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Article

Effect of adding different additives on silage quality and milk production of lactating crossbred cows

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Abstract: The objective of this study was to determine the effect of urea-molasses and di-calcium phosphate additives on silage quality and milk yield of cows. Hence, three types of silages were prepared from Napier fodder namely-Napier silage, urea and molasses added Napier silage (UMN); and di-calcium phosphate added Napier (DCPN) silage. These types of silage fed to the selected nine lactating Holstein-Friesian crossbred cows and divided into three groups considering three of each. Along with 5 kg of respective silages, *ad-libitum* rice straw and 3 kg concentrate mixture supplied to each group of cows. Physical attributes of all prepared silages were possessing characteristics of good quality silage. Dry matter content in UMN and DCPN silages were 1.67 and 1.01% higher than Napier silage. UMN silage had 1.59 and 2.33% lower ADF from Napier and DCPN silage, respectively. Again, 1.29% higher NH_3-N presents in UMN silage than Napier silage. From 1st to 4th fortnight milk yield data it was found that 23.70, 23.19 and 27.06% milk production increased those cows received Napier, UMN and DCPN silage, respectively. Considering above these, it might be concluded that addition of di-calcium phosphate as additive during silage making would be beneficial for the dairy farmers.

Keywords: additives; silage; crossbred cows; milk yield

1. Introduction

Silage is fermented feed material, high-moisture stored fodder which can be fed to cattle, sheep and other ruminants or used as a bio-fuel feedstock for anaerobic digesters. It is fermented and stored in a process called ensilage or ensiling, and is usually made from grass crops. Silage making is done under anaerobic fermentations where microorganisms use the fermentable sugars in fodder and produce organic acids, mainly lactic acid (Bolsen *et al*., 1996) and it helps to break down some nutrients of fodders to simpler forms so that they can be digested and utilized by the animals easily. Silage is usually included in the diet with other feeds and it is not always easy to accurately estimate its contribution due to interactions between numerous dietary components. Due to rising human population and industrialization in Bangladesh, traditional grazing lands are widely being converted to crop lands, commercial fodder production and farmers forcing cattle to graze on marginal and overgrazed lands with poor quality forge (Islam *et al*., 2017). Necessity of fodder production and feeding to livestock has been focused by many scientists in their research reports in the past of Bangladesh (Akbar *et al*., 2005) and livestock feeding involves 70-75% of the total cost. However, there are many types of roughage that can be fed to lactating dairy cows. Beside these, farmers are getting interested in dairy farming in a commercial way and cultivate improved varieties of fodder as feed to the milking cows for better health and milk production. Again, Bangladesh is a flood prone country in the world which creates scarcity of feeds and

fodder during rainy season. That's why researchers were tried out to conserve animal feeds in better way through emphasizing nutritive value of that conserved feed. Conservation of forages can be achieved by sun drying (hay), artificial drying (meal) and through silage making (Mannetje, 2003).

Complete feed silage is made from a mixture of some feed ingredients including forage, concentrate and additives. The advantage of complete feed silage is that it can be made any time and has long shelf life to solve the problem of feed shortage during lean season. Complete feed silage is expected to be used for maintaining the productivity of dairy cows. Kaiser and Evans (1997) and Vargas-Bello-Perez *et al*. (2008) mentioned that silage feeding has positive impacts on milk production. High yielding fodders like Napier (*Pennisetum purpureum*), German (*Echinochloa crus-galli*) and similar others with low NFC containing fodders can be a source of good silage through adding additives which provides soluble carbohydrates. It has been showed that Napier grass contains low concentrations of fermentable carbohydrates (Nisa *et al*., 2005) and thus various additives like molasses (Khan *et al*., 2006) can be used as a source of fermentable sugars to achieve better fermentation and preservation. Napier grass has low crude protein content and its quality can be improved with the incorporation of urea (nitrogen), molasses (energy supplier and facilitates natural silage preservation) as well as di-calcium phosphate (minerals) as additive during silage making. However, research work regarding the additives added silage preparation and its quality as well as feeding effect to crossbred dairy animal is limited in our country context. For this reason, present study was undertaken to prepare silages using different additives, assaying the silage quality and monitoring milk yield of the lactating crossbred dairy cow's thorough additive added silage feeding.

2. Materials and Methods

2.1. Preparation of silage from Napier fodder

Napier fodder (*Pennisetum purpureum*) was cultivated in a farmers fodder plot at Shahjadpur Upazila in Sirajganj District. BLRI developed hybrid Napier-4 fodder was used as cutting and; nitrogen and phosphorus fertilizer applied 100 and 10 kg/hector, respectively. The fodder was harvested at 70 days of age from 15 cm above the ground level. After harvesting, fodder was wilted to bring down their moisture content to the desired level and chopped at 3 cm using locally manufactured grass chopper. Three types of silo pits were prepared for making Napier silage (treated as control), urea and molasses added Napier (UMN) silage and di-calcium phosphate added Napier (DCPN) silage. The polyethylene sheet was spread in the pit to make the mass airtight. Fodder was spread out layer after layer in a pit and some persons involved in foot pressing into chopped fodder for compactness. Thus, silo pit was filled with the chopped fodder and; finally, covered the pit with the polythene and loose soil spread above to ensure airtight as well as anaerobic condition inside the pits. For making UMN silage, urea-molasses solution (0.25% urea and 3% molasses) were sprayed over the layer of chopped fodder and mixed properly. In case of DCPN silage, 2.5 g di-calcium phosphate added in per litre water to make solution and then sprayed this solution over the chopped Napier fodder. Finally, silo pits were covered with loose soil to ensure complete.

2.2. Evaluation of silage

Silo pits were opened after 8 weeks from the date of preparation and silage samples were collected by using hand gloves from small opening area of silo pit. The samples were placed in the plastic containers and immediately transferred to the laboratory for evaluating physico-chemical attributes of silage. The mouth of the container was sealed immediately after collection to avoid the evaporation losses of nitrogen. Silage quality was evaluated by a panel of 3 adept academic teachers from Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh for colour, aroma and texture using sensory organ. Temperature of the silage determined through thermometer in degree celcius and pH content estimated through pH-mV meter (Germany). Dry matter content determined through oven drying method and crude protein (CP) content estimated through Kjeldahl method as described by AOAC (2000). Neutral detergent fiber (NDF) analyzed with heat-stable amylase and without Na-sulfite; and acid detergent fiber (ADF) was determined according to the sequential method of Van Soest *et al*. (1991) by an ANKOM fiber analyzer (ANKOM 220 Technology, Macedon, NY, USA). Ammonium nitrogen also determined in silage samples using an ammonia electrode.

2.3. Study site, animals and diets

The study was carried out at the farmer's house of Shahjadpur upazila under the Sirajganj district in Bangladesh. Nine Holstein-Friesian (50%) crossbred cows were selected for this study and total feeding duration of the study was 70 days of which first 10 days were for diet adaptation. Selected cows were divided into three dietary groups like Napier silage diet, UMN silage diet and DCPN silage diet. Each group having 3 cows and the

average live weight of each group was 500±5 kg which belongs to 2nd lactation. The study was conducted using rice straw (*Oryza sativa*), concentrate mixture (wheat bran, rice polish, mustard oil cake, molasses, mineral mixture and salt), Napier silage, UMN silage and DCPN silage. Rice straw and concentrate mixture were used as basal diet in all groups where variations existed in urea-molasses and di-calcium phosphate addition during silage making. Ingredients composition of different diets fed to the dairy cows is shown in Table 1. Rice straw was fed *ad-libitum* basis only whereas, silage and concentrate mixture were fed 5.0 and 3.0 kg per day per cow, respectively. Roughage and concentrate were fed separately twice daily and roughages were offered after concentrate feeding.

2.4. Data recording and analysis

Milk yield of the cows were recorded in a register book at fortnightly and data generated on milk production from lactating cows were analyzed in a completely randomized design using SPSS software (SPSS version 16, Inc. Chicago, USA). Duncun multiple range test (DMRT) was also done to compare the treatment means as described by Gomez and Gomez (1984).

Table 1. Ingredient composition of different diets fed to the dairy cows.

Ingredients	Napier silage diet	UMN silage diet	DCPN silage diet
Rice straw	*Ad-libitum*	*Ad-libitum*	*Ad-libitum*
Concentrate mixture (g/1000g)			
Wheat bran	360.0	360.0	360.0
Rice polish	400.0	400.0	400.0
Mustard oil cake	150.0	150.0	150.0
Molasses	50.0	50.0	50.0
Mineral mixture	20.0	20.0	20.0
Common salt	20.0	20.0	20.0
Napier silage (g)	5000.0	-	-
UMN silage (g)	-	5000.0	-
DCPN silage (g)	-	-	5000.0

UMN, urea and molasses added into chopped Napier and DCPN, di-calcium phosphate added into chopped Napier.

3. Results and Discussion

3.1. Physico-chemical attributes of silage

Physico-chemical attributes of different silages are shown in Table 2. The results showed that average pH of silage varies from 4.28 to 4.50 and lower pH was found in UMN silage which might be due to addition of urea as additives during silage making. This pH range was similar to Menesses *et al*. (2007), Babayemi (2009) and Kung and Shaver (2002) who stated that normal p^H value of the good silage within the range of 3.5-5.5. The colour of all the silages were found straw yellowish which is supported by the report of Oduguwa *et al*. (2007) who indicated that this silage colour was good in quality. Pleasantly alcoholic aroma and soft texture were found in all types of silages which were expected to the best texture of good silage according to Kung and Shaver (2002). Lower temperature observed in without any additive added silage (20°C) and almost similar temperature (21°C) was found in both additive added silage. The temperature of fermenting forage varying from 27-38°C was presumed to produce excellent silage (Muck, 1996). In the current study temperature were lower than the range described by Babayemi (2009) through studying in Guinea grass silage.

The UMN and DCPN silage-based diets had more or less similar contents of DM, CP and NDF (Table 2) only Napier silage. The DM content of the UMN-based diet was higher than those of the Napier and DCPN silage-based diets. Pilipavicius *et al*. (2003) reported that maize silage contained 7.8% CP and lower CP content in silage is the indication of more breakdown of protein. The lower ADF content was found in UMN silage diet but nearly similar ADF values were found in Napier silage and DCPN silage. The ADF content in forages is adversely related to the digestibility of organic matter as well as metabolizable energy content of forages. Higher NDF value shown in Napier silage than other additives added silage. Ammonia-N value of UMN silage (11.21) based diet differed from Napier and DCPN silage based diet. The ammonia-N content in silages indicates that the levels of protein break down or proteolysis as well as fermentation during the ensiling process. The standard range of ammonia-N in silage is 5-15% (Ranjit *et al*., 2002) which agrees with the present findings of the study and indicated that all types of silages were of good quality.

Table 2. Physico-chemical attributes of different types of silage.

Parameters	Napier silage	UMN silage	DCPN silage
Physical characteristics			
pH	4.50	4.28	4.31
Colour	Straw yellowish	Straw yellowish	Straw yellowish
Aroma	Pleasantly alcoholic	Pleasantly alcoholic	Pleasantly alcoholic
Texture	Soft	Soft	Soft
Temperature (ºC)	20	21	21
Chemical constituents (g/100g DM)			
DM	21.27	22.94	22.28
CP	8.78	8.97	8.81
ADF	45.11	43.52	45.85
NDF	69.23	68.05	68.35
Ammonia-N	9.92	11.21	10.04

UMN, urea and molasses added into chopped Napier; DCPN, di-calcium phosphate added into chopped napier; DM, dry matter; CP, crude protein; ADF, acid detergent fibre; NDF, neutral detergent fibre and ammonia-N, ammonia nitrogen.

3.2. Effect of silages on milk yield of lactating cows

Impacts of feeding different types of silages on milk production of dairy cows are shown in Table 3. Milk yield was significantly different at 1st (P=0.001), 2nd (P=0.004) and 3rd (P=0.04) fortnights among the silage types where UMN silage fed cow had higher milk yield than Napier and DCPN silage. But 4th fortnight milk yield of DCPN silage found statistically similar in UMN and Napier silage (P=0.046). Considering the avg. milk yield of cows from 1st to 4th fortnight it seems that UMN silage fed cow's milk production varies from Naiper and DCPN silage fed cows (P=0.006). Milk yield of cows depends on types of silages, quality, and additives which are collaborate with the findings of Vargas-Bello-Pe´rez *et al*. (2008) who stated that alfalfa silage had more milk yield than soybean silage. Present study revealed that the milk yield of cows fed UMN silage had produced higher quantity of milk than that of Napier and DCPN silage. This reason might be due to higher digestibility of silage enhanced by lower ADF content of the diet because of ADF content of forage is adversely related to digestibility. Another reason could be that the level of CP and ammonia-N were higher in the silage having urea and molasses additive compared to those of the other two silages.

Table 3. Impact of feeding different types of silages on milk production of dairy cows.

Types of silage	Milk yield (L/d) at fortnight intervals				
	1st	2nd	3rd	4th	Avg.
Napier silage	11.77^{b}	12.67^{b}	13.52^{b}	14.56^{b}	13.13^{b}
UMN silage	12.72^{a}	13.51^{a}	14.65^{a}	15.67^{a}	14.13^{a}
DCPN silage	11.64^{b}	12.66^{b}	13.67^{b}	14.79^{ab}	13.19^{b}
LSD	0.14	0.15	0.29	0.23	0.18
SEM	0.13	0.10	0.13	0.09	0.11
P-value	0.001	0.004	0.04	0.046	0.006

UMN, urea and molasses added into chopped Napier; DCPN, di-calcium phosphate added into chopped napier; LSD, least-significant differences and SED, Standard error of the mean.
[ab]Mean values having different superscripts in a column differ significantly.

4. Conclusions

This study shows that di-calcium phosphate added as additives in Napier silage can be an effective alternative feeding approach to green fodder during lean period to boost up the milk production of crossbred dairy cows.

Conflict of interest

None to declare.

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