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Effect Of Supplementation With Different Proportions Of Breweries Dried Grain And Maize Bran Mixtures On The Performance Of Crossbred Dairy Cows

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ABSTRACT: Effect of supplementation with different proportions of breweries dried grain and Maize bran mixtures on feed intake, digestibility, milk yield and milk composition of crossbred dairy cows were assessed at Holetta Agricultural Research Center by using five crossbred cows of similar milk yield (8-10 kg/d), body weight (355+47), age of lactation (early lactation), but differ in parities arranged in 5*5 single Latin square design; being started at December/2010 and finished at March/2011. Experimental animals were fed ad libitum natural pasture hay basal diet and supplemented with different treatments; T1 = Concentrate mix that consisted 65% wheat bran, 33% noug (Guizotia abysinica) seed cake and 2 % salt, T2 = 20% breweries dried grain (BDG) + 78% maize bran (MB) + 2% Salt ; T3 = 38% BDG + 60% MB + 2% Salt ; T4 = 58% BDG + 40% MB + 2% Salt and T5 = 78% BDG + 20% MB + 2% Salt. Laboratory analysis of experimental feeds showed that all ingredient feeds except maize bran had adequate CP content required for moderate level of ruminant production, which is greater than 15%, a level that is usually required to support lactation and growth. Dry matter and metabolisable energy intakes were the same in all groups while basal diet and crude protein intakes were significantly different where by cows maintained on T1 ration consumed high basal intake with the average daily intake of 8.04 kg/d. Similarly, significantly higher (P<0.001) CP intakes were recorded for T1 and T5 groups with the average value of 1.56 and 1.54 kg/d, respectively. Treatment effects were also non-significant (P>0.05) for apparent dry matter digestibility and apparent acid detergent fiber digestibility, but significance difference (P<0.05) existed for apparent crude protein digestibility, apparent metabolisable energy digestibility and apparent neutral detergent fiber digestibility whereby animals consumed T5 concentrate diet digest higher (P<0.01) CP than those on T2, T3 and T4. In addition to this, animals that received T3 and T5 concentrate diet digested higher (P<0.05) NDF than those consumed T1 concentrate diet. Milk yield, milk protein, lactose and total solids were not affected by experimental rations, but significant variation was existed for milk fat between animals fed with the different experimental rations whereby cows consumed T1 gave milk with high (P<0.05) fat of 4.62% when compared to T2 (4.14%) and T5 (4.06%). The average daily milk yields were 10.28, 9.72, 10.20, 10.66 and 10.79 kg in T1, T2, T3, T4 and T5, respectively. Economic analysis showed that T5 concentrate diet was economically feasible than the control group and the remaining dietary treatments. However, due to significantly lower milk fat in T5 than the control, it can be concluded that breweries dried grain and maize bran mix at the proportion of 58% BDG +40% MB+2% Salt (T4) can be proposed as alternative concentrate diet for the control (T1) for lactating dairy cows.

Key words: feed intake, diet digestibility, milk yield, crossbred dairy cows

1 INTRODUCTION

Mohamed et al. (2004) showed the development of the milk sector in Ethiopia can contribute significantly to poverty alleviation and improved nutrition of the rural community. However, rate of livestock productivity is very slow and lag behind the growth of the population mainly due to insufficient supply of feeds (both quantity and quality) and poor management practices. Inadequate nutrition (both in quantity and quality) among milking animals, especially during the dry season, is considered to be the major limitations to dairy productivity. This is because the quality of feed, particularly available forage, which is the major feed resources, fluctuates with season and its availability is limited. Green feeds, mainly grasses which are mostly annuals, are nutritious at the beginning of the rainy season and commonly utilized in the large peri-urban dairy farms. However, its use is limited to the rainy season only. Though cereal grains are important as concentrate feeds, they are not usually used as animal feed in Ethiopia, because the quantity produced in the country has not yet satisfied the demand for human consumption. In addition, cereal crop residues that are used to augment the year round ruminant feed budget are of low nutritive value and cannot fulfill the nutrient requirement of livestock even at maintenance level. Thus, the nutritional requirements of dry-pregnant and lactating cattle for milk synthesis and let-down are not sufficiently met. It is therefore imperative to explore for alternative, highly nutritive feed resources that could increase the total dry matter intake of fibrous feed and eventually enhance productivity. Ketema and Tsehay (1995) showed that one of the feasible method by which the low quality feed utilization can be enhanced is through supplementation of agro-industrial by-products, which are the main feed sources utilized in the urban and peri-urban dairy production systems. Nowadays, noug seedcake and wheat bran/middling blend are invariably used across all the urban and peri-urban production systems in Ethiopia. However, the cost of noug seedcake and wheat bran is becoming increasingly expensive may be due to high grain price (shortage of raw materials) and competition due to less diversified animal feed in the country. The ever escalating concentrate price may continue for the coming few years and go beyond the farmer's ability to use it as animal feed, unless otherwise alternative options that can be used as energy and protein source as an alternative option to wheat bran and noug seedcake are designed in due time. Maize bran and breweries dried grain are among the agro-industrial by-products that can be used as energy and protein source in the absence of wheat bran and noug

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seedcake mixture, and can be used to alleviate the problem of inadequate nutrition and boost the productivity of dairy cattle. CSA (2010) showed that maize is a leading cereal crop with a production of 38.97million quintals accounting for 21.56% of the grain production (180.76 million quintals) and yields of 21.99 qt /ha in Ethiopia. The amount of maize bran produced is about 20% of the maize grain milled. This gives a potential of 7.79 million quintals of maize bran production, if all of the maize grain produced would be milled. Similarly, the expansion and newly emerging brewery industries in the country will remarkably increase the supply of breweries spent grain. According to Varela-Alvarez (2006), the annual production capacities of breweries by-product from different breweries in Ethiopia were 67365 MT, excluding the 3356 tons DM of dried brewery spent grains produced from Kombolcha and Dashen brewery factories. But, information on the use of maize bran in mixture with some protein supplement feeds, such as breweries dried grain in the diet of dairy cattle under Ethiopian condition is not evaluated. Therefore, the objectives of this study were:

- To assess the effect of supplementation with different proportions of breweries dried grain and Maize bran mixtures on feed intake, digestibility, and milk yield and milk composition of crossbred dairy cows fed natural pasture hay basal diet.

2 MATERIAL AND METHODS

2.1 Study Area and Management of Experimental Animals

The study was conducted at Holetta Research Center. The center is located at 93o N latitude and 38o 30' E longitude at an altitude of 2400 masl. The mean annual rainfall is 1000 mm and the mean minimum and maximum temperatures are 6oC and 22oC, respectively. A total of five lactating F1 crossbred cows (Boran x Fresian) with similar lactation performance (daily initial milk yield of 8-10 l/ head), same stage of lactation (early lactation), but differ in parities, ranging from 1 to 6 were selected from the dairy herd of experimental station. The cows were periodically treated for external and internal parasites and vaccinated for the major diseases. The calves were separated from their dams five days after parturition.

2.2 Feed Preparation and Feeding

Natural pasture hay was made before it is matured, sun dried, baled and stored under a hay shade and used as basal diet throughout the experimental period. The wet breweries grain was sun dried and thoroughly mixed with maize bran based on the proposed proportion. The basal feed offer was adjusted daily by allowing 20% of refusal from previous day's intake. Water and mineral blocks were available at all time. The quantity of concentrate mix offered daily was at the rate of 0.5 kg/l of milk produced by each cow and offered with equal portions at 5:00 am and 5:00 pm during the morning and evening milking time, respectively. Representative and composite samples of all experimental feeds were taken for laboratory analysis.

2.3 Experimental Design, Treatments and Measurements

The five experimental treatment diets were randomly assigned to the five cows in a 5*5 Single Latin Square Design composed of 7 days of adaptation and 14 days of measurement period. The experimental animals were then randomly allotted to one of the five dietary treatments given below:

T1: Concentrate mix (0.5 kg/l of milk) + ad libitum natural pasture hay (control)

T2: 20% BDG + 78% MB + 2% Salt + ad libitum natural pasture hay

T3: 38% BDG + 60% MB + 2% Salt + ad libitum natural pasture hay

T4: 58% BDG + 40% MB + 2% Salt + ad libitum natural pasture hay

T5: 78% BDG + 20% MB + 2% Salt + ad libitum natural pasture hay

The concentrate mix was composed of 65% wheat bran, 33% noug seed cake and 2% salt. The daily feed offered to experimental animals and the corresponding refusals were measured and recorded daily to determine daily feed intake. Feed offer and refusal samples were taken daily per cow, bulked on a weekly basis, sub-sampled and oven dried at 65 ˚C for 72 hour. Samples were then ground in laboratory mill to pass through 1 mm sieve and kept at room temperature in sealed plastic bags until required for laboratory analysis.

2.4. Apparent digestibility

Apparent digestibility of treatment diets were determined using total fecal collection methods for a period of 7 consecutive days in each period. Contamination of feces with urine was minimized by frequent washing of the concrete floor with high pressure running water using a plastic water hose. Daily feces collection per animal was weighed, thoroughly mixed and a sample of 1% was taken and stored in a deep freezer at -4 ºC. At the end of the collection period, the 7 days pooled samples were subsequently thawed and mixed thoroughly. Subsamples were taken and oven dried at 105oC for 24h to determine DM content. Another sample was oven dried at 65oC for 72 hour for chemical analysis. Apparent digestibility of DM or nutrients was determined using the formula;

$$\text{Apparent DM digestibility} = \frac{\text{DM intake-Fecal DM excreted}}{\text{DM intake}} *100$$

$$\text{Apparent Nutrient Digestibility(\%)} = \frac{\text{Nutrient intake- Nutrient in feces}}{\text{Nutrient intake}} *100$$

2.5. Chemical Analysis

Chemical analysis of the experimental feeds, refusals and feces were carried out after taking representative samples. DM, OM, and N (Kjeldahl-N) content of samples of feed offered, refusal and feces were analyzed according the procedures of proximate analysis method of the AOAC (1990). Neutral detergent fiber (NDF), Acid detergent fiber (ADF) and acid detergent lignin (ADL) was analyzed according to the procedure of Van Soest and Robertson (1985). *In vitro* organic matter digestibility was determined

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using procedures outlined by Tilley and Terry (1963). Gerber method (AOAC, 1990) was used for milk fat analysis, while the formaldehyde titration method (Pyne, 1932) was used to analysis milk protein. Total solid in the milk was determined using the procedures outlined by Richardson (1985). NIR-Infrared milk product analyzer (user manual ver. 1.1, 2000) was used for lactose determination.

2.6 Statistical Analysis

Analysis of variance of experimental data was run using the general linear model in SAS (2004). The treatment means were separated by using Least Significant Difference (LSD). The Model used for the analysis of data was:

$Y_{ijkl} = \mu + C_i + P_j + T_k + E_{ijkl}$,

Where; μ = overall mean; C_i = cow effect; P_j = period effect; T_k = treatment effect; E_{ijkl} = random error

3 RESULTS

3.1 Chemical Composition of Experimental Feeds

The DM and OM contents of the experimental feeds were high and almost greater than 90% for all experimental diets. The neutral detergent fiber (NDF) concentration showed much variation with the highest value recorded for the natural pasture hay followed by BDG, MB, WB and NSC while the highest ADF concentration was recorded in natural pasture hay followed by WB, BDG, NSC and hay. However, the lignin content was higher in BDG which contained 0.3%, 1.4%, 5.7% and 6.2% more lignin when compared to NSC, hay, MB and WB, respectively. Crude protein and ME concentration were found to be lower in hay, which contained 1.2, 2.2, 3.4 and 4.0 times less CP and 1.7, 1.4, 1.3 and 1.2 times lower ME concentrations as compared to MB, WB, BDG and NSC, respectively.

Table 1. *Chemical composition of experimental feeds*

Chemical composition	Hay		WB	NSC	MB	BDG
	Offer	Refusal	Offer			
DM (%)	93.10	93.04	90.22	92.24	89.35	92.46
OM (%)	91.25	91.41	95.34	92.57	98.92	95.86
CP (%)	7.43	7.54	16.06	29.89	8.82	25.05
NDF (%)	71.98	70.94	42.85	35.56	47.28	65.50
ADF (%)	40.05	39.84	12.03	31.14	11.00	28.15
Hemicelluloses (%)	31.93	31.10	30.82	4.42	36.28	37.35
Lignin (%)	6.78	6.45	2.02	7.89	2.47	8.20
IVOMD (%)	52.14	51.99	74.06	64.67	89.30	67.44
EME (MJ/kg DM)	8.34	8.32	11.85	10.35	14.29	10.79

* DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; IVOMD = in vitro organic matter digestibility; EME= Estimated metabolisable energy (0.16 * IVOMD) as cited in McDonald et al. (2002), WB = wheat bran; NSC = noug seed cake; MB = maize bran; BDG = breweries dried grain

3.2 Feed Intake and Digestibility

Dietary treatment did not result in significant difference ($P > 0.05$) for TDMI, but significantly ($P < 0.01$) affected the basal feed intakes of animals. Cows maintained on control (T1) had consumed significantly high ($P < 0.01$) hay than cows fed on other dietary treatments, which consumed 25%, 18.9%, 17.9% and 11.4% more hay over T2, T3, T4 and T5, respectively. Total DM intake across all dietary treatments seems to have followed the same trend as hay intake though there is no significance difference ($P > 0.05$) between dietary treatments. The intake of hay was 2.3%, 1.8%, 1.9%, 1.9% and 2.0% of body weight and total DM intake was 3.6%, 3.1%, 3.2%, 3.3% and 3.4% of body weight for T1, T2, T3, T4 and T5, respectively. Total CPI was significantly higher ($P < 0.001$) for cows on T1 and T5 rations over other dietary treatments. Unlike total CPI, dietary treatment did not ($P > 0.05$) affect the ME intakes of animals. Neutral detergent fibre intakes was higher ($P < 0.05$) for cows supplemented with T5 compared to T2 and T3. Cows in T1 had higher ($P < 0.001$) ADF intake compared to T4, T3 and T2.

Table 2. *Dry matter and nutrient intakes of crossbred cows fed different concentrate mixture supplements as treatment feeds and natural pasture hay basal diet*

Feed intake (kg/d)	T1	T2	T3	T4	T5	Mean	SEM
Hay DM intake	8.04a	6.43c	6.76bc	6.82bc	7.22b	7.05	0.62
Total DM intake	12.80	11.13	11.44	11.58	11.92	11.77	0.72
CP intake	1.56a	1.04d	1.19c	1.37b	1.54a	1.34	0.07
ME intake (MJ/d)	119.99	116.07	115.61	113.83	113.21	115.74	0.07
NDF intake	7.67ab	6.98c	7.36bc	7.62abc	8.04a	7.53	0.39
ADF intake	4.08a	3.24d	3.52dc	3.72bc	4.03ab	3.72	0.26

abc means with different superscripts within row are significantly different ($P < 0.05$): DM = dry matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ME= metabolisable energy; SEM = standard error of means;

The apparent digestibility of DM was not significantly different ($P > 0.05$) among all treatments considered (Table 3). The digestibility of CP in T5 was higher ($P < 0.01$) than the other dietary treatments except T1 while the digestibility of ME in T3 was higher ($P > 0.05$) than in T1 and T4. Cows supplemented with T3 and T5 digest more ($P < 0.05$) NDF over the control group. However, dietary treatments failed to exhibit differences ($P > 0.05$) in terms of apparent acid detergent fiber digestibility.

Table 3. *Effect of different concentrate mix supplements on*

apparent digestibility of experimental diets by crossbred dairy cows fed ad libitum natural pasture hay

	T1	T2	T3	T4	T5	Mean	SEM
ADMD (%)	62.1	62.9	66.6	61.0	64.2	63.3	1.62
ACPD (%)	69.2 ab	60.3 c	67.9 b	67.5 b	72.7 a	67.5	1.41
AMED (%)	84.4 b	86.3 ab	87.2 a	84.8 b	85.6 ab	85.7	0.64
ANDFD (%)	55.5 b	58.4 ab	63.6 a	58.3 ab	62.8 a	59.7	1.81
AADFD (%)	38.2	34.2	44.2	37.3	45.5	39.9	3.09

abc = Means with different superscripts within row are significantly different (P < 0.05); T1= 65% WB + 33% NSC + 2% salt + ad libitum natural pasture hay; T2 = 20% BDG + 78% MB + 2% salt + ad libitum natural pasture hay; T3 = 38% BDG + 60% MB + 2% salt + ad libitum natural pasture hay; T4 = 58% BDG + 40% MB + 2% salt + ad libitum natural pasture hay; T5 = 78% BDG + 20% MB + 2% salt + ad libitum natural pasture hay; SEM = standard error of means; ADMD = Apparent dry matter digestibility; ACPD = Apparent crude protein digestibility; Apparent metabolisable energy digestibility; ANDFD = Apparent neutral detergent fibre digestibility; AADFD = Apparent acid detergent fibre digestibility

3.3. Milk Yield and Composition

Dietary treatment did not result in significant difference (P > 0.05) for milk yield, although cows on T5 diet tended to have slightly higher milk yield of 4.96%, 11.01%, 5.78% and 1.22% than T1, T2, T3 and T4, respectively. Milk yield seemed to have declined with an increase in maize bran proportion in the total ration (Table 4). In general, cows on all dietary treatment able to retained the average milk yield of 10.35 kg/d for the entire lactation period of 105 days. Treatment effects were also non-significant (P > 0.05) for all milk composition parameters considered except for milk fat. However, there seems to be numerically small linear increments from T1 to T5 for milk protein and T2 to T5 for lactose. Unlike milk protein, lactose and total solids, a significant variation existed for milk fat whereby cows supplemented with both T1 and T3 had higher (P < 0.05) fat percentage than cows fed on both T2 and T5. But, there was no significant (P > 0.05) difference for fat percentage among T1, T3 and T4.

Table 4. *Average daily milk yield and milk composition of crossbred dairy cows fed natural pasture hay basal diet and supplemented with different concentrates*

Treatment	Milk yield (kg/d)	Milk composition Fat (%)	Protein (%)	Lactose (%)	Total solids (%)
T1	10.28	4.62a	2.33	4.70	14.28
T2	9.72	4.14b	2.36	4.60	12.90
T3	10.20	4.48a	2.51	4.70	12.94
T4	10.66	4.32ab	2.52	4.80	12.92
T5	10.79	4.06b	2.53	4.90	12.52
Mean	10.33	4.32	2.45	4.74	13.11
SEM	0.46	0.14	0.11	0.06	0.47

abc = within column, means with different superscripts are significantly different (P<0.05); T1= 65% WB + 33% NSC + 2% salt + ad libitum natural pasture hay; T2 = 20% BDG + 78% MB + 2% salt + ad libitum natural pasture hay; T3 = 38% BDG + 60% MB + 2% salt + ad libitum natural pasture hay; T4 = 58% BDG + 40% MB + 2% salt + ad libitum natural pasture hay; T5 = 78% BDG + 20% MB + 2% salt + ad libitum natural pasture hay; SEM = standard error of means; WB = wheat bran, NSC = noug seed cake, MB = maize bran and BDG = breweries dried grain

4 DISCUSSIONS

4.1. Chemical Composition of Experimental Feeds

The concentrate mix (wheat bran and noug seedcake) and breweries dried grain have CP contents greater than 15%, a level that is usually required to support lactation and growth (Norton, 1982). However, the CP concentration of maize bran was lower than 15%, which indicate that it is inadequate to support lactation unless supplemented with other protein sources. Both breweries dried grain and noug seed cake are a good source of protein supplement feed ingredients for dairy cows due to its higher protein contents relatively. Furthermore, all ingredient feeds except BDG have NDF values lower than the level (55% NDF) above which voluntary feed intake is limited (Van Soest, 1965). Similarly, based on Singh and Oosting (1992), the concentrate mix (wheat bran and noug seedcake) used in the present study fall in the category of high quality feeds while maize bran with the NDF value of 47.28% can be categorized as medium quality feeds. However, the slightly higher NDF content in BDG categorize this supplement as low quality feeds. The CP content of natural pasture hay in the present study was within the range (6-8%) below which appetite and forage intakes are depressed (Forbs, 1995) and within the range (7.0-7.5%) required for maintenance of animals (Van Soest, 1994).

4.2 Feed and Nutrient Intakes

The increment of total CP intake and dry matter intake as the proportion of breweries' dried grain increased in the present study was in agreement with the finding of Mulu (2005). The depression in the basal diet intake, total DM intake and total CP intake observed for T2 compared to the other dietary treatments may be attributed to the high energy content of T2 which was consistent with the general idea that animals consume to meet their physiological energy demand. In other words, if feeds are sufficiently palatable, the main dietary factor that controls voluntary feed intake is dietary energy concentration (Cheeke, 1999). The other reason for the depression of nutrient intake (DM intake , CP intake and basal intake) might be due to the relatively low CP content of dietary treatment which is consistent with the finding that supplementation of low protein hay with low protein concentrate depressed the hay intake of cattle, while high protein concentrate stimulated hay intake (Elliott, 1967a). The ME intake in all treatments of the present study was higher than estimated daily ME

(97.6 MJ/head/day) requirement of lactating cows weighing 400 kg and producing 8-10 kg milk with 4.5% butter fat (ARC, 1990). When compared to the daily requirement of cows yielding 8-10 kg milk of 4.5% butter fat, there is still an advantage of 22.39, 18.47, 18.01, 16.23 and 15.61 MJ/d for T1, T2, T3, T4 and T5, respectively. As far as protein requirement is concerned, the CP intake in all treatments of the present study was higher than the estimated daily allowance of CP (866.5 g/d) requirement of lactating cows producing 8-10 kg of milk yield per day with 4.5% butter fat (ARC, 1990). It could be realized from the present study that CP intake was not at all a limitation to the estimated (8-10 kg/d) milk yield. When compared with the estimated daily allowance of CP (866.5 g/d), there is an extra allowance of 0.69, 0.17, 0.32, 0.50 and 0.67 kg/d for T1, T2, T3, T4 and T5, respectively.

4.3. Apparent Dry Matter and Nutrient Digestibility

The apparent DM digestibility coefficient of treatment feeds in the present study were in agreement with the finding of Emebet (2008), who reported non-significant difference for dry matter digestibility among the supplemented groups of blackhead Ogaden sheep fed haricot bean haulms with mixtures of wheat bran and breweries dried grain. The higher ($P < 0.01$) digestibility of CP in T5 supplemented animals compared to T2, T3 and T4 in the present study could be attributed to the higher supply of dietary protein which was comparable with the findings of McDonald et al. (2002) who noted better CP digestibility due to high CP intake. It has been reported that increasing CP in the concentrates increased the digestibility of CP (Hirut, 2008). In addition, Ranjhan (1997) reported that the level of protein may influence the digestibility of feed and higher level of protein may improve the apparent digestibility of feeds. Similarly, Sievert and Randy (1993) reported the significantly higher ($P < 0.001$) total apparent digestibility of CP due to the higher dietary CP content. The insignificant variation among the different proportion of breweries dried grain and maize bran supplemented groups for apparent neutral detergent fiber digestibility and between different treatment diets for apparent ADF digestibility in the present study was comparable with different research results. Kaitho et al. (1998) indicated that supplementation had little or no effect on fiber digestibility. Similarly, Ash and Norton (1987b) reported that high protein diets had no effect on the digestibility of ADF and NDF.

4.4 Milk Yield and Composition

Milk yields of all experimental cows except those maintained on T2 in the present study were higher than the requirements of the projected milk yield (8-10 kg/d) with 4.5% butterfat content of cows weighing 400 kg body weight (ARC, 1990) when supplemented with concentrate ration at the rate of 0.5 kg/l of milk. However, the milk yields of cows received T2 was within projected range (ARC, 1990). Protein requirements and ME intakes were observed to be fully met by dietary treatments and slightly higher than the CP and ME projected by ARC (1990) (Table 2). The higher energy and protein intake of lactating crossbred dairy cows greater than those described by ARC (1990) in the present study resulted in mean daily milk yield of 10.33 kg/d, which is slightly higher than the range (8-10kg/d) documented by ARC (1990). Milk yield and milk protein constituent in the current experiment increased as the proportion of breweries dried grain in the total ration increased and numerically highest for cows maintained on T5 possibly because the diet had high proportion of breweries dried grain which contain high amount of undegradable protein essential for building up body reserves needed for milk synthesis during lactation. This was comparable with the finding that noted dried breweries grains contain high amount of undegradable protein, which make them a good source of rumen by-pass protein (Merchen et al., 1979) that remains intact and becomes available in the abomasum and small intestine where they are utilized by the animals. This apart, the supplement contained BDG which has high amount of undegradable protein, making them a good source of rumen by-pass protein (Chiou et al., 1998) and the use of increased amount of rumen undegradable protein (by-pass protein) from dietary concentrates increased milk yield because of improved protein supply and improved intake of metabolisable energy from the concentrates which is agreed by the report of Cunningham et al. (1996). However, the low daily milk yield recorded in T2 might be due to the low DMI coupled with low total CPI of cows supplemented with diets of those treatments. The high milk protein content observed for T5 in the current study compared to others could be attributed to the high protein intakes of the cows (Table 3) which has been reported to increase milk yield and milk protein concentration. This is in agreement with the findings of Phipps (1994). However, the level of CP intake didn’t significantly ($P > 0.05$) affect the concentration of milk protein. Increased dietary protein levels often increase ration digestibility and feed intake, thus increasing a cow's energy status and milk yield. In this situation, protein yield may be increased through increased milk production while milk protein percentage may not be affected as it is reported by Murray (1992). The decreased milk fat percentage in animals maintained on T2 in the present study was consistent with the findings of Janicek et al. (2007) who reported decreased milk fat percentage by 0.26% with increased corn bran inclusion from 10 to 25% of the diet DM, but total milk fat yield was not affected. The author noticed the decreased milk fat percentage with increasing inclusion of corn bran related to the high fat content and rich source of linoleic acid of the diet. A build up of the unsaturated fatty acid, linoleic acid, in the rumen may lead to events that can cause milk fat depression which is in agreement with the report of Baumgard et al. (2000). In addition to this, it might be also the higher energy content of the diet when compared with other dietary treatments used for the study. Increasing the energy content of the diet by feeding concentrate will decrease forage (fiber) intake which lead the depression of fat percentage. The decreased milk fat percentage with increasing proportion of BDG in the present study might be the high fat (EE) composition, total long chain fatty acids and total unsaturated fatty acids of the feed. According to Solomon (2007), the EE of Brewers grains were 6.30. If the diet contains over 5-6% and there are large amounts of unsaturated fatty acids, the bio-hydrogenation increased leading to milk fat depression which was also similar with the report of Dhiman et al. (1999). Similarly, Mahnken (2010) showed that, the short and medium chain fatty acids were decreased with increasing brewery spent grain

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inclusion. In other words, total long chain fatty acids and total unsaturated fatty acids were increased with increasing brewery spent grain inclusion. Increased amounts of long chain fatty acids supplied in the diet can inhibit de novo synthesis. As a consequence decreased quantities of short and medium chain fatty acids may be the outcome which contributes a reduction in milk fat percentage. The absence of significant difference for milk lactose and total solids in the present study was in agreement with the findings of Varga and Ishler (2008) who reported that concentrations of lactose, minerals and other solids constituents of milk do not respond predictably to adjustments in diet.

5 CONCLUSIONS

It can be judged from the present study that the different proportion of concentrate mixture used in the current study contained sufficient amount of energy and protein feeds above the level recommended in ARC (1990), and sufficient enough to support the projected milk yield (8-10 kg/d). Therefore, it can be concluded that supplementing low quality basal diets with breweries dried grain and maize bran could be alternative sources of dairy feed supplements to provide adequate and required amount of protein and ME for dairy animals. Thus, it can be concluded that the different proportion of breweries dried grain and maize bran mixtures in the present study have a potential to replace the concentrate mix (T1) without significant reduction in milk yield of lactating crossbred cows fed a basal diet of natural pasture hay and able to support the observed milk yield (10.33 kg/d).

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