replacing soy bean meal with brewers' spent grain pellets in dairy feed on feed intake, milk production, and milk quality.

Method

Animal subjects, experimental plans and management

8 dairy cows during the mid-lactation period (DIM 90) which have 75 percent of the Hochstein Friesian blood were randomly assigned to the test using a 4x4 double Latin square trial. Each animal would receive brewers' spent grains as a replacement for soy bean meal in concentrated feed formulas at substitution levels of 0, 60, 80 and 100 percent (levels in concentrated feed were 0, 20, 30 and 40 percent) respectively (Table 1). Cattle were given the concentrated feed at 1.8 percent of body weight. Rice hay was given as coarse feed ad libitum. Each cow was raised in a 2x4 meter corral with clean water and lump minerals to consume freely. The experimental period was divided into 4 trials, each trial took 21 days. The first 14 days were for animal adjustment and the last 7 days were the experimental period. Milking was done 2 times a day in the morning at 6:00 am and in the afternoon at 4:00 pm using the milking machine. The concentrated feed was mixed according to the experimental formulas every week.

Data collection and sampling

Data Collection: The changes of cows' weight were recorded by weighing them before entering the experiment period and on the last day of each experiment period in order to calculate the feed intake. The amount of coarse and concentrated feed was also recorded by weighing the food before feeding and weighing the remaining food (feed refusal) the next morning. The calculation of the feed intake was done every day along with the record of milk production.

Sampling: Concentrated feed was sampled every time it was mixed for animal husbandry. The concentrated and coarse feeds that were given and that were left on day 1, 7, 14, 15, 16, 17, 18, 19 and 20 of the experiment were randomly collected, weighed, and oven-dried at 60 degrees Celsius for 72 hours. After the drying process, the samples were

then weighed after to find the percentage of dry matter (% DM) and then ground to be analyzed for the chemical composition including DM, Ash and CP according to the method of AOAC (1990) and to analyze NDF and ADF according to the method of Goering and Van Soest (1970). The milk produced was sampled on day 20 and 21 of the experiment by collecting samples of morning and afternoon milk in the proportion of 60:40 and then analyzed for milk composition in order to check for milk quality by using a Mikoscan device.

Statistical data analysis

The data obtained from the experiment was analyzed using Variance Analysis (ANOVA) according to the experimental plan. Proc GLM was used to compare the mean values of the treatments using the Duncan's New Multiple Range Test.

Results and Discussion

The replacement of soy bean meal with brewers' spent grain pellets in concentrated feed formula did not affect the intake of coarse food, concentrated food, total intake and milk yield ($P > 0.05$) (**Table 2**) (**Table 3**). However, it was found that the use of brewers' spent grain pellets as a substitute for soy bean meal in concentrated feed made the fat level in the produced milk increase ($P < 0.05$) (**Table 3**). According to a report by Hoffman et al. (1988), it was possible to use drier brewers' spent grain in dairy feed at 21.5 percent of the total without affecting feeding and milk production, which was consistent with the result of this study as the calculations of the proportion of dry brewers' spent grain that animals consumed were approximately 24 percent of the total feed. However, using a high level of brewers' spent grain pellets might result in reduced consumption as reported by Faccenda et al. (2017) which in their study used 30 percent drier brewers' spent grains in all feeds and caused the intake of dry feed and the milk yield in dairy cows to be reduced. Using brewers' spent grain pellets to replace soy bean meal helped increase milk fat as the animals got more NDF fiber because the brewers' spent grain pellets contain higher NDF content than soy bean meal.

Conclusion

The results of this revealed that it was possible to replace soy bean meal with brewers' spent grain pellets in concentrated feed formula up to 100 percent without affecting the total feed intake and milk production and could also help increase fat content in the milk.

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Table 1. Ingredients and chemical composition of the diet used in the experiment

Item	Level of replacing in concentrate (%)				Rice straw
	0	60	80	100	
Cassava chip	61.0	54.2	49.3	44.7	-
Rice bran	10.1	9.6	9.3	8.2	-
Soybean meal	20.5	8.2	3.8	0.0	-
Brewers' spent grains pellets	0.0	19.8	30.0	39.8	-
Molasses	3.8	3.8	3.5	3.2	-
Urea	2.3	2.2	2.1	2.0	-
Salt	0.9	0.9	0.9	0.9	-
Sulfur	0.4	0.4	0.4	0.4	-
Mineral mix	0.9	0.9	0.9	0.9	-

Chemical composition (% DM)					
Dry matter	96.6	96.7	96.6	96.7	93.6
Organic matter	93.6	94.8	93.1	94.1	87.6
Crude protein	18.0	18.1	18.2	18.5	3.1
Neutral detergent fiber	43.4	48.8	54.2	59.7	72.1
Acid detergent fiber	12.8	16.4	18.6	23.4	54.1
Ash	6.4	5.2	6.6	5.9	12.4
Total Digestible Nutrient*	74.8	74.7	74.7	74.5	44

* From calculation

Table 2. Effect of replacing soy bean meal with brewers' spent grain pellets in dairy feed on feed intake in dairy cow

Item	Level of replacing in concentrate (%)				SEM	P-value
	0	60	80	100		
DM intake						
Rice straw						
kg/d	6.29	6.31	6.22	6.18	0.11	ns
%BW	1.27	1.24	1.25	1.25	0.02	ns
Concentrate						
kg/d	8.97	9.15	9.02	9.03	0.04	ns
%BW	1.80	1.80	1.80	1.80	0.00	ns
Total intake						
kg/d	15.25	15.53	15.24	15.21	0.14	ns
%BW	3.08	3.08	3.05	3.05	0.07	ns

Table 3. Effect of replacing soy bean meal with brewers' spent grain pellets in dairy feed on milk production and milk quality in dairy cow

Item	Level of replacing in concentrate (%)				SEM	P-value
	0	60	80	100		
Milk yield kg/d	11.22	12.03	11.85	12.08	0.80	ns
Milk composition						
Fat	3.40 ^b	3.99 ^{ab}	4.59 ^a	4.58 ^a	0.29	**
Protein	3.39	3.33	3.59	5.28	1.19	ns
Lactose	5.04	5.01	5.42	5.34	0.35	ns
Solid not fat	9.10	9.15	9.70	9.74	0.61	ns