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Effect of Ensiled Barley Distillers' Grains for Holstein Dairy Cows

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Abstract: An experiment was carried out to evaluate the substitution of Barley distillers' Grains (BG) ensiled by different level molassed sugar Beet Pulp (BP) with of corn silage on milk production and health of dairy cows. A total 18 Holstein dairy cows (86±10 days postpartum 600±20 kg BW), were randomly assigned to 3 treatments in a balanced completely randomized design (repeated measures). Three diets were formulated to evaluate the replacement of 30% corn silage by an ensiled mixture of BG with and without BP. Treatments were an ensiled mixture of 60% BG with 40% BP (BGBP40%), an ensiled mixture of 80% BG with 20% BP (BGBP20%) and BG ensiled without BP (BGBP0%). Experimental diets contained, 40% forage (60:40, corn silage: Alfalfa hay) and 60% concentrate. Cows were fed a total mixed ration and milked 3 times daily. Diet concentrations of NDF, ADF and CP were 33.2, 19.6 and 16.4% DM (for BGBP40%), 33.7, 20 and 16.8% DM (for BGBP 20%) and 33.8, 20.5 and 16.8% DM (BGBP 0%), respectively. The feed intakes, daily milk yield and milk composition were not significantly different between treatments. There was no significant effect of treatments on rumen pH and NH3-N. Also, there was no significant effect on blood plasma metabolites. Partial substitution BG ensiled with or without BP for corn silage did not have any negative effect on the performance of Holstein dairy cows.

Key words: Barley distillers' grains, molassed sugar beet pulp, dairy cows, silage, BG, BP

INTRODUCTION

An important objective for farmer in to promote the use of non-conventional local feedstuffs for animal in order to reduce costs (Lanza *et al*., 2001). Agro-industrial by-products are typically high in fiber and low in starch with some variation in protein content based on source and processing method. Barley distillers' Grains (BG) are a co-product of the distillers' industry. This agro-industrial by product can be sold as a wet form (70-80% water) or as a dried form (8-10% water). Escalating of energy expenditure has led to large amounts of BG being marketed in wet form. The shelf life of the wet material is restricted to a few days, especially in warm weather. The incorporation of these by-products has helped solve available problems associated with some industries and reduced the quantity of feed grains required in animal production. BG has a high palatable protein (approximately, 23% CP with a relatively high RUP) and fiber sources for livestock. Besides its protein and fiber value, BG are best suited to extending forage/roughage supplies when good quality corn silage and hay are not readily available at competitive prices. Although, the nutritional value of these by-products in a dry form has been investigated extensively, little information is available from wet form of BG in animal nutrition. A practical concern in utilization of BG is rapid molding and spoilage within a few days after production. Preservation of BG through ensiling has been verified, but data are not available on feeding value or palatability of ensiled BG for lactating dairy cows. Although, dried BG is easy to store due to its low moisture content but, drying increase additional costs. Several researchers have studied the feeding value of BG for dairy cows. McKendrick *et al*. (2003) ensiled BG with BP very well. Also, the storage of BG was evaluated by Hyslop *et al*. (1989) and the most successful method, in terms of reduction of DM losses, was their ensilage with BP. BP has been used as fermentation stimulant and decreasing moisture in silo. Ensiled mixtures of BG and BP can be used to replace conventional concentrates for cows giving moderate yields without serious loss of production (McKendrick *et al*., 2003). Younker *et al*. (1998) reported BG can be substituted for forage on a short-term basis Based on milk production and DMI. Also, they found that Dry matter intake was depressed when BG replaced both forage and concentrate (23.5% BG) and was depressed more when BG replaced only concentrate (11.75% BG).

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Cozzi and Polan (1994) substituted the partial of soybean meal with corn gluten meal or dried brewers' grains in the diet of Holstein dairy cows and they found that relative to cows consuming soybean meal diets, cows consuming dried brewers' grains diets produced 4 kg or 13% more milk. Also, Seymour and Polan (1986) observed an advantage of 1 kg day^{-1} in milk production (average = 31.8 kg day^{-1}) for dried brewers' grains diets compared with soybean meal diet. Dried distillers grains derived from a mix of 65% barley and 35% corn is an acceptable protein supplement for dairy cows and the high NDF content of this feed does not restrict intake as compared to soybean meal-based diets (Weiss *et al*., 1988). The present experiment was, therefore, undertaken to investigate the response of dairy cattle performance with ensiling BG with different level of BP.

MATERIALS AND METHODS

Animals and treatments: The study was conducted from February 20th to April 29th, 2008 in Ferdowsi (Mashhad-Iran) University Dairy Cattle Research Unit. Eighteen Holstein dairy cows (7 primiparous and 11multiparous (86±10 days postpartum 600±20 kg BW) were assigned to 3 groups of 6 cows in balanced completely randomized design (repeated measures). The groups of animals were balanced for milk yield and live weight of the week prior to the start of experiment. At the beginning of the experiment, the mean milk yield and live weight were 31.71 (S.D., 7.62) kg day^{-1} and 617.66 (S.D., 64.39) kg, respectively. The experimental period was 10 weeks, with first 2 weeks were assigned as an adaptation period. Cows were housed in a tie-stall barn and fed individually.

Sampling was repeated 2 weeks interval. Treatments consist of ensiled BG with different level of BP and provided by this instruction: 60% BG + 40% BP on DM basis (BGBP40%), 80% BG + 20% BP (BGBP20%) and 100% BG + 0% BP on DM basis (BGBP0%). These silages were substituted with 30% of corn silage in TMR ration.

Chemical composition of BGBP silages are shown in Table 1. Experimental diets contained, 40% forage (60:40, corn silage: Alfalfa hay) and 60% concentrate. Cows were fed 5-10% more than their anticipated intake on an as-fed basis. Access to water was provided at all times. Cows fed total mixed ration at three times daily after milking (6:00, 14:00 and 22:00 h). Ingredient composition of the diets is shown in Table 2. Diets had similar ingredient composition, except that 30% (DM basis) corn silage was substituted with mentioned silages above. Diets were formulated to meet the nutrient requirements of cows producing 30 kg of 3.5% milk fat and 3% milk protein day^{-1} according to NRC (2001) recommendations. BG was supplied by the Niro malt company (Mashhad).

Table 1: Chemical composition of ensiled barley distillers' grains

Composition (%)	[1]BGBP40(%)	[2]BGBP20(%)	[3]BGBP0(%)
DM	33.00±.0.06	30.00±.0.05	30.00±0.04
CP	18.15±0.60	24.19±0.60	24.38±0.30
NDF	44.50±0.41	51.00±0.50	52.16±0.40
ADF	37.35±0.47	32.25±0.57	39.95±0.42
Ether extract	2.35±0.50	3.84±0.40	5.11±0.50
ASH	9.66±0.00	9.33±0.00	8.00±0.00

[1](40% molassed sugar beet pulp+60% barley distillers' grains) (DM basis), [2](20%molassed sugar beet pulp+80% barley distillers' grains) (DM basis), [3](0%molassed sugar beet pulp+60% barley distillers' grains) (DM basis)

Table 2: Ingredient and chemical composition of experimental diets

	Diet[1] (DM%)		
Composition	BGBP40	BGBP20	BGBP0
Ingredient			
Alfalfa hay[2]	15.37	15.37	15.37
corn silage[2]	16.81	16.81	16.81
40% BP+60% BG silage[3]	7.20	0.00	0.00
20% BP+80% BG silage	0.00	7.20	0.00
0% BP+100%BG silage	0.00	0.00	7.20
Barley grain, rolled	4.80	4.80	4.80
Corn grain, ground, dry	21.61	21.61	21.61
Soybean, meal, solV,44%CP	8.65	8.65	8.65
Canola meal, mech. extract	8.65	8.65	8.65
Wheat bran	8.41	8.41	8.41
Beet sugar pulp, dried	7.68	7.68	7.68
Calcium carbonate	0.29	0.29	0.29
Vitamin and mineral mix[4]	0.29	0.29	0.29
Salt	0.24	0.24	0.24
Chemical			
DM	49.86	49.33	49.33
NDF	33.20	33.70	33.80
ADF	19.60	20.00	20.50
CP	16.40	16.80	16.80

[1]Cows were fed diet containing ensiled Barley distillers' Grains (BG) at 30% of corn silage (DM basis), [2]Alfalfa hay and corn silage contained 89.00, 16.00, 45.00, 33.40 and 18.00, 7.00, 54.10, 34.10% DM, CP, NDF and ADF, respectively, [3]BP = Molassed sugar beet pulp; BG = Barley distillers' Grains, [4]Contained 19.6% Ca, 9.6% P, 7.1% Na, 0.0% K,1.9% Mg, 0.0% S, Mn (0.20 mg kg^{-1}), Zn (0.30 mg kg^{-1}), Fe (0.30 mg kg^{-1}), Se(0.0 mg kg^{-1}), Cu(0. 03 mg kg^{-1}), I (0. 02 mg kg^{-1}), Co (0.01 mg kg^{-1}), Vit-A (500000 IU kg^{-1}), Vit-D (100000 IU kg^{-1}), Vit-E (1000 IU kg^{-1})

Sampling, analysis and calculations: Feed offered and feed refused were monitored daily for each cow and averaged/week. Samples of each TMR and orts from individual cows were collected daily. The TMR samples for each diet were stored in the freezer (-20°C) until required for analyze. Weekly, composite samples of TMR and orts were analyzed for DM. Samples of forage and other dietary ingredients were collected once weekly and analyzed for DM. Diet ingredients and orts were dried in a 60°C forced air oven for 48 h and analyzed for DM content. Body weight was recorded biweekly on 2 consecutive days. Dietary formulations were adjusted weekly, if necessary, to account for small changes in ingredient DM content. Samples of dried feed were ground through a Wiley Mill using a 1-mm screen (Arthur H. Thomas, Philadelphia, PA). Samples were analyzed for Ash, NDF, ADF and CP. Ash content was determined after 5 h of oxidation at 500°C. NDF and ADF

Contents were determined according to Van Soest *et al.* (1991). Daily feed intake for individual cows was calculated by subtracting the weekly mean of orts from the weekly mean of feed offered during that week. Milk production was recorded daily. Milk samples were collected biweekly from 6 consecutive milking. Milk samples were analyzed for fat, protein, lactose, SNF, TS and urea, with milk analyzer (Foss Electric, conveyor 4000). Blood samples were collected at 10.00 h (approximately, 3 h post feeding) from a jugular vessel into heparinized tubes (containing sodium heparin) biweekly. Blood was centrifuged at 3000×g for 15 min immediately after sample collection and plasma was harvested and frozen at -20°C until required for assay. Ruminal samples were taken through mouth using a vacuum pump at 10.00 h (3 h after the am feeding) to determine pH and NH3-N concentrations (biweekly). Samples were filtered through two layers of cheesecloth and pH was measured immediately by glass electrode (Metrohm, 691 model). For determination of NH3-N, 10 mL of filtered rumen fluid were added to 10 mL of 0.2N HCl ($v\ v^{-1}$) and were frozen immediately at -20°C. Commercial kits were used to determine plasma concentration of glucose, albumin. BUN, cholesterol, SGOT and SGPT (ZiestChem Co., Tehran, Iran).

Statistical analysis: Statistical analysis was performed using repeated measures analysis of variance (SAS, 9.1). Initially, a base model that included the independent variables of period and treatment and a period x treatment interaction term was evaluated for each production and variable. The least squares means procedure was used to separate differences among treatment means.

The model of experiment is:

$$Y_{ijk} = \mu + T_i + \delta_{ij} + t_k + (T*t)_{ik} + \varepsilon_{ijk}$$
$$i = 1,...,a;\ j = 1,...,b;\ k = 1,...,n$$

where:

Y_{ijk} = Observation ijk

μ = The overall mean

T_i = The effect of treatment I

t_k = The effect of period k

$(T*t)_{ik}$ = The effect of interaction between treatment i and period k

δ_{ij} = Random error with mean 0 and variance σ^2_{δ}., the variance between animals (subjects) within treatment and it is equal to the covariance between repeated

ε_{ijk} = Random error with the mean 0 and variance σ^2, the variance between measurements within animals

Also,

a = The number of treatments

b = The number of subjects (animals)

n = The number of periods

The mean of treatment i in period k is:

$$\mu_{ik} = T_i + t_k + (T*t)_{ik}$$

The variance between observations is:

$$\text{Var}\ (Y_{ijk}) = \text{Var}\ (\delta_{ij} + \varepsilon_{ijk}) = \sigma^2_{\delta} + \sigma^2$$

The covariance between observations on the same animal is:

$$\text{Cov}(Y_{ijk}, Y_{ijk'}) = \text{Var}(\delta_{ij}) = \sigma^2_{\delta}$$

RESULTS AND DISCUSSION

Ensiled BG with different level of BP was submitted for chemical composition analysis. As a results showed in Table 2 approximately, Concentrations of DM, NDF, ADF and CP were equal between diets. No visible molding or heating of ensiled BG were noted. Care was taken to ensure that BG had consistent nutritive quality prior to shipping. All rations were consumed without digestive disturbances or metabolic disorders. Hyslop *et al.* (1989) showed that the incorporation of BP with malt distillers' grains improved fermentation in the silo as shown by the pattern of fermentation acids. Hyslop and Roberts (1988) reported no effect on performance when malt distillers' grains were used to replace cereal-based concentrates up to the level of 2·1 kg DM day^{-1} when the supplement was fed twice daily in a grass silage-based ration. The results of feeding trial on the utilization of BG ensiled with and without BP on DM intake, daily milk yield and composition represented in Table 3. Dry matter intake trend to decrease by decreeing the concentration of BP in ensiled diets. However, dairy cattle in fed a ration containing BGBP 40% had a 8.8% higher feed intake compare to BGBP0% (Table 3) although the differences are not statistically significant. The DM content of the diet has been shown to influence feed intake and maximizing DMI is a primary concern in feeding dairy cows to achieve optimum milk production. Conrad and Rogers (1977) reported that cows produced more milk/ unit of DM for rations containing wet BG than dried form at 20% of dietary DM when TMR had different moisture content. Younker *et al.* (1998) reported that DMI decreased when dried brewers' grains replaced concentrate but not when it replaced forage. Attempt was

Table 3: Effect of Barley Distillers' Grains ensiled with or without molassed sugar beet pulp on dairy cow performance

	Treatments[1] (%)			Treatment effect		Period	T*P
Items	BGBP40	BGBP20	BGBP0	SEM	p-value	effect/ (p-value)	effect/ (p-value)
DMI (kg d^{-1})	20.900	20.000	19.200	0.880	0.41	***	0.51
DMI (kg/100 kg BW)	3.530	3.400	3.120	0.140	0.17	0.09	0.50
Milk yield (kg d^{-1})	33.680	33.210	32.560	2.760	0.95	**	0.98
3.5%FCM	26.930	28.640	26.570	1.990	0.73	0.06	0.55
4.5%FCM	24.910	26.500	24.570	1.840	0.73	0.06	0.55
Component yield (g day^{-1})							
Fat	762.600	880.910	770.300	61.500	0.34	0.22	0.47
Protein	998.570	1061.820	1005.820	81.350	0.83	***	0.99
Lactose	1564.690	1603.330	1554.890	119.940	0.95	***	0.99
SNF	2980.770	3071.730	2961.120	231.130	0.93	***	0.99
TS	3685.800	3924.280	3703.320	273.020	0.79	***	0.77
Urea	10.010	12.470	12.250	1.570	0.49	**	0.92
Milk composition (%)							
Fat	2.350	2.640	2.360	0.140	0.30	0.60	0.38
Protein	3.000	3.170	3.095	0.110	0.55	**	0.73
Lactose	4.690	4.810	4.770	0.100	0.68	**	0.98
SNF	8.930	9.220	9.100	0.180	0.54	**	0.92
TS	11.110	11.770	11.420	0.330	0.39	0.47	0.70
Urea	0.029	0.036	0.037	0.003	0.15	***	0.76
Efficiency of milk production							
3.5%FCM/DMI	1.290	1.430	1.420	0.110	0.64	0.53	0.43
4.5%FCM/DMI	1.190	1.320	1.310	0.100	0.64	0.53	0.43
Body weight (kg)	600.250	589.540	612.170	26.580	0.83	***	0.27
Body weight gain (kg day^{-1})	0.390	0.480	0.480	0.090	0.72	0.39	0.30

[a, b, c]Means in row with different superscript letter are different, **p = 0.01, ***p = 0.001, [1]Treatments consist of ensiled Barley distillers' Grains (BG) with different level of molassed sugar Beet Pulp (BP) and provided by this instruction a): 40% BP+60% BG (BGBP 40%) (DM basis), b): 20% BP+80% BG (BGBP20%) and c): 0% BP+100% BG (BGBP0%); 30% (DM basis) corn silage was substituted with above treatments

made in the present study to maintain similar DM in TMR of diets (49.86, 49.33 and 49.33). Because of low DM in corn silage (18%), DM of diets decreased. Lahr *et al.* (1983) added water directly to the mixer with other feed ingredients immediately prior to feeding and observed that feeding TMR with <63% DM reduced DMI of lactating dairy cows. They have shown that DMI decreased linearly as DM content of diet decreased from 78-40% by addition of water and neither milk yield or BW were affected (Lahr *et al.*, 1983). No significant difference was seen in DMI between diets. In this experiment with replacing of corn silage by ensiled BG, the NDF of forage were decreased from 19.9-16%. Firkins *et al.* (2002) reported that replacement of forage NDF with NDF from wet brewers' grains could have decreased the digestion rate but increased the passage rate of NDF, apparently counteracting effects on rumen fill. Firkins (1997) noted that DMI was decreased when forage NDF was decreased below 14% in several studies when by-products were used to decrease forage NDF, apparently because of insufficient effective fiber in the diet. Allen and Grant (2000) noted that DMI by lactating cows was maintained in most studies when non forage fiber sources replaced forage. All diets in the current study had 16% forage NDF, supporting the potential for ensiled BG to serve as a partial forage replacement in diets meeting NRC (2001) guidelines for forage NDF and NFC. Also, NFC of diets in this experiment was 43-44%. Slater *et al.* (2000) showed that DMI was increased when forage NDF was decreased below 10% of DM so long as NFC was decreased. McKendrick *et al.* (2003) reported that incorporation of BP would have diluted the fat concentration and thus, may have had an ameliorating effect on ruminal microbial activity. The provision of a steady supply of nutrients to rumen micro-organisms associated with three times daily feeding may also have been a contributing factor to the higher intakes of the BP (McKendrick *et al.*, 2003). According to reported data by McKendrick *et al.* (2003), also, in this experiment the DMI trend to higher with increasing of BP in ensiled BG. Thus, ensiling BG with BP leads to slightly increases in intake of DM. Milk yield increased in current experiment as the level of BP increased. However, there was no significant effect between treatments, despite the fact that total DM intakes by cows of the diets containing BP were numerically higher, particularly at the higher level of inclusion of BP. Murdock *et al.* (1981) reported that wet brewers' grain can replace concentrate effectively in rations of lactating dairy cows at up to 30% of the DM of the ration without any decreasing in milk yield. Hoffman and Armentano (1988) observed no change in feed intake, milk yield and milk composition of cows fed diets containing 21.5% dried brewers' grain and 23.5% wet brewers' grain and total diet DM 69.9 and 47.3%, respectively. However, milk yield and DMI were reduced when wet brewers' grains replaced soybean meal at >20% of dietary DM in cows fed diets

Table 4: Effect of Barley Distillers' Grains ensiled with or without molassed sugar beet pulp on rumen fluids and blood plasma in dairy cows

Items	Treatments[1] (%)			Treatment effect		Period effect/ (p-value)	T*P effect/ (p-value)
	BGBP40	BGBP20	BGBP0	SEM	p-value		
Rumen fluids							
pH	6.15	6.44	6.51	0.07	0.73	***	0.56
NH3-N (mg/100 mL)	14.32	14.66	15.04	0.30	0.27	0.78	0.91
Blood plasma							
BUN[2] (mg dL^{-1})	20.19	20.70	20.98	0.72	0.73	0.03	0.85
Glucose (mg dL^{-1})	51.00	52.60	51.74	2.26	0.88	0.10	0.48
Albumin (g dL^{-1})	3.84	3.88	3.82	0.12	0.94	***	0.88
Cholesterol (mg dL^{-1})	128.20	127.33	131.64	4.64	0.78	***	0.20
SGPT[3](U L^{-1})	27.37	26.33	25.87	0.73	0.35	0.07	0.89
SGOT[4](U L^{-1})	53.45	54.91	52.75	1.35	0.52	***	0.21

[a, b, c]Means in row with different superscript letter are different, **p = 0.01, ***p = 0.001, [1]Treatments consist of ensiled Barley distillers' Grains (BG) with different level of molassed sugar Beet Pulp (BP) and provided by this instruction: a) 40% BP+60% BG (BGBP40%) (DM basis). b) 20% BP+80% BG (BGBP20%) and c) 0% BP+100%BG (BGBP0%); 30% (DM basis) corn silage was substituted with above treatments, [2]Blood Urea Nitrogen, [3]Glutamic-Pyruvic Transaminase, [4]Glutamic-Oxalacetic Transaminase

based on corn silage (Davis *et al*., 1983). There was a reduction in milk fat content when the level of BP in the diet increased, although this trend was not statistically significant. Also, Hyslop and Roberts (1990) reported a decreasing in milk fat content when the proportion of BP in diet increased but this decreasing wasn't significant. The depression in milk fat content occurring on diets containing BG may be related to the fatty acid composition (unsaturated fatty acids) of the feed (McKendrick *et al*., 2003). Feeding 0, 15 or 30% of dietary DM as wet brewers' grain in diets containing 54.6, 43.3 and 35.5% DM, respectively to Jersey cows during hot humid weather did not influence feed intake or milk yield, however, milk protein content was decreased by 0.17 percentage units in 30% WBG compared with control diet containing ground corn (West *et al*., 1994). Warner *et al.* (1957) demonstrated that Holstein cows produced some what more milk when dried corn distillers' grains were used as the primary protein supplement than when certain other protein sources were employed. Results from the present study suggest that DMI, milk yield and milk composition of dairy cows fed diets containing 7.2% of dietary DM as ensiled BG did not significant difference when diets had the same amount of DM. There were no significant treatment differences in feed efficiencies (FCM/DMI). Body weight gains were numerically greater for treatment BGBP20% and BGBP40% than treatment BGBP0% (Table 3), but differences were not significant. Feed efficiencies were not corrected for changes in body weight because differences between treatments in weight changes were not significant. There was no interaction between treatment and period for milk yield, milk composition, DMI and blood plasma. Urea N in milk reflects dietary CP content and protein quality because excess ruminal ammonia enters the blood and is converted to urea in the liver. As a water-soluble compound, urea enters the mammary gland and eventually into the milk. Urea N concentration in milk was the same in 3 treatments but trend to higher in treatment BGBP0%. Effects of rations on rumen and blood measures are in Table 4. Rations had no significant effect on rumen pH. There was a non significant trend to higher NH3-N for lower ratios of BP. Dhiman *et al.* (2003) reported that rumen fluid NH3-N and PH of dried brewers' grain or wet brewers' grain is the same for lactating dairy cows when fed at 15% of dietary DM in a TMR containing similar DM. Protein, fat, SNF, TS, urea and lactose were trending to higher for treatment BGBP20%. Plasma BUN followed the same response as rumen ammonia and numerically increased for treatment BGBP0%. There were no significant changes in serum albumin, glucose, cholesterol, SGPT and SGOT between treatments. Blood and rumen parameters were normal for these diet types. More CP dietary for treatment BGBP0% and BGBP20% appeared to have an increasing effect on plasma BUN and rumen fluid NH3-N. Plasma concentration of SGPT and SGOT, 2 factors of liver health and performance, didn't had any significant differences between treatments, that shows ensiled BG no negative effect on cows fed treatments because of micotoxin or any other toxins. Maybe increasing cholesterol plasma was associated with greater fat dietary. Treatment interaction with period wasn't significant for ruminal pH and NH3-N concentrations. The average price for dried BG and wet BG in the I.R. Iran (Niro malt co, Mashhad City) from February 20th to April 29th (2008) was \$222 and \$160 (per 1000 kg of DM), respectively. As discussed earlier, the relative nutritive value of dried BG and wet BG is the same for lactating dairy cows. Therefore, using wet BG instead of dried BG will save \$62/1000 kg DM minus the difference in storage costs. Also, Rogers *et al.* (1986) reported that with drying of wet brewers' grains, the digestibility of protein in dried brewers' grains decreased. The storage of wet BG for a lengthy time is always a concern, particularly in warm weather. However, some of researcher (McKendrick *et al*., 2003) had demonstrated that, wet BG can be ensiled with some of material such as BP very well. Whenever, wet BG are ensiled with BP, the pH of the blend decreases immediately and also BP act as moisture absorbing in silo.

CONCLUSION

Wet BG can be ensiled with BP very well. Ensiled BG with and without BP can be used to replace 30% corn silage for cows giving moderate yields without serious loss of production. Also, Cow performance data from the present study indicate that the relative nutritive value of ensiled BG with or without BP is the same for lactating dairy cows when fed at 7.2% of dietary DM in a TMR containing similar DM.

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