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EFFECT OF FEEDING UREA-MOLASSES TREATED TEFF STRAW ON MILK YIELD AND COMPOSITION OF CROSS BRED DAIRY COWS

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ABSTRACT: An experimental work was conducted on crossbred lactating dairy cows in University of Gondar dairy farm with the objective of investigating the effect of urea-molasses treated teff straw feeds on milk yield and its composition. Six Holstein-Friesian crossbred experimental animals with the blood level of 75%, the first stage of lactation and all on fourth parity were purposively selected. Experimental animals were assigned to the three treatments by lottery system using completely randomized design. Treatments were prepared with the protocol of low protein concentrates mix + untreated straw (T1) as a control group, low protein concentrates mix + urea molasses treated straw (T2) and high protein concentrates mix + untreated straw (T3). The straw was sprayed with 5kg of urea, 50 liters of water and 5 kg of molasses solution per 100 kg of Teff straw incubated for 14 days in a pit silo. About 250 ml of milk was taken every week for milk composition analysis during the study. The result of this study indicated that statistically significant ($P<0.05$) difference on daily milk yield between cows fed on low protein concentrates mix plus urea molasses treated straw (T_2) and cows fed on low protein concentrates mix (LPCM) + untreated straw (US) (T_1). Similarly, there was statistically significant ($P<0.05$) difference on daily milk yield between cows fed on low protein concentrates mix plus urea molasses treated straw (T_2) and cows fed on high protein concentrates mix (HPCM) + untreated straw (US) (T3). But there was no statistically significant ($P>0.05$) difference among treatments for fat, protein, lactose and ash contents of milk. The result also showed no statistically significant ($P>0.05$) difference among treatments for dry matter intake. From this result, it can be concluded that treating crop residues like straw with urea and molasses can improve milk yield of dairy cows but has less impact on milk composition. The statistically non significant differences of milk yield between cows fed on low protein concentrate and high protein concentrate invites researchers to investigate the nutritional qualities of ingredients used in the high protein concentrate mixture.

Keywords: Composition, Milk Yield, Molasses, Treatment, Urea

INTRODUCTION

Livestock production is an important part of the farming practice in Ethiopia and it plays an important role in the livelihoods of the majority of people in the country. Livestock has serving in providing milk, meat, draught power, manure, hides and skins. The livestock population of Ethiopia is estimated to be 56.70 million cattle, 29.33 million sheep, 23.11 million goats, 2.03 million horses, 0.40 million mules, 7.42 million donkeys, 1.16 million camels and 56.86 million chicken and 5.88 million beehives (CSA, 2015).

In Ethiopia about 3.07 billion liters of milk produced from 11.8 million milking cows, an average of 1.35 liters per cow per day over a lactation period of six months (CSA, 2015). Per capita milk consumption of Ethiopia is estimated to be 14.6 kg (Speedy, 2003) and 32% of the total milk produced, is estimated to be consumed by calf (Getachew and Gashaw, 2001). The nutritional importance of Dairy products such as whole milk, cheese butter, whey, skimmed milk, cream and ghee is very high in human diet by providing nutrients such as Vitamin A, carbohydrates, protein and calcium. Genetic makeup and nutrition are the main factors that affect milk yield and composition. Nutrition has a direct impact on milk composition. Level of milk production has also some influence on milk constituents (Tripathi, 2014).

Currently, the feeding habit and preference of milk protein of Ethiopian people in common with people in other regions of the globe are becoming changed and increase rapidly both in quality and quantity (Delgado, 2003). Especially the demand of animal protein source diets such as milk, meat and eggs is being reasonably increased from time to time. Though the demand is rising, Per capita milk consumption in Ethiopia is estimated to be 20 litters which is still much lower than the recommendations of world health organization that is 200 liters of per capita consumption. This is due to the dairy sector in Ethiopia is highly constrained by different factors. Feed and weak animal health service are the leading factors affecting the production potential of the country (Tassew and Seifu, 2009). The main source of feed for dairy cows are natural grass hay, elephant grass, purchased concentrate feeds (soya bean, wheat, grass pea and maize) and brewery grain. However the fluctuation in the supply of these concentrate feed sources is becoming a common tragedy for dairy producers in the area. Moreover, low quality hay

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and crop residues which are the basal feed of our farm induces big fluctuation in milk production when concentrate feed sources are in short supply. Looking for different feeding strategies may be a solution so as to sustain the production in the farm to provide the product to the community in a sustainable manner. Feed treatment and supplementation are considered as feeding strategies in dairy feeding. However feed treatment technologies to improve feeding value of poor quality hay and crop residues used in the farm are not yet being practiced in the farm as well as in the study area. This study was therefore initiated with the general objective of investigating the effect of feeding urea- molasses treated teff straw on milk yield and composition of a crossbred dairy cow as one feeding strategy.

MATERIALS AND METHODS

Description of the study area

The study was conducted in the University of Gondar dairy farm found in Gondar town of North Gondar Administrative Zone, Amhara Region, Ethiopia. Gondar is located 738km and 180km northwest of the capital, Addis Ababa and regional city of Bahir Dar respectively. The area is located between geographical coordinates 12.3º to 13.38 north latitudes and 35.5º to 38.3º east longitudes and the altitude ranges from 550 to 4620 meters above sea level. The average annual rainfall varies from 880mm to 1772 mm, which is characterized by Bimodal type of distribution. Minimum and maximum temperatures are 10ºC and 44.5ºC respectively.

Sampling techniques and sample size

Six Holstein Friesian crossed experimental animals with a 75% of blood level, fourth parity and up to 6 weeks (first stage) of lactation were purposively selected. Experimental animals were assigned to the three treatments by lottery system using completely randomized design method.

Feed preparation

All the feeds required was cheeked for their availability in the farm first and no external source was needed. Urea-molasses treated straw was prepared by treating the 100kg Teff straw with a solution of the ratio 5kg urea to 50 liter water to 5kg molasses. A pit silo (3m×4m×1m volume) was prepared and covered with 22 µm plastic sheet. The straw was sprayed with the solution prepared and compacted layer by layer to exclude the entrance of oxygen. Then after the silo was covered with the plastic sheet and incubated for 14 days. Two different concentrate feed mix for treatment were prepared from different types of feed on the basis of their protein content as high protein concentrate mix and low protein concentrate mix. Urea Molasses treated and untreated straw was given to experimental animals as a basal diet for the entire six experiment and two adaptation weeks. Two adaptation weeks (14 days) to the test feeds was given to introduce the feed to the animals and avoid effect of previous feed on milk yield (Broster, 1984) .

Experimental design and treatments

Six Holstein Friesian and Fogera cross bred dairy cows with the same parity(fourth parity) and stage of lactation (first stage of lactation) was selected to make the experimental animals homogenous and assigned to the three different treatments with a complete randomized design. The treatments employed were the following; Treatment one (T1) = Low protein concentrates mix (LPCM) + untreated straw (US), Treatment two (T2) = Low protein concentrates mix (LPCM) + urea molasses treated straw (UMTS), Treatment three (T3) = High protein concentrates mix (HPCM) + untreated straw (US). Employing such treatments seems odd but, it was designed to evaluate the effect of urea molasses treatment of teff straw by comparing T1 and T2 means. Along with that, effect of high protein concentrate mix was evaluated by comparing group of animals received high protein concentrate mix (T3) with the group of animals received low protein concentrate mix (T1) where both of the treatments received the same basal diet, untreated teff straw.

The model used in CRD was $Y_{ij} = \mu + t_i + \varepsilon_{ij}$

Where: Yij is the jth observation of the ith treatment, µ= is the population mean, t_i= is the treatment effect of the ith treatment, and ε_{ij}= is the random error

Data collection and analysis

The primary data on milk yield was recorded daily in the morning and afternoon and 250 ml milk was taken for milk composition analysis every week of the experimental period. A total of forty two days milk yield were collected at morning and evening from selected experimental animals by using recording sheet. Statistical analysis system (SAS version 9.2) was used to analyze the quantitative data collected and presented with tables.

Table 1 - High proteins concentrate mix formulated

S.N	Ingredient	Proportion in the concentrate mix (%)
1	Full fatted soya bean	16
2	Grass pea/ guaya	15
3	Maize	43.8
4	Wheat bran	22
5	Salt	1
6	Limestone	2.2
Total		100

Table 2 - Low proteins concentrate mix

S.N	Ingredient	Proportion in the concentrate mix (%)
1	Wheat	44
2	Wheat bran	12
3	Maize	40.7
4	salt	1
5	Limestone	2.3
Total		100

RESULTS AND DISCUSSION

Dry matter intake

Due to the limitation of facilities, only dry matter and crude protein contents of the feed ingredients were analyzed (Table 3). The result of this study showed that there were no statistically significant difference (P>0.05) among treatments in the dry matter intake. But, cows fed on low protein concentrate plus urea molasses treated straw (T2) consumed numerically higher dry matter than cows fed on low concentrate mix plus untreated straw (T1) and cows fed on high protein concentrate mix plus untreated straw (T3).

Research reports showed that urea treatment of straw resulted in saving the amount of the expensive protein supplement incorporated into the concentrate mixture and increase of straw intake leading to enhanced animal performance (Al-Shami and Al-Sultan, 2006). But, the result of this study did not bring significance difference in the dry matter intake of treated and untreated straw. Since roughage diets are poor in their nutritional value the bioavailability of nutrients will be affected which in turn affects the intake. Though there is no statistically significant difference (P>0.05), cows fed on high concentrate mixture consumes numerically more dry matter of the straw than cows fed on low protein concentrate mixture. This result was supported by reports indicating that feeding concentrates can improve dry matter intake of straw (Mesfin and Ledin, 2004).

Contrary to this result; increment in the voluntary dry matter intake of the urea treated roughage component of the ration was reported by (Dejene et al., 2009). In line with the result of this study, other researchers reported that urea treated straw to be superior to untreated straw in terms of crude protein content (Saadullah et al., 1981). The nitrogen posed on the treated straw improves the microbial protein synthesis which was shown to improve milk yield (Table 4). As a result of increase in milk yield, the amount of concentrate was increased. This is because provision of concentrate was based on milk yield as recommended by Harrington and Kellaway (2004) so that the total DM intake was numerically higher.

Table 3 - Chemical composition of feed ingredients used in the experiment

Feed ingredient	Dry matter content (%)	CP content (% DM basis)
Full fatted soya bean	87.8	38.9
Grass pea	91.4	29.8
Maize	87.6	9.7
Wheat bran	89.1	17.9
Wheat	88.2	11.5
Un treated teff straw	94.7	3.6
Urea-molasses treated teff straw	45.3	8.5

Cp= crude protein, DM= dry matter

Table 4 - Dry mater intake of experimental animals

S.N	Treatment / Dry Matter Intake (kg/day; mean ±SD)	Concentrate mix	Straw	Total
1	T1 (LPC+US)	5.25±0.31^a	8.48±0.35^a	13.73±0.66^a
2	T2 (LPC+ UMTS)	6.00 ±0.00^a	8.58±0.47^a	14.58±0.47^a
3	T3 (HPC +US)	4.25±1.06^a	8.81±0.15^a	13.06±1.21^a
Least significant difference (LSD)		2.05	1.07	2.68

LPC= low protein concentrate mix; HPL= high protein concentrate mix; US= untreated straw; UMTS= urea molasses treated straw;

Milk yield of dairy cows

There was statistically significant (P<0.05) difference in the milk yield per day between cows fed on low protein concentrate plus urea molasses treated straw (T2) and cows fed on low concentrate mix plus untreated straw (T1). Similarly, cows fed on low protein concentrate plus urea molasses treated straw (T2) and cows fed on high protein concentrate mix plus untreated straw (T3) showed statistically significant (P<0.05) difference in the daily milk yield. In line with the result of this study the Substantial increase in milk yield of crossbred dairy cows fed on urea treated Teff straw supplemented with a concentrate mixture was reported (Dejene et al., 2009). But, there was no statistically significant difference (P> 0.05) between cows fed on low concentrate mix plus untreated straw (T1) and cows fed on

high protein concentrate plus untreated straw (T3). But; there was numerical differences between the cows fed on low concentrate mix plus untreated straw (T1) and cows fed on high protein concentrate plus untreated straw (T3).
In fact; the high protein concentrate mixture should bring high milk yield than low protein concentrate mix received the same basal diet. But the result of this study is contradictory to the fact. This might be attributed by the anti-nutritional factors contained in full-fat soybean in high protein concentrate mixtures. There are evidences that many kinds of anti-nutritional factors, such as trypsin inhibitor, lectin, α-amylase inhibiting factor, goitrin, and soybean antigen are contained in soybean (Grant, 1989). The existence of these anti-nutritional factors affects the nutritional value, utilization and digestibility of soybean protein (Gilani et al., 2012)

The milk yield curve (Figure 1) showed the experimental animals about to end the first stage of lactation and entered in to second stage of lactation where the yield remains nearly constant. In a research reported, supplementation of heifers in early lactation build rapid response over the first two weeks of supplementation and further developed till the eighth week (Broster et al., 1975). That means supplementation response will remain nearly constant after the eighth week.

Chemical composition of milk

The protein, lactose, fat and ash content of the milk recorded in this study showed statistically non significance difference (P>0.05) among treatments. But, the result showed numerical difference between Cows fed on high protein concentrate plus untreated straw (T3) and cows fed on low concentrate mix plus untreated straw (T1) as well as T2. Lactose plays a vital role in determining the volume of milk secreted. Insignificance difference in concentration of lactose among treatments in this study is therefore expected. There are reports that concentrations of lactose and minerals constituents of milk do not respond predictably to adjustments in diet (Looper, 2012) which supports the results of this study. Contrary to this result fat concentration is reported to be the most sensitive to dietary changes and can vary over a range of nearly 3.0 percentage units (Looper, 2012).

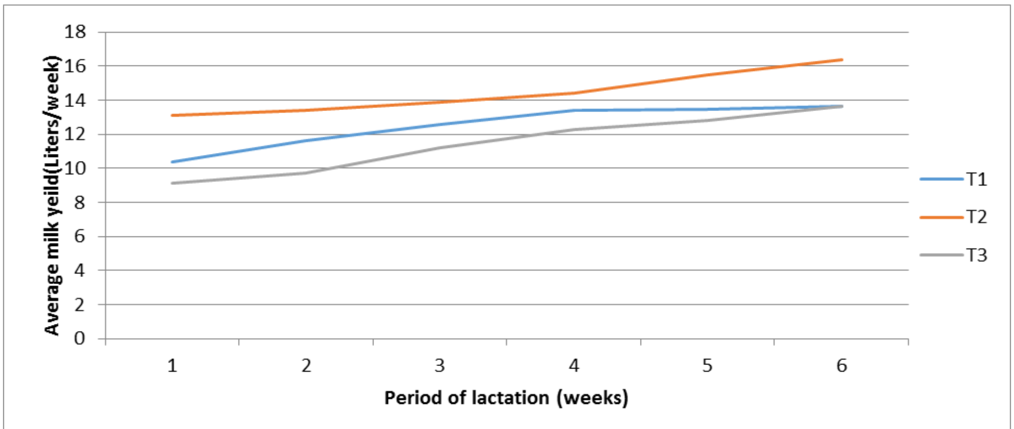

Figure 1. Graph showed milk yield curve of experimental cows

Table 5. Milk yield of dairy cows during the experiment

S.N	Treatment \ Milk Yield (mean ± SD)	Morning(l/milking)	Evening(l/milking)	Total Milk yiel(l/d)
1	T1 (LPC+US)	6.84 ±1.0[b]	5.68 ±1.34 [b]	12.52 ± 2.13 [b]
2	T2 (LPC+ UMTS)	7.84 ± 0.85[a]	6.61± 1.42 [a]	14.45 ±1.96 [a]
3	T3 (HPC +US)	6.05± 0.86[c]	5.41± 1.55 [b]	11.46± 2.16 [b]
Least significant difference (LSD)		0.48	0.76	1.11

[a,b,c,] means with different superscripts in a row are significantly different (p<0.05); LPC= low protein concentrate mix; HPL= high protein concentrate mix; US= untreated straw; UMTS= urea molasses treated straw; l= liter

Table 6. Milk composition of dairy cows during the experiment

S.N	Treatment \ Milk Composition (Mean±SD)	Protein	Lactose	Fat	Ash
1	T1 (LPC+US)	3.2± 0.24[a]	4.71± 0.29[a]	3.32±0.18[a]	0.59±0.01[a]
2	T2 (LPC+ UMTS)	3.2±0.16[a]	4.77±0.18[a]	3.56±0.65[a]	0.61±0.04[a]
3	T3 (HPC +US)	3.4±0.54[a]	4.85±1.05[a]	3.59±0.97[a]	0.64±0.13[a]
Least significant difference (LSD)		0.32	0.59	0.62	0.07

[a,] means with same superscripts in a row are not significantly different (p>0.05); LPC= low protein concentrate mix; HPL= high protein concentrate mix; US= untreated straw; UMTS= urea molasses treated straw.

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CONCLUSION AND RECOMMENDATION

From the results obtained in this study, It can be concluded that treating crop residues like straw with urea and molasses can improve milk production. Urea molasses treatment of straws did not bring difference in the milk composition rather supplementation with high protein concentrate has numerically better results in altering milk composition. From this result it can be recommended that milk yield can be improved through feed treatment of poor quality roughages than adding the highly expensive protein concentrates. Moreover, the statistically nonsignificant differences of milk yield between cows fed on low protein concentrate and high protein concentrate invites researchers to investigate the nutritional qualities of ingredients used in the high protein concentrate mixture.

DECLARATIONS

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Ethical approval

The ethical review board of the Department of Animal production and extension, University of Gondar evaluate and approved the protocols followed in the study

Authors' contributions

YD, AA and KE participated in the design of study, conducted the experiment and wrote the manuscript. AA revised the manuscript for important intellectual contents.

Competing interests

The authors read the final version of the manuscript and declare that they have no competing interests.

Consent to publish

Not applicable

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