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Effects of urea treated maize stover silage on growth performance of crossbred heifers

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Abstract: *The main objective of this experiment was to assess the effect of urea treated maize stover silage on growth performance of crossbred heifers. Eighteen crossbred heifers of about 6 to 10 months age were selected and distributed into three treatment groups. The experimental animals were fed on the basis of thumb rules. The maize stover was treated with 4% urea. The experimental feeding was carried for 3 months. Seven days digestion trial was conducted. Average fortnightly DM intake of experimental heifers under all three treatments differed significantly (P<0.01). The DM digestibility in* T_1 *and* T_2 *(67.63% and 67.42%) were significantly (P<0.05) different from* T_0 *(61.56%) however,* T_1 *and* T_2 *were at par to each other. Digestibility of CP found to be significantly high in* T_1 *(57.77%) and* T_2 *(57.26%) over* T_0 *(47.68%),* T_1 *and* T_2 *were at par to each other. The results showed non-significant difference on body weight gain among the treatments and thus treatment variations were unable to express their effect on the growth performance of crossbred heifers. Therefore, from the results, it may be concluded that 4% urea treated maize stovers could be utilized for feeding of heifers to sustain the growth performance in the scarcity condition.*

Keywords: *Conventional fodder, crossbred heifers, growth performance, maize stover, urea treatment*

I. Introduction

Maize stover consists of the leaves, husks, stalks and cobs of maize plants left in a field after harvest of cereal grain. It makes up about half of the yield of a crop. Maize stover is a very common agricultural product in areas having large acreage under maize cultivation. The stover may contain other weeds and grasses, the non-grain part of harvested corn and has low water content and is very bulky. Maize stover is utilized for animal feeding during the scarcity of green fodder called lean periods. In the north-western plane regions farmers are often faced with scarcity of green fodder during the months of May-June and again during November-December. During this period wheat straw as well as maize stovers are the principle sources of fodder. Stover is stored in large heaps to be used during lean periods. Maize stover can successfully be incorporated in ruminant rations and that such rations have relatively high digestibility [1].

However, the nutritional quality of maize stover is poor. It is made up of cellulose, hemicelluloses, lignin etc. Cellulose (30–50% of total feedstock dry matter) is a glucose polymer linked by ß–1,4 glycosidic bonds. The basic building block of this linear polymer is cellobiose, a glucose-glucose dimer (dimer: two simpler molecules—monomers—combined to form a polymer). Cellulose is almost completely digestible by ruminants as they contain the enzyme cellulase responsible for cellulose breakdown. Hemicellulose is a short, highly branched polymer of five-carbon and six-carbon sugars.

Maize stover possesses very little moisture ranging from 9-12 per cent. Lignin is structural carbohydrate which is almost indigestible to ruminants. Compared to wheat straw maize stover contain more protein but higher lignin content. This may be the reason why wheat straw is considered more popular as animal fodder compared to maize stover. As already indicated, maize is considered as the best fodder among cereals as it contains sufficiently higher quantities of protein and palatability. The quality of maize decreases with maturity. However, the deterioration in quality is more severe in leaves compared to stems. The leaves which are succulent at physiological maturity become hard and develop many indigestible components with maturity. Soluble solids rapidly decrease and lignin and xylan increase shortly after grain physiological maturity. In the rumen, many fiber-digesting bacteria require ammonia for protein synthesis [2]. Protein requirements are provided by microbial protein and rumen escape dietary protein [3]. Urea is commonly added to ruminant diet as a source of non-protein nitrogen that is rapidly hydrolyzed to ammonia in the rumen. Therefore, it is apparent that the nutritional quality of maize stover is poor and to maintain the health and to increase the milk production potential of milch animals, maize stover should be fed along with the concentrate. The concentrates will provide the required concentration of protein as well as other nutrients. Urea treatment on the nutritive value of roughage is the result of two processes which occur within the treated forage: Firstly, ureolysis which turns urea into ammonia through enzymatic reaction that requires the presence of the urease enzyme and secondly, the effect of ammonia on the cell walls on the forage. Several factor such as urea doses, moisture, temperature, affect the effectiveness of urea treatment. The nutritional quality of urea treated maize stover is drastically enhanced compared to normal stover. The increased microbial biomass in the treated stover may contribute significantly towards higher crude protein content. In countries where dairy industry is well developed, a voluminous work has been done and is being done on maize to increase the protein content of the crop. The addition of protein rich concentrates or chemicals when feeding maize crop or its silage are being worked out. Thus efforts were directed to increase the contents of protein in maize silage by incorporating non-protein nitrogenous compounds.

In regard to this aspect, a research work entitled Effects of urea treated maize stover silage on growth performance of crossbred heifers was proposed and carried out for further investigations.

II. Materials and methods:

The present investigation entitled Effects of urea treated maize stover silage on growth performance of crossbred heifers was conducted at Research Cum Development Project (RCDP) on Cattle, Department of Animal Husbandry and Dairy Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri. The project is located 160 km north-east of Pune and 30 km from Ahmednagar on state highway No. 14 and is at an elevation of 569 meters above mean sea level on the 19° 57´ north latitude and 74° 19´ longitudes in Maharashtra state. The area is categorized as semi-arid and scarcity zone.

The maize stovers were chopped into the size of 2-3 cm prior to ensiling process. In 100 litres of water 8 kg of urea was dissolved and sprinkled uniformly over the 200kg of chaffed maize stovers by using sprinkler and buckets. The treated maize stovers were mixed by using a fork. More batches were treated in the same procedure. Then the treated maize stovers were filled in double layer big polythene silo bags of 200kg each. All mixtures were firmly packed by trampling to remove as much air as possible and the bags were sealed. The treated maize stover was supposed to be ensiled for 45 days. Then used for conducting the experiment with crossbred heifers.

2.1Experimental Animals: Eighteen crossbred heifers of almost similar weight and age about 6 to 10 months were selected and randomly divided into three groups. Each group was designated as treatment and heifers in each group were considered as replication.

2.2 Experimental Feeding: All the crossbred heifers were fed according to nutrient requirements of livestock [4]. The DM offered to the crossbred heifers was 3 % of their body weight. For daily feeding of animals, DM was calculated at the end of every fortnight on the basis of body weight at the end of previous fortnight. Then the total dry matter was partitioned into 35 % DM through concentrates and 65% DM through roughage. The concentrate mixture was common in all the treatment groups.

T_0: designated as Control: (concentrates + roughage). 35 % DM through concentrates and 65% DM through roughage.i.e. 25% untreated maize stover, 25 % jowar kadbi, 50% green lucerne . T_1: Concentrates + roughage 35 % DM through concentrates and 65% DM through roughage.i.e. (25% urea treated maize stovers + 25% jowar kadbi + 50% lucerne). T_2: Concentrates + roughage 35 % DM through concentrates and 65% DM through roughage .i.e 50% urea treated maize stovers + 50% Lucerne.

Treated maize stover was taken out from the silo bag and kept for 24 hours in the air before feeding to remove the pungent smell. The concentrate ration was also mixed well with the stovers immediately before feeding. Total feed of individual animal was divided into two halves and supplied to the animal at 09:00 a.m and 16:00 p.m. Clean and fresh drinking water was offered twice a day at around 11.00 a.m. to 16:00 p.m to all animals individually using 20 litres unbreakable buckets.

2.3 Housing and health management: The experimental crossbred heifers were housed separately. All the animals were examined for parasitic infestation and de-wormed before the experiment and kept under strict hygienic and uniform management throughout the experiment. The pens of experimental animals were cleaned daily before offering the feed and fodder throughout the period of the experiment.

2.4 Body weight: Individual body weights of heifers were recorded at the beginning of experiment, then at every succeeding fortnightly interval. The heifers were weighed during the morning before the feed and water offered. Then, the change in body weight was calculated by differences from previously fortnight body weights.

2.5 Digestion trial: A digestion trial was conducted for a period of 7 days at the end of experimental period. The animals were fed daily with the required quantity of experimental feed in the morning and in the evening. Daily feed intake and faeces voided were recorded individually. Faeces voided and experimental feed left overs were collected in the following day manually during the collection period.

2.6 Chemical analysis of feeds and faeces: The sample of experimental feeds and fodders were dried in an oven at 105 ˚C for the determination of dry matter. At the end of the collection period the pooled samples of faeces and samples of experimental feeds were subjected to proximate analysis such as crude protein (CP), crude fibre (CF), ash, ether extract (EE) and nitrogen free- extract (NFE) as per [5].

2.7 Statistical analysis: The data generated during the experiment was subjected for analysis by randomised block design (RBD) and analysis of variance given by [6].

III. Results and discussion:

3.1 Chemical composition of experimental feeds and fodders: The maize stover is supposed to be inferior source of nutrients. Hence in order to improve the CP content, it was treated with fertilizer grade urea through the process of ensiling. The chemical changes took place (before and after treatment) in composition of maize stovers and other convensional fodder crops viz jowar kadbi (sorghum), green lucerne (Medicago sativa) and concentrate mixture are presented in the table 1, and it was observed that, there was significant improvement in crude protein content in urea treated maize stover (UTMS) which may be due to impregnation of nitrogen on the particle/pieces of stovers while little reduction in all other proximate constituents.

Table 1. Proximate composition of feeds and fodder fed to crossbred heifers

		Proximate Composition					
Sr. No	**Particular**	**DM**	**CP**	**CF**	**EE**	**NFE**	**TA**
1	Untreated Maize Stovers	91.66	4.31	43.81	1.98	40.98	8.92
2	Urea Treated Maize Stovers	91.12	9.98	41.02	3.78	35.94	9.28
3	Jowar Kadbi	90.93	5.67	38.89	2.43	45.12	7.89
4	Green Lucerne	25.26	18.61	27.49	1.51	44.51	7.88
5	Concentrate Mixture	91.20	20.72	15.40	5.54	46.14	12.20

The results revealed that urea treatment of maize stovers seems to be useful to improve the crude protein content of maize stover. It improved the status of crude protein 2 times than that of the untreated maize stovers and became superior to conventional dry fodder jowar kadbi.

The increase in CP content of the stovers as a result of urea treatment was supported by [7]. The CP content of UTMS was comparable with the results reported by [8] and [9] which were 8.7 and 8.3% CP, respectively. Furthermore, this is in line with the pioneer works of [10] who reported that crude protein content increased from 2.9 to 5.9 per cent in rice straw. [11] with sorghum stovers and [12] with Gamba grass (Androgan gayanus) treated with urea and both reported an increase in crude protein content of the crop residues.

Table 2. Average fortnightly DMI in crossbred heifers (kg)

Period in fortnight	Treatments			Mean
	T_0	T_1	T_2	
1	55.60^c	56.39^b	62.87^a	58.29
2	59.96^b	56.93^c	63.07^a	59.99
3	68.74^b	67.93^c	72.59^a	69.75
4	72.14^b	67.21^c	74.01^a	71.12
5	74.57^b	71.03^c	79.98^a	74.96
6	77.20^b	71.64^c	79.27^a	76.04
Total	408.21	391.13	431.79	410.15
Mean	68.04	65.19	71.97	68.35
Daily DMI	4.54	4.35	4.80	4.56

3.2 Dry matter intake (DMI): It is seen from the data presented in the table 2 that, the average fortnightly DM intake of experimental heifers under all three treatments differed significantly ($P<0.01$). The average fortnightly DM intake was significantly higher in T_2 (71.97kg) and followed by T_0 and T_1 (68.04kg and 65.19kg) treatments, respectively. The overall daily DM intake was calculated and found to be 4.80, 4.54 and 4.35kg in T_2, T_0 and T_1, respectively. The overall daily DM intake for treatment T_2 differed significantly from the rest of the treatments, whereas treatment T_0 and T_1 were at par.

The results are in agreement with [13] who stated that urea treatment may increase voluntary intake of the treated straw as compared to the untreated one by as much as 25 to 30%. [14] also reported a significant increase in DMI of urea-treated maize stovers compared with dry fresh maize stovers.

From the perusal of data presented in table 7, it revealed that the DM digestibility of T_1 and T_2 (67.63% and 67.42%) was statistically superior over T_0 (61.56%) treatments. Treatments T_1 and T_2 were at par to each other. Digestibility of CP was found to be significantly high in T_1 (57.77%) and T_2 (57.26%) over T_0 (47.68%). T_1 and T_2 were at par to each other. Similar results have been reported by [15] who found that supplementing rice straw (crop residue) together with nitrogen sources such as urea in the form of soft-cake molasses-urea block (MUB) and or Gliricidia leaves, increased feed intake of rice straw as well as improving its digestibility both in sheep and steers. The differences in apparent digestibility coefficient for EE, CF and NFE were found to be non-significant.

Table 3. Average digestibility coefficient of nutrients of experimental feeds

Treatment group	Apparent digestibility coefficient				
	DM	**CP**	**EE**	**CF**	**NFE**
T_0	61.56[a]	47.68[a]	45.44	42.09	39.15
T_1	67.63[b]	57.77[b]	44.95	38.50	44.54
T_2	67.42[b]	57.26[b]	49.65	38.87	43.63
SE ±	1.86	3.86	6.08	3.74	2.96
CD(0.05)	5.86	9.17	NS	NS	NS

Note: Mean values with different superscripts in a column differ significantly (P<0.05) with each other.

3.3 Average daily gain in body weight of experimental heifers: The treatment differences were non-significant. Thus the present results are in line with the findings of [16] who concluded that urea treated maize stovers could be used to replace grass for ruminant feeding as cattle had acceptable weight gains.

[17] also concluded that the increased intake of energy and an accompanying improvement in the utilization of non-protein nitrogen in the treated straw resulted in improvement of live weight gain of the animals.

3.4 Feed conversion efficiency of experimental crossbred heifers: With regard to feed efficiency, the differences were not significant (P>0.05), the animals on T_0 was (15.35%) higher followed by T_1 and T_2 (13.59% and 12.58%) treatments, respectively. On the other hand [18] reported significantly better feed efficiency in Sahiwal calves which fed with urea treated wheat straw as compared to untreated wheat straw based ration.

Table. 4 Average feed conversion efficiency (kg)

Treatment	Overall total weight gain (kg)	Overall total DM consumed (kg)	Average feed efficiency (2/3 x 100)
T_0	62.67	408.21	15.35
T_1	53.17	391.13	13.59
T_2	54.33	431.79	12.58

3.5 Feed conversion ratio of experimental crossbred heifers: It was found that experimental feeds had non-significant effect on the average FCR, whereby T_0 (6.51kg) treatment was the lowest whereas T_1 (7.36kg) and T_2 (7.95kg) treatments were at par. The treatments did not differ significantly (P>0.05) from each other. This is in agreement with the works of Li et al. (1993) who from their study on the effect of untreated and treated wheat straw and maize stovers on performance of crossbred cattle, observed an improvement of 13.3% (from 2.33 to 2.02) in feed conversion ratio as a result of ammonia treatment of maize stovers.

Table .5. Average feed conversion ratio

Treatments	Overall total DM consumed (kg)	Overall total weight gain (kg)	Average feed conversion ratio (2/3)
T_0	408.21	62.67	6.51
T_1	391.13	53.17	7.36
T_2	431.79	54.33	7.95

IV. Conclusion and recommendations:

On the basis of the results obtained in this study, urea treatment markedly increased (P<0.05) CP content of the maize stovers as compared with the untreated maize stovers. The increments in dry matter intake of urea treated maize stovers by crossbred heifers have been achieved. The changes in proximate constituents resulted improvement in digestibility of nutrients as comparable to that of conventional feeds. It could sustain the growth performance of experimental animals which fed with urea treated maize stovers as comparable with the animals fed the diet containing untreated stovers.

In general, it can be stated that maize stover can be used after 4% urea impregnation treatment to substitute the conventional fodder like jowar kadbi during the period of scarcity for feeding of cattle.

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