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Article

Effect of sugar beet silage on milk production of dairy cows in Bangladesh

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Abstract: The aim of this study was to examine whether the positive response in milk production and nutritional quality of milk in local dairy cows in Khulna fed with sugar beet silage. 18 dairy cows of local breed and cross-breed were used in as 2x2 Latin square design experiments with 2 rations: (1) control with wheat bran as energy source and (2) treatment group with sugar beet silage as energy source. A total of 72 milk samples were collected to evaluate fat, solids not fat, (SNF), total solids (TS), protein, lactose. The milk production and nutritional quality of sampled milk for both group 1 and 2, milk yield (2.04%±1.20 and 2.28%±1.52%),fat (3.47%±1.64% and 3.49%±1.71%), SNF (8.20%±0.69% and 8.17±0.95), TS (12.39%±1.89% and 12.37%±2.20), protein (3.61%±0.50% and 3.66%±0.90%), lactose (4.55%±0.53% and 4.52%±0.78%), were not significant (p>0.05).The correct lactometer reading for both locations was 29.83%±2.11% and 29.41%±3.16%, respectively. Nutritional composition of sample milk in local and cross breed, milk yield (1.31±0.18 and 3.86±1.09), fat (4.101±1.43 and 2.26±1.42), SNF (8.31±0.87 and 7.94±0.66), TS (13.11±1.91 and 10.91±1.41), Protein (3.62±0.78 and 3.67±0.60), Lactose (4.67±0.52 and 4.26±0.83) were statistically significant ((p>0.05).) In conclusion, sugar beet silage feeding has no negative effect and milk production and milk quality. Feeding ensiled sugar beets as an alternative energy-rich, highly palatable feedstuff to ruminants in Bangladesh seems therefore to be promising.

Keywords: sugar beet; milk production; milk quality; nutritional value of beet silage

1. Introduction

Feed cost, a major expense in animal production, may be reduced by including locally and regionally grown crops and local crop processing by products in animal diet. Silage is fermented, high-moisture stored fodder which can be fed to ruminants (cud-chewing animals such as cattle and sheep) or used as a bio-fuel feedstock for anaerobic digesters. It is fermented and stored in a process called ensilage and is usually made from grass crops, including maize, sugar beet, sorghum or other cereals, using the entire green plant (not just the grain). Sugar beet pulp silages have a relatively high feed out value for livestock (Bell *et al*., 2001) which may be attributed to the highly digestible fiber fraction of wet pressed sugar beet pulp (WBP) (Tatlli *et al*., 2001). Ensiled products are produced through anaerobic fermentation. Anaerobic bacteria are critical for the production of organic acids (primarily lactic acid and acetic acid), which lower silage pH and create an efficient fermentation environment (Oude Elferink *et al*., 2000). Sugar beets are a crop that can be grown successfully in high- alkaline soils. Whole beets can be fed successfully to cattle. Whole beets are low in crude protein (6.8%) but high in energy (75% TDN, source internet). Beets also be chopped or making silage to feed animals reported that Lardy *et al*. (2003) in alternative feed for ruminants. Sugar beet produces excellent yield in piloting plot in polder 29 under Dumuria upazila of Khulna district which are uniquely tolerant of saline soil conditions. Soil salinity was measured using a handheld refractometer. The productive soils typically have a value of 18 PPT (parts per thousand).Beets contain more energy than corn silage (80vs. 70 percent total

digestiblenutrients [TDN] but are typically lowers in dry matter (DM; 25% vs. 35%). Sugar beet can be grown for feed, stored and fed to cattle with no negative effects.

Evaluated diets consisting of either maize (Zea maize) silage or sugar beet (Beta vulgarisL.) pulp silage with molasses (Karalazos and Giouzeljannis, 1988). Beet pulp silage with molasses achieved a lower pH and a higher lactic acid concentration, as a % of DM, than maize silage (Lardy *et al*., 2003). Silages with molasses-urea mixture added had a lower pH than beet pulp ensiled alone or beet pulp ensiled with laying hen excreta (Leterme *et al.*, 1992). Similarly, Silages based on sugar beet pulp ensiled with formic acid had a lower pH than silage with an additive based sugar beet pulp. In the silo the pressure of the material, when chaffed, excludes air from all layer. Then covered by polythine sheet and finally mud was given on it and kept completely air tightened for 4 months. The quantities of the main milk constituents can vary considerably depending on the individual animal, its breed, stage of lactation, age and health status. Herd management practices and environmental conditions also influence milk composition However, beets alone are too moist (about 75 to 80 percent moisture) to make a good –quality silage, according to Lardy *et al.* (2003). Thus, they need to be mixed with some types of dry feed, such as straw to achieve the proper moisture content (60 to 70 percent) and be stored effectively as silage. Sugar beet silage contents slightly lower energy than corn or barley silage, but the silage still makes a very acceptable feed, (fresh and ensiled) is eaten willingly by cattle, back grounding calves or other ruminants. The main reason for lower cattle production is fodder crisis in Bangladesh. Thus, we look for alternation source of feed for livestock. That's why; the study has been conducted for observing the effect of beet silage for milk production.

2. Materials and Methods

2.1. Selection of study criteria and period

The present research work was conducted with four group of experiment plot. The researcher selected four groups of cattle for the experimental plot. Firstly, six local cattle at Kumarghata village under Sahash union in group-A, six local cattle at Keyakhali village under sharafpur union in group-B, three cross breed cattle in Kumarghata village under Sahash union in group-C and finally three cross breed cattle in Gushgati village under Sahash Uunion in group-D. The whole experiment was conducted from August12 to September 22, 2015.

2.2. Collection of milk sample and analysis

The raw milk samples were collected in the morning and send them to Milk Vita Chilling plant in Khulna by keeping them in an ice containing box for analysis. A total 72samples were collected and analyzed by dairy milk analyzer.

2.2.1. Nutritional parameters of milk

The parameters used to monitor the quality of milk were Fat, Protein (P), Lactose (L), Total Solids (TS) and Solids-not-fat (SNF) performed by using dairy milk analyzer.

2.3. Important properties determining the value of sugar beet silage

2.3.1. High energy

From a cereal crop we can expect mainly energy supply, and less protein. Water soluble carbohydrate content (WSC), structural carbohydrates and non-starch polysaccharide are the main energy sources in sugar beet. However, starch is mainly accumulated in the grain, the amount of which greatly affects the total energy content. The higher the proportion of grain in the plant, the more the total energy. The positive effect of the presence of starch is especially important for dairy cows.

2.3.2. Nutritive value of silage

The three types of silage were prepared. Their color, odor (smell) of the silage was normal. The samples were analysis in laboratory to know the proximate composition. The analysis was done in office of the principal scientific officer, Animal nutrition section, Department of livestock services, Dhaka, Bangladesh. The proximate value is given below in Table 1.

Table 1. Chemical examination (% on DM basis).

Sample Features	Beet + Leaf	
	Analyzed Value	Standard Value
Moisture	52.58	
Dry Matter (DM)	47.42	
Crude Protein (CP)	07.08	
Total Ash (TA)	15.22	
Acid Insoluble Ash (AIA)	0.30	
Crude Fiber (CF)	15.60	
Crude Fat (EE)	Nil	
Non Protein Nitrogen (NPN)	0.21	
Calcium (Ca)		
Phosphorus (P)		

2.4. Research design

The sugar beet is harvested by hand and allowed to wilt for a day or so until the moisture content drops to a suitable level which was 33 percent in the experiment. In this experiment silage is made by sugar beet and its leaves. After harvesting, crops are shredded to pieces about 8-10 centimeters long. The beet had been dried over the plastic sheet for 22 hours and 45 minutes and leaves for 12 hours 20 minutes until its moisture is 33.33% and 22.34 respectively. Silage is prepared for the trial which was mixed with beet and leaves of the sugar beet. It was prepared in silo which was 0.9 meter depth, 1.5 meters width and 2.13 meters length that is total 2.87 cubic meters. The material is spread in uniform layers over the floor of the silo, and closely packed. The floor of the silo covered by white plastic sheet. At the bottom of silo a layer of straw is spread and then beet spread and sprays 4 percent molasses over the beet and then spread straw and gradually it was stacked. The whole experiment was carried out in polder 29 of Dumuria upazila under Khulna district. Twelve local lactating cows that were in milking stage during the experiment going on where six cattle in each group those were from Kumarghata and Keyakhali. The method followed 2X2 Latin Square Design (LSD). In addition six cross breed cattle were selected and divided into two groups and three in each group. The animals at least three lactation periods were only used for this study. The cows were fed one kg of beet silage dry matter and one kg of wheat bran during the experiment but cross breed fed additional two kg concentrate feed. Cows were milked by hand once daily in the morning for local cattle but two times for cross breed cattle. The ration formation of one kg formulation of breed cattle is given below in Table 2.

Table 2. Ration formulation for one kg formulation.

Items	Amount (gm)
Wheat bran	400
Rice polish	220
Pulse bran	150
Mastered oil cake	200
Di calcium phosphate	10
DB powder-Multivitamins	10
Salt	10

2.5. Research question and null hypothesis

In the total research period researcher was looking for one question. The main question of the research was what are the effect of the sugar beet on milk production and its changes of chemical composition on local cattle?

The research hypothesis was to assume that the effect of sugar beet silage and wheat bran on milk production and its chemical changes in local cow is similar.

2.6. Data storing and analysis

The data analyzed using SPSS program (Two-sample Kolmogorov-Smirnov test).

3. Results and Discussion

3.1. Nutritional parameters

The mean and standard deviation of the milk yield collected from sugar beet silage feeding were 2.04 ± 1.20 and for wheat bran 2.28±1.52 respectively (Figure 1) as well as local and cross breed were 1.31±0.18 and 3.86±1.09 respectively (Figure 2).

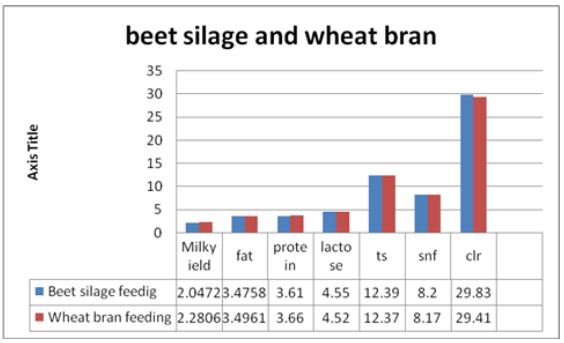

Figure 1. Sugar beet silage and wheat bran feeding.

3.1.1. Fat percentage

The mean and standard deviation of the fat content of milk from sugar beet silage and wheat bran feeding were 3.47±1.64 and 3.49±1.71, respectively. The fat content of milk from both groups was not significant (p> 0.05) due to supply of wheat bran and sugar beet silage along with farmers being fed dry roughphase especially rice straw offer on account of their milk production which was supported by Hossain (1968) who found that milk fat of indigenous cows was 4.60% ±0.64 and fat content in milk ranged from 4.28 % to 5.60% (Uddin *et al*., 2003). Data indicated that content of milk in two places were within normal range which agrees with Islam *et al*. (2008) and this result also agrees with Debnath *et al*. (1990). In comparison between local and cross breed that the data reveals the fat content in local and cross bred were 4.101±1.43 and 2.26±1.42 respectively (Figure 2).

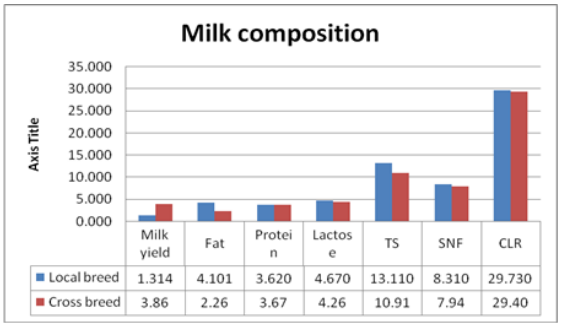

Figure 2. Local and cross breed.

3.1.2. Solids- Not- Fat (S.N.F) percentage

We analyzed the milk samples to find out the SNF content of milk from both sides (Kumarghata and Keyakhali groups) that the mean and standard deviation were 8.32 ± 0.77 and 8.30± 0.98, respectively (Figure 1). The difference among the SNF percentage of milk samples collected in the above experiment was found not significant (p>0.05). The result of this parameter in two places was almost similar. This result agrees with the findings of Yadab *et al*. (1982), Debnath *et al*. (1990) and Talukder (1989). According to the definition of milk it should contain at least 8.5 SNF but obtained result was very much similar. It might be due to the maintaining energy balance by same amount sugar beet silage and wheat bran in feeding with the cows. On the other hand the SNF found in local and cross breed were 8.31±0.87 and 7.94±0.66 respectively (Figure 02).

3.1.3. Total solids percentage

The mean and standard deviation of TS content of milk collected from both Kumarghata and Keyakhali groups were 12. 28± 1.79 and 13.94± 1.69, respectively (Figure 1). There results found in experiment from both groups was not significant difference (p>0.05) among the TS content of milk collected in two areas. This result of groups agrees with the findings of Islam (2008). In local and cross breed were 13.11±1.91 and 10.91±1.41 respectively (Figure 2).

3.1.4. Protein percentage

The mean and standard deviation of protein content of milk collected from both Kumarghata and keyakhali groups were 3.41± 0.71 and 3.82± 0.81respectively (Figure 1). The statistical analysis shows that there was no significant difference between two groups ($p>0.05$).Though the protein percentage of Keyakhali was little bit higher than the normal composition of milk and Kumarghata but statistically result shows no significant. These results also agree with the finding of Debnath *et al*. (1990). Protein content of local and cross breed were 3.62±0.78 and 3.67±0.60 respectively (Figure 2).

3.1.5. Lactose percentage

The mean and standard deviation of lactose content of milk collected from both Kumarghata and keyakhali groups were 4.87±0.47 and 4.47 ± 0.50 respectively (Figure 1). Lactose is the major carbohydrate fraction in milk. It is made up of two sugars, glucose and galactose. The average lactose content of milk varies between 4.7 and 4.9%, though milk from individual cows may vary more. Lactose is a natural sugar that is secreted in the udder of the cow. The presence of lactose in the milk gives milk its sweet taste. It reveals that lactose levels fall below a certain threshold (~4.2%) the milk is difficult to process (Eg. cheese making). This explains why co-ops impose penalties when lactose levels fall below their minimum threshold. This lactose level falls due to seasonal effect in autumn. Due to changes in the physiology and metabolism of the mammary gland in late lactation the lactose content in milk declines, coinciding with the decline in milk production. Statistical analysis shows that the lactose content in local and cross breed were 4.67±0.52 and 4.26±0.83 respectively (Figure 2).

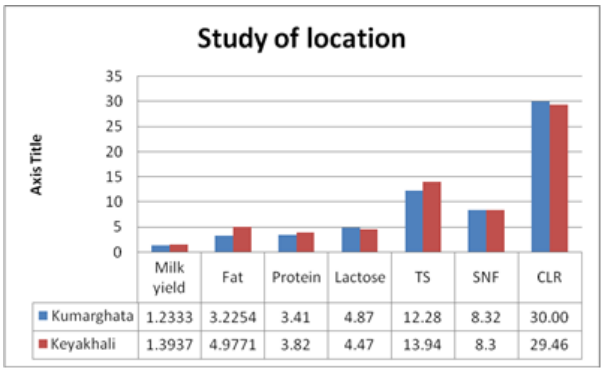

Figure 3. Study of location.

3.2. Correct lactometer reading

The lactometer test is designed to detect the change in density of adulterated milk. According to Lampert (1965) the lactometer is used as an aid in detecting milk to which water might have been added. Carried out together with the Gerber butterfat test, it enables the milk processor to calculate the milk TS and solids not fat. Average correct lactometer reading (CLR) of cow milk is 28 to 30 at 15.6°C (S. DAS 2010). A CLR below 26 it is suspected that addition of water to milk (Gichohi *et al.*, 2004). The mean and standard deviation of correct lactometer reading for both Kumarghata and Keyakhali were 30.00±2.49 and 29.46±3.27, respectively (Figure 3). The result showed in the experiment not significant ($p>0.05$). According to Sukomer, Pandey and Voskuil it should (fresh milk) be 28 to 30 at 15.6◦C which agrees with Pandey *et al.* (2011). Milk was collected in the morning and no adulteration in milk, this result also agrees with Rahman (2013).

In the experiment at two places of Kumarghata and Keyakhali, in same region it was found that the chemical compositions of milk (mean of fat 3.22 and 4.97, mean of lactose 4.87 and 4.47, mean of total solid 12.28 and 13.94 respectively) statistically significant ($p<0.05$). The effects of regional environment; years and seasons on the milk technological quality (contents of fat; protein, lactose, solids-non-fat; somatic cell number and number of total germs) were studied by multivariate statistical methods. These results agree with Mironeasa *et al.* (2011). In our present research the researchers also compared between local and cross breed in the locality. The comparison between local and cross breeds are given below in Table 3.

Table 3. Comparison between local and cross breed.

Parameters	Local breed		Cross Breed		Sig local	Sig Cross
	Mean	Std. Deviation	Mean	Std. Deviation		
Milk yield	1.3135	0.18701	3.8646	1.09589		
Fat	4.1012	1.43268	2.2554	1.42912	0.00	0.002
Protein	3.62	0.789	3.67	0.609		
Lactose	4.67	0.525	4.26	0.837	0.005	0.002
Ts	13.11	1.918	10.91	1.412	0.002	0.034
Snf	8.31	0.876	7.94	0.661		
Correct lactometer reading	29.73	2.891	29.4	2.249		

The results on table reveal that, fat, lactose ,total solid, and solid not fat content of milk were statistically significant ($p<0.05$). The feeding intervention positively influenced fat content of milk. These results agree with Ahmed *et al*. (2013).

4. Conclusions

As the observation of significant value of milk composition of groups, the effect of sugar beet silage and wheat bran on milk production and its chemical changes in local cow is similar. But, a significant difference between location and or race was observed. However, beet silage might be a good option for the farmers to reducing feed cost and during rainy seasons when natural grazing field remains submerged. Saline-tolerant sugar beet fodder might be introduced that will reduce feed shortage for livestock alternatively and giving economic benefit compare to concentrate feed during rainy season when grazing fields sources are extremely water logged in the south west part of Bangladesh.

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Conflict of interest

None to declare.

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