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# Effect of different types of silage on milk production of dairy cows

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## ABSTRACT

The experiment was carried out in a village called Digholgao under Muktagacha upazila of Mymensingh BD to investigate the effect of different types of silage on milk production .Twelve milking cows (age 5-6 years, live weight 450±5 kg) divided into 4 groups each having 3 animals were used in the experiment They were assigned randomly to 4 dietary treatments: $T_0$ = Basal diet + napier grass and maize fodder, $T_1$= Basal diet + napier whole silage, $T_2$= Basal diet + napier chopped silage, $T_3$= Basal diet + maize silage. Basal diet was composed of rice straw, wheat bran, rice polish, mustard oil cake, DCP powder, salt and mineral mixture. All the animals of this experiment were offered *ad libitum* clean water. The design of experiment was completely randomized design. A feeding trial of 90 days duration was conducted on 12 dairy cows of mild lactation stage. The everyday milk production of those cows was recorded in a record book. The physico-chemical characteristics of different types of silages showed that maize and napier chopped silages were having similar $P^H$, colour, aroma, texture and temperature which were within the normal range of good quality silage. However, the silage of napier whole grass was having relatively poor quality characteristics compared to those of the other silages. The DM content of maize silage, napier chopped and whole silage were 18.47, 19.13 and 17.89% respectively. The $P^H$ of maize silage, napier chopped and napier whole silage were 4.26, 4.27 and 5.26 respectively. The CP contents of maize silage (9.16%) and napier chopped silage (8.96%) were almost similar and higher than napier whole silage (7.03%). Meanwhile, the ADF content of napier whole silage (57.40%) was higher than maize silage (45.66%) and napier chopped (53.60%). The ammonia nitrogen ($NH_3$-N) content of maize silage (9.20%) and napier chopped silage (9.85%) were almost similar and higher than napier whole silage (7.57%). Meanwhile, the total volatile fatty acids (TVFAs) content of maize silage, napier chopped and whole silage were 11.75%, 11.40% and 10.20% respectively. The average milk production (L/d) of maize, napier chopped and napier whole grass silage fed dairy cows were 18.94, 17.82 and 16.79 respectively. On the other hand, the control group or only mixed green grass fed dairy cows produce on average 14.73 litres milk per day. Milk yield of all the silage fed animal groups have given significantly ($p<0.01$) higher yields than that of the control group of animals. Among the silage supplemented groups the animals of maize silage group gave significantly ($p<0.01$) higher milk yield than that of napier whole grass silage group of animals but non-significantly higher yield than that of napier chopped silage group. The average milk production (L/d) of the 90 days feeding trial period for maize silage, napier chopped silage, napier whole grass silage and control diets were found as 18.94, 17.82, 16.79 and 14.73 respectively. Here all the silage fed groups of animals gave significantly ($p<0.01$) higher milk yield than that of the animals fed control ration. However, maize silage showed significantly better yield of milk compared to other silages. It was also found that milk yield was increased 28.59%, 20.96% and 13.97% of maize, napier chopped and napier whole silage fed cows, respectively over the control group. Based on the findings in respect of physical characteristics, chemical composition, pH, ammonia nitrogen ($NH_3$-N), total volatile fatty acids (TVFAs) of silages and effect of silage on milk production of dairy cows it may be concluded that maize or chopped napier silage can be an effective alternative to green fodder during the period of fodder scarcity for continuing the milk production of dairy cows. Feeding silage to dairy cows increase milk production compared to fresh grass. Maize can produce better silage for increasing milk production compared to napier silage. Chopping napier grass before ensiling can give slightly better quality silage than whole napier grass.

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## INTRODUCTION

Bangladesh is having the highest livestock density in the world (145 large ruminants/km$^2$ compared to 90 for India, 30 for Ethiopia and 20 for Brazil) but the productivity is far below the world average, even lower than the Asia average. The major setback adversely affecting livestock productivity is the shortage of quality feeds and fodder (Akbar et al., 2005). There is a big gap between the requirements and availability of livestock feeds and fodder. An estimate showed that the availability of straw, green fodder and concentrates were 20.51, 23.58 and 2.79 MMT against the requirement of 16.27, 70.42 and 27.73 MMT (Alam, 2002). The importance of fodder production and feeding to livestock has been highlighted by many scientists in their research reports in the past (e.g. Akbar et al., 2005; Akbar et al., 2003; Shahjalal et al., 1994; Khan et al., 2006). It is fact that feed cost in a farm constitutes ~75% of the total cost for rearing livestock and therefore almost consideration must be given to reduce feed cost keeping the nutrient supply optimum. This is a key factor in making profit in livestock farming. Feeding fodders to livestock for milk production and fattening not only stimulates milk yield and growth of livestock but also reduces feed cost and make the farming profitable. Therefore, throughout the world fodder is the major ingredient in a dairy ration.

In our country shortage of fodder is the main hindrance for dairy development. Usually the rural farmers do not grow fodders in the cultivable land for feeding livestock because of the pressure of land use for food crop production. Therefore, the scanty amount of forages, which are available, mostly from the roadsides, fallow homesteads, crop weeds etc. and are of poor quality indigenous species. These forages are absolutely seasonal, available in monsoon when plant growth is high. During dry season and flood there are no grasses available for the animals. However, now-a-days even in the rural areas the farmers are getting interested in dairy farming and therefore a number of medium scale dairy farmers are growing throughout the country in response to the increased demand for milk production and consumption. These farmers are also growing improved varieties of grasses and other forages to feed their milking cows for better production. In some cases where the farmers are able, growing forages in excess of their requirements and facing problems with the utilization of the costly grown forages, which is otherwise being wasted. This problem is causing reduced interest in dairy farming among such farmers. On the other hand, during dry season there is poor growth of even high yielding fodders, the total yield of which cannot satisfy the requirements of the milk producing crossbred cows. Consequently there is obviously a reduced milk production of cows of the farmers. The main reason for the problem is that the farmers never practice preservation of forages for future feeding during scarcity period e.g. during dry and flood season. The fluctuation of fodders in the country is a big problem and is another important reason for reduced milk yield and growth of our livestock which has been highlighted (Akbar, 2003). The seasonal deficits can considerably be reduced by the conservation of excess forage produced in a monsoon and feeding to animals in the periods of need.

Forages are usually consumed fresh by domestic animals. However, it is possible to conserve them for use during future periods of feed shortage. Conservation of forages can be achieved by sun drying (hay), artificial drying (meal) and through silage making (Mannetji, 2003). Among these three processes hay and silage making are more popular. Silage feeding to milk producing cows is very important and there are number of reports available regarding the benefits and positive effect of silage feeding on increased milk production (Kaiser and Evans, 1988; Vargas-Bello-Perez et al., 2008). Preservation of fodder by silage making is done under anaerobic conditions where microorganisms use the fermentable sugars in fodder to produce organic acids, mainly lactic acid (Bolsen et al., 1996) also break down some nutrients of fodders to simpler forms so that they can be digested and utilized by the animals easily. Apart from that, silage is very palatable due to its aromatic smell, juicy in nature and softness. All these characteristics of silage contribute to increased production. Grass silage forms the basal forage for the majority of ruminant livestock, particularly dairy cows, during the winter in developed countries. The feed value of grass silage is a combination of its intake potential and nutritive value, which is determined primarily by digestibility. Grass silage feed value impacts on milk production (Anwar, 1991).

The most widely ensiled fodder for silage is maize due to its high contents of non-fiber carbohydrate (NFC) which is the key for lactic acid production for better preserving forages. Other high NFC containing forages are Jumbo, sorghum, oat, barley, pearl millet and other similar cereal grain producing forgaes can also produce good quality sialges. However, the high yielding grasses like napier, german, dal and similar other grasses with low NFC containing forages can also make good silage with some additives supplying soluble carbohydrates. It has been reported 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. Even leguminous grasses and fodders can also be made silage with addition of ingredients containing soluble sugars. Since silage can be made from various types of grasses and forages containing different levels of NFCs, and can be made with different NFC supplying agents, there might be variation in the quality of silage and in consequence that might have effect on milk production of the fed cows.

In this country works have been done on the methods of preservation of forages by silage and development of low cost silage making system. However, in our country the works on feeding silage to dairy cows and its impact on milk yield and overall performance of the cows are scanty. Therefore making silage, feeding to crossbred dairy cows and its effect on milk yield is important in the context of growing interest of the rural farmers in dairy farming as well interest in growing high yielding fodders. Moreover, these farmers need to be motivated to adopt the technology of fodder preservation and feeding during scarcity period to get better production of animals. With these views in mind the present study was undertaken to examine the quality of different types of silage made from different forages as an alternative to feeding in fresh form and to investigate the effect of different silages on milk production of milch cows.

## MATERIALS AND METHODS

### Site of the experiment

The experiment was carried out in a village called Digholgao under Muktagacha upazila of Mymensingh district. In that village the animals of a farmer having a good number of milking crossbred cows were used for the experiment. The farmers cultivate improved varieties of grasses in his crop field for feeding livestock but yet he faces fodder scarcity during dry season.

The experimental activities done in the above village involved fodder cultivation and harvesting, silage making, feeding trials with dairy cows and the laboratory analysis. The fodder cultivation, silage making and feeding trials were conducted in the farm of that village and the analysis for chemical composition of feeds & fodders and silages were accomplished in the laboratory of the Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh.

### Fodder cultivation

Maize and napier fodders were cultivated in two different field plots. The land for maize fodder was ploughed and cross ploughed four times with tractor and bullock drawn country plough by laddering to obtain desirable soil texture. Weeds and stubbles of the previous crops were removed from the lands. In the case of napier fodder cultivation, the BLRI hybrid napier cutting was used and BARI hybrid maize seed was cultivated. In both maize and napier cultivation, the N and P fertilizer were applied at the rate of 100 and 10 kg/ha respectively. The maize and napier fodders were harvested at 70 days of age about 15 cm above the ground level. All these works were done in the farmers' field by the farmer himself.

### Silage making

After harvesting maize and napier fodders were wilted to bring down their moisture content to the desired level for good silage preparation. Three types of silage were prepared: (i) chopped maize silage, (ii) chopped napier silage and (iii) whole grass napier silage. For chopped silage, maize and napier fodders were chopped at 3 cm using a locally manufactured grass chopper so that the ensiling material was pressed properly in the silo pit to remove as much air as possible in order to make anaerobic condition for desirable microbial fermentation. Three different silo pits were prepared by manually digging on a high and leveled ground for making silages for chopped maize fodder, chopped napier fodder and for whole grass napier fodder. The polythene sheets were spread in the pit with the four well extended sides so that after filling the pit the silage mass could be covered to make the mass airtight. The chopped maize was spread evenly in one of the pit in layer after layer and in between three persons was foot pressing the chopped forages to make the mass as compact as possible. In this way the silo pit was filled with the forage and finally covered the pit with the extended sides of the polythene and again covered with loose soil and ensured it for complete airtight. The next pit was filled with chopped napier in the same way as in the case of maize forage filling, but during the filling in layers, 2% molasses (silage additive) solution were sprayed over the layer of chopped grass for efficient microbial fermentation. In case of whole grass napier silage making, the procedure was the same as in the case of chopped napier. All the silo pits were covered with loose soil to ensure complete anaerobic condition inside.

## Nutritional evaluation of silages

### *Silage opening, sample collection and processing*

The silo pits were opened after 8 weeks of their date of preparation. Samples of each silage were collected by opening in one side of the pit with a small opening area so that large amount of air cannot enter. The samples from each silage were collected in triplicate for nutritional evaluation. The silage samples were collected manually from the silo pits by using hand gloves. The samples were placed in the plastic containers and immediately transferred to the laboratory for testing $P^H$ and determination of dry matter. The mouth of the container was sealed immediately after collection to avoid the evaporation losses of N. After determination of $P^H$ and DM, the samples were sun-dried and were pooled to ground to pass through 20 mm screen sieve for chemical analysis.

### *Physical characteristics of silage*

For testing physical characteristics, the three silage samples were taken on a tray and placed on the table. The color, smell and texture of the silage were observed by the sense organs such as eye, nose and hands. The temperature of the silage samples was determinate by the thermometer. $P^H$ of Silage was determined by using a laboratory pH-mV meter (in Lab, Germany).

### *Chemical Analysis of Silage*

Dry matter of silage was determined by the elimination of moisture from the silage samples by low heating in an oven at $50^0$C at the start and thereafter slowly increasing heat to $80^0$C in 2 days. During heating a considerable amount of moisture was removed and the remaining residue was the dry matter of the silage.

Crude protein of silage was determined by Kjeldahl method according to AOAC, 1990. Ammonia-N ($NH_3$-N) of the silage samples were determined by using Markham still following a standardized method of the Animal Nutrition laboratory of the DLS, Khamarbari, Farmgate, Dhaka. Total Volatile Fatty Acids (TVFAs), Acid Detergent Fibre (ADF), Neutral Detergent Fibre (NDF) were determined according to the methods described elsewhere.

## Animal feeding trial

### *Selection, housing and management of animals*

Twelve (12) Holstein Friesian crossbred dairy cows of the farmer in the village of Digholgao were selected for the feeding trial experiment. The cows were almost similar live weight around 450±5 kg and approximately 5-6 years old. They were all at $2^{nd}$ to $3^{rd}$ lactation and the cows were in $30^{th}$ to $40^{th}$ days of lactation. The average daily milk production of those cows was ~14 kg. They were randomly distributed to four groups each group consisting of 3 animals. The animals were housed in a well ventilated shed having 5 x 8 ft cemented floor pen with stanchion face-in system, well drained floor and good hygienic condition. The experiment was continued for 90 days.

***Formulation of diets***

Fresh napier grass, rice straw, wheat bran, rice polish, mustard oil cake, molasses, mineral mixture, di-calcium phosphate (DCP) powder and common salt were the basal dietary ingredients of the experimental cows. Three rations (considered as dietary treatments) were prepared manually using the above ingredients: (i) Control containing the above basal ingredients and mixture of napier and maize designated as $T_0$ ; (ii) ration containing basal ingredients + whole grass napier silage $T_1$; (iii) ration containing basal ingredients + chopped napier silage $T_2$ ; (iv) ration containing basal ingredients + maize silage $T_3$. The four rations were randomly supplied to four groups of cows so that each cow received one ration. The cows were fed with the ration formulated manually by the farmers which he has been practiced for long time and having a good milk production. Only the concentration of energy and protein were checked and found alright according to the Morrison feeding standard. The cows were supplied daily ~ 3.5 kg dry matter for every 100 kg of live weight. In the experimental diet approximately two third of total dry matter was roughages and little more than one third the concentrates. In the total roughage feed, two third of dry roughage and one third of green roughage was considered for feeding. The amount of silage was supplied to the cows as a replacement of the basal diet with green grass. The ingredients and their amount in the rations are shown in Table 1.

Table 1
Ingredient composition (fresh basis) of the rations fed to cows.

| Ingredients (kg) | Dietary Treatments | | | |
|---|---|---|---|---|
| | $T_0$ Mixture of fresh grass | $T_1$ Napier whole grass silage | $T_2$ Napier chopped silage | $T_3$ Maize silage |
| Straw | 10.00 | 10.00 | 10.00 | 10.00 |
| Napier Grass | 15.00 | 7.50 | 7.50 | 7.50 |
| Maize Silage | - | - | - | 7.50 |
| Napier Silage (Chopped) | - | - | 7.50 | - |
| Napier Silage (Whole) | - | 7.50 | - | - |
| Wheat bran | 2.80 | 2.80 | 2.80 | 2.80 |
| Rice polish | 2.20 | 2.20 | 2.20 | 2.20 |
| Mustard oil cake | 0.55 | 0.55 | 0.55 | 0.55 |
| Molasses | 1.40 | 1.40 | 1.40 | 1.40 |
| Di-calcium Phosphate | 0.07 | 0.07 | 0.07 | 0.07 |
| Mineral Mixture | 0.07 | 0.07 | 0.07 | 0.07 |
| Salt | 0.07 | 0.07 | 0.07 | 0.07 |
| Estimated nutrients (kg/100 kg BW): | | | | |
| Digestible Crude Protein | 0.23 | 0.22 | 0.23 | 0.23 |
| Total Digestible Nutrient | 1.99 | 2.15 | 2.15 | 2.16 |

DM, TDN and DCP requirements were calculated based on Morison Feeding Standard.
BW= Body weight.

***Methods of silage feeding***

Since the animals were not habituated with silage feeding, it was supplied to the animals gradually increasing the amount over a few days. The feeds, both roughage (green grass and silage) and concentrates were fed separately and concentrates were given first followed by roughage. In the roughage, the silage was given first followed by green grass. Total amount of required concentrate, rice straw, green grasses and silages were weighed out daily and divided into two halves and were supplied to the cattle twice daily, one half in the morning at 7:30 a.m. and the other at 2:30 p.m.

Drinking water was available all the time to the animals. When silage feeding was started, the polyethylene sheet of silo pit was removed and silage was withdrawn starting with the upper layer and working downwards to the lower layer. After taking required amount of silage from each silo pit, just sufficient for one day's feeding, the polythene sheet was put back to keep the pit sealed.

**Record of milk production**

Daily milk yield of the cows were recorded in a register book throughout the experimental period.

**Statistical Analysis**

The data on daily milk production of the experimental cows were analyzed statistically following completely randomized design (CRD) and the significant differences among the treatment means were determined using DMRT (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

**Physico-chemical characteristics of silage**

The data on physico-chemical characteristics of maize, napier chopped and napier whole grass silage are shown in Table 2. Maize and napier chopped silages were similar in their properties having straw yellowish colour, pleasant alcoholic odour, soft texture, pH of 4.26-4.27 and temperature of 20°C while the whole napier grass ensiled properties possessing slightly lower quality characteristics than those of maize and chopped napier silages such as sour smell, hardy texture, higher pH of 5.26 and temperature of 22°C. It has been reported that good silage usually preserves the original colour of the pasture or straw yellowish colour, aromatic smell, and the PH around 4 (Mannatje, 1999).

The straw yellowish colour of the two silages (maize and chopped napier) as has been found in the present study is in agreement with the report of Oduguwa et al. (2007) indicating that the silages were of good quality.

The silages of maize and napier chopped exhibited pleasant alcoholic aroma which is an indication of well-made silage as has been reported by Kung and Shaver (2002) stated that pleasant smell was indication of good or well-made silage. The temperature of fermenting forage varying from 27-38°C was presumed to produce excellent silage (Muck, 1996). In the present study the temperature of maize and napier chopped silages were 20°C which was lower than the range (25-27°C) obtained by Babayemi (2009) in silage of Guinea grass. However, there are reports that the good quality silage should be cooled at opening and at feed out phase having a normal room temperature (McDonald et al., 1995). Bolsen et al. (1996) reported that any excessive heat production can result in maillard or browning reaction which can reduce the digestibility of protein and fibre components. The useful proteins form complexes with carbohydrate and thereby making them less digestible. Temperature is one of the essential factors affecting silage colour. The lower the temperature the better the silage, the less the colour change. If the temperature obtained for the present silages was above 30°C the grass silage would have become dark yellow or brown due to caramelization of sugars in the forage (McDonald et al., 1995). However the temperature (20°C) obtained in the present study indicates that the silages were well-made and of good quality. The texture of the silages was firm which was expected to the best texture of good silage (Kung and Shaver, 2002). Slimy texture or mould or fungi growth indicates spoilage in the silage. The pH value of the silages was within the range of 3.5-5.5 classified to be pH for good silage (Menesses et al. 2007). Generally pH is one of the simplest and quickest ways of evaluating silage quality. However, pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage that has been properly fermented will have a much lower pH (be more acidic) than the original forage. Kung and Shaver (2002) in their interpretation of silage analyses stated that a good quality grass and legume silage pH values in the tropics ranges between 4.3 and 4.7. The pH value of 4.3 obtained in the present experiment was in agreement with the values 4.2 – 5.0 reported by Babayemi (2009) and 4.3-4.7 by Kung Shaver (2002).

**Chemical composition of silage**

The data on chemical composition of maize, napier chopped and napier whole grass silages are shown in Table 3. The DM contents of maize, napier chopped and napier whole silages were 20.47, 21.13 and 17.89% respectively. All these values seem to be slightly lower than that reported by Kaiser et al. (2010) who found the DM content of ryegrass silage given to cows for milk production ranging from 22.4 to 25.7. The lower values of the DM of silages of the present study might be due to high moisture content of the forages during ensiling as because the forages could not be wilted enough to reduce their moisture due to rainy season. However, Yang (2004) found even lower values (16.9%) of DM of napier silage. The author also found an almost similar (15.6 and 16.9%) DM content of fresh napier grass and napier silage. It is evident in the present findings that the DM content of fresh grass and silage of maize and napier were almost similar. In fact excellent silage DM should range from 25 to 30%. The higher values were also reported by some scientists. Pilipavicius et al. (2003) reported that maize silage contained 34% DM. Pilipavicius et al. (2003) reported that maize silage contained 34% DM, 7.8% CP, and 19.0% CF. Meanwhile, the CP content in maize silage (9.16%) was higher as observed by Pilipavicius et al. (2003).

Table 2
Physico-chemical characteristics of silage.

| Parameter | Maize | Napier chopped | Napier whole grass |
|---|---|---|---|
| $P^H$ | 4.26 | 4.27 | 5.26 |
| Color | Straw yellowish | Straw yellowish | Light green |
| Aroma | Pleasantly alcoholic | Pleasantly alcoholic | Slightly sour |
| Texture | Soft | Soft | Slightly hard |
| Temperature ($^0$C) | 20 | 20 | 22 |

Table 3
Chemical composition of maize, napier chopped & whole grass silage (g/100g DM).

| Parameter | Maize | | Napier | | |
|---|---|---|---|---|---|
| | Fresh | Silage | Fresh | Chopped Silage | Whole grass silage |
| DM | 19.00 | 20.46 | 18.78 | 21.13 | 17.89 |
| CP | 8.10 | 9.16 | 8.73 | 8.96 | 7.03 |
| ADF | 32.34 | 45.66 | 43.60 | 53.60 | 57.40 |
| NDF | 55.80 | 77.20 | 62.36 | 77.27 | 88.45 |
| Ammonia-N | - | 9.20 | - | 9.85 | 7.57 |
| TVAFs | - | 11.75 | - | 11.40 | 10.20 |

Where, DM- Dry Matter, CP- Crude Protein, ADF- Acid Detergent Fiber, NDF- Neutral Detergent Fiber, TVFAs- Total Volatile Fatty Acids.

The crude protein (CP) contents of maize, napier chopped and napier whole grass silage were 9.16%, 8.96% and 7.03%, respectively as can be seen in Table 4.2. The CP content of maize silage was reasonably high which the indication of good silage is. Related to these findings, Pilipavicius et al. (2003) reported that maize silage contained 7.8% CP. Lower CP content in silage is the indication of more breakdown of protein and more nitrogen loss from silage mass. The slightly lower CP contents of napier chopped silage (8.96%) also indicates that the silage was of good quality. More breakdown of protein in the silage of whole napier grass indicated from low level of its CP content. The acid detergent fiber (ADF) contents of maize silage (45.66%) and napier chopped (53.60%) and whole napier silage (57.40%) were higher than fresh maize (32.34%) and napier fodder (43.60%).

The ADF content in forages is adversely related to the digestibility of organic matter and accordingly metabolizable energy content of forages. So, from that point of view it is assumed that maize silage is the best among all the silages prepared in this study. The ammonia-N content of maize, chopped napier and whole grass napier silage were 9.20%, 9.45% and 7.57%, respectively. The ammonia-N content indicates the level of protein break down or proteolysis and fermentation during the ensiling process. For good fermentation process, some level of proteolysis process takes place and brakes down the some portion of proteins of silage and produce ammonia-N. The ammonia-N content of maize silage in the present experiment was 9.20% which is an indication of good silage. The chopped napier silage gave rise to 9.85% which is well within the normal range and also indicative to a good silage. However, the CP content of whole napier silage (7.57%) is surprisingly lower than the other two silages indicating that the fermentation process might have been very low during ensiling.

Table 3 also shows the Total Volatile Fatty Acids (TVFA) contents of maize, napier chopped and napier whole grass silage were 11.75%, 11.40% and 10.20%, respectively. Generally it is recommended that lactic acid should comprise 65 % of the total TVFAs content and that the lactic acid: acetic acid ratio should not be less than 3:1. The recommended TVFAs of silage are 6-13% (Technical Paper, Hill Laboratories). The TVFAs value indicates the fermentation level of soluble carbohydrates during the ensiling process. High TVFAs values are the indication of higher level of lactic acid present in the silage for effective fermentation during the ensiling process. In the present experiment it was observed that the TVFAs content of maize and chopped napier silages were similar although maize fodder inherently contained higher soluble carbohydrate than that in napier. The reason could be that during ensiling molasses solution was added as additive to the napier silage

**Milk Production due to silage feeding**

Data of milk production of the dairy cows fed on different rations collected at fortnight (15 days) intervals are presented in Table 4. The data shows that there are significant ($p<0.01$) differences among the mean values of milk yield of cows fed different rations at all the fortnights. Milk yield data in the table also shows that all the silages (irrespective of type) fed animal groups have given significantly higher yields than that of the control group of animals. This might be due to higher digestibility of silage compared to that of fresh grass.

Table 4
Effect of feeding different types of rations including silage on milk production of dairy cows.

| Treatments | Milk yield (L/d) at fortnight interval | | | | | | |
|---|---|---|---|---|---|---|---|
| | Average Milk Production | 1st | 2nd | 3rd | 4th | 5th | 6th |
| $T_0$ | 14 | 14.06b | 13.93c | 14.60c | 14.79c | 15.92c | 15.09c |
| $T_1$ | | 14.39b | 15.58b | 16.61b | 17.39b | 18.12b | 18.64b |
| $T_2$ | | 14.51ab | 16.18ab | 17.20ab | 18.14ab | 19.40ab | 21.48a |
| $T_3$ | | 15.53a | 17.08a | 18.07a | 19.13a | 20.86a | 22.99a |
| LSD | | 0.60 | 0.57 | 0.70 | 0.70 | 1.23 | 1.11 |
| SED | | 0.21 | 0.37 | 0.42 | 0.51 | 0.61 | 0.94 |
| Level of sig. | | * | ** | ** | ** | ** | ** |

$T_0$= Basal diet + Mixture of fresh grass (Napier+Maize); $T_1$= Basal diet + Napier grass + Napier whole grass silage; $T_2$= Basal diet + Napier grass + Napier chopped silage; $T_3$= Basal diet + Napier grass + Maize silage; NS= Non-significant, **= Significant at 1% level of probability; Abc = Mean values having different superscripts in a row differ significantly; SED= Standard error of deviation

There are evidences that silage making improved the digestibility of fodder. Sarwar et al. (2005) reported that the digestibility of silage was higher than the fresh grass. In his research he found that the apparent DM digestibility (DMD) of fodder-based diet was significantly ($p<0.05$) different than that of silage-based diet. However, in the present study the milk yield of cows fed maize silage produced significantly ($p<0.01$) higher quantity of milk than that of animals in control group as well as that of animals in group consuming whole napier grass silage. Vargas-Bello-Perez et al. (2008) reported that feeding silage to dairy cows increased milk yield. There was no significant difference in milk production of animals of treatment group $T_3$ consuming maize silage and those of treatment group $T_2$ receiving chopped napier grass although the production was higher in animals receiving maize silage.

It is well known that maize forage contains plenty of soluble carbohydrate, part of which can be broken down to produce sufficient lactic acid during ensiling to better preserve the silage materials. On the other hand napier contains less sugar for microbial fermentation consequently less lactic acid production during ensiling for preservation. Based on this assumption, it was expected that maize silage would give significantly higher milk yield than that of napier silage. However, the non-significantly higher milk yield of animals fed maize silage could be due to the fact that napier silage was added with molasses solution during its preparation. Molasses was added to the napier silage in order to increase the production of lactic acid during ensiling process. Amer and Mustafa (2010) reported that milk yield response by corn silage was better than that of pearl Millet. Cabral et al. (2006) also observed that corn silage diet resulted in the greater apparent total tract digestibility of DM (66.3%), OM (68.9%), NDF (55.7%) and total carbohydrates (68.2%).

Milk production of the animals of receiving ration $T_1$ containing whole napier grass was significantly lower than that of animal fed rations containing maize silage. This might have been due to the fact that the whole napier grass silage was of lower quality than maize silage. The underlying reason for inferior quality of whole napier silage has been evident from its physico-chemical characteristics as well as lower crude protein content compared to those of the maize silage.

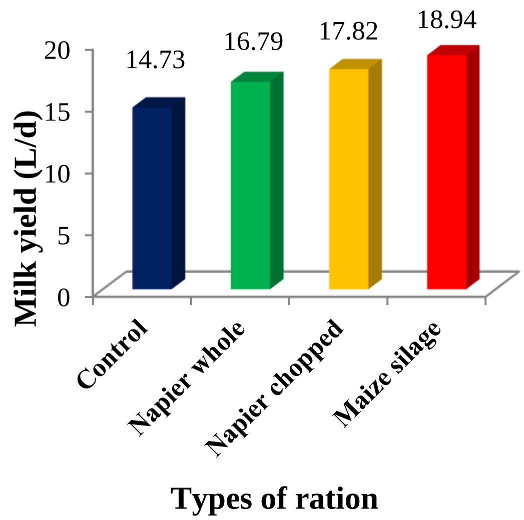


Figure 1
Average milk yield per day of cows fed different rations.

The average of all fortnight's (90 days) milk production of dairy cows of all groups receiving different rations and increase in yield of the silage fed animals over that of the control has been shown in Figure 1. There are significant ($p<0.01$) differences among the mean values of different groups of animals consuming different rations. In fact all the silage fed animals of the treatment groups maize silage, napier chopped and napier whole silages gave rise to significantly increased milk yield over that of the control group where maize silage group showed the highest followed by chopped napier and then napier whole silage.

Average milk production were increased at 13.97%, 20.96% and 28.59% for the animals fed napier whole grass, napier chopped and maize silages, respectively over that of the animals of control group as shown in Figure 2.

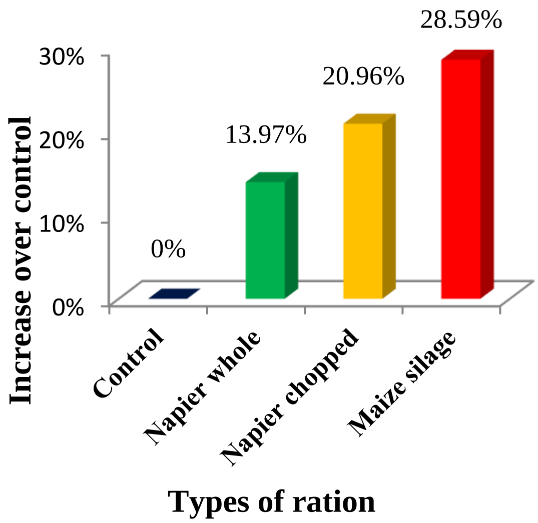


Figure 2
Increase in milk yield (over control) due to feeding different rations.

Animals of all the groups receiving silage containing rations gave significantly ($p<0.01$) higher percentage of increase over that of the control. On the other hand when the silage fed groups of animals were compared it was found that maize silage containing ration resulted in significantly higher percentage of increase in milk yield. The increased milk production of dairy cows fed maize silage diets might be due to higher level of digestibility of silage as might be assumed from the higher crude protein and lower level of ADF content. The results are in similarity with the findings of Cowan (1997) and Kaiser and Evans (1988) who observed that dairy farms which persist with using maize silage have larger herd sizes (by 40 to 60 cows), higher milk production per cow (by 600 to 2000 liters) and greater total milk output (by 300000 to 700000 lit/yr) than farms not using silage.

## CONCLUSION

Based on the findings in respect of physical characteristics, chemical composition, pH, ammonia nitrogen ($NH_3$-N), total volatile fatty acids (TVFAs) of silages and effect of silage on milk production of dairy cows it may be concluded that maize or chopped napier silage can be an effective alternative to green fodder during the period of fodder scarcity for continuing the milk production of dairy cows. Feeding silage to dairy cows increase milk production compared to fresh grass. Maize can produce better silage for increasing milk production compared to napier silage. Chopping napier grass before ensiling can give slightly better quality silage than whole napier grass.

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