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Study on Comparative Economics of Silage Additives on Green Maize and Wheat Straw Based Silage

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ABSTRACT

Huge amount of low quality feedstuff is available in Saurashtra region and wheat straw is one of them and is of poor quality but available locally and inexpensive. It's use in silage along with additives may improve its quality and there by its utilization in animal feeding. Thus, it is essential to develop silage preparation methods to use these locally available feed resources effectively. The current investigation was carried with the objective to study various combinations of biological and chemical additives on cost of silage production for green maize and wheat straw based silage and to evaluate cost effective additives for green maize and wheat straw based silage.Different silages were prepared using green maize fodder and wheat straw as such in the proportion of 10:0 & 7:3 ratio in plastic jar of 3 kg capacity (3 replication in each) by adding common salt @ 0.5%, urea @1% and molasses @ 1.5% in each silages with seven different treatments *viz.* Control (only green maize), WS (green maize and wheat straw in 7:3 ratio), X (WS added with Xylanase), LP (WS added with *L. plantarum*), LF (WS added with *L. fermentum*), LPLF (WS added with both bacterial inoculants) and XLPLF (WS added with Xylanase and both bacterial inoculants). Xylanase, *L. plantarum* and *L. fermentum* were used @ 1500 IU/g, 1 x 10^6cfu/g and 2 x 10^6cfu/g, respectively. All silages were evaluated in terms of quality parameters of silage on 45 days of ensiling to compare the nutritive value of silage, cost of silage production and hence, to evaluate cost effective silage additive. Cost of silage production was noticed lower in Xylanase treated silage with higher cost saving (7.30 %) as compared to all other inoculated silages. Thus, keeping in mind, advantage of Xylanase inoculated silage, it is concluded that Xylanase can be used as a cost effective feed additive when green maize and wheat straw are principal fodder for silage production in the ratio of 7:3 to improve nutritive values of silage, nutrient utilization and for overall economic benefits in feeding of animals as Xylanase is cost effective feed additives as compared to others. It reduces the cost of silage production when green maize and wheat straw are used in 7:3 proportion for maximum benefits.

KEYWORDS: Cost, *L. fermentum, L. plantarum,* Silage, Xylanase

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INTRODUCTION

'According to 20th livestock census, the total livestock population in India is 536.76 million showing an increase of 4.8 percent over previous census (Anonymous, 2019). The health and productivity of livestock are closely related to quantum of high satisfactory forage supplied to the animals. India is facing an acute shortage of animal feed due to urbanization and extended animal population.

Agro-industrial wastes captured interest owing to its abundant availability, among agricultural residues, straw is the most abundant and the cheapest pollution mitigator. Wheat straw is being deserted directly in the field or burned for cooking, which cause serious environmental problems (Liu et al., 2005).

As wheat straw is inexpensive and available locally, its use in silage along with additives may improve its quality and its utilization in animal feeding. Mostly farmers in India are not making silage on regular basis due to lack of knowledge. Also, silage is not made routinely by use of various silage additives which enhance the quality of silage and thereby

increase the productivity of animals. Also, the most commonly used green fodder in silage making is maize. Incorporating wheat straw in silage production will improve wheat straw quality and reduces the silage production cost.

MATERIALS AND METHODS

Experimental material and treatments

The present study was conducted at Department of Animal Nutrition, College of Veterinary Science and A. H., Kamdhenu University, Junagadh, Gujarat. Green maize fodder and wheat straw in chaffed form were spread on plastic sheet in the proportion of 10:0 and 7:3 separately with uniform mixing and used as base material for preparation of silage in different treatments. Common salt, urea and molasses were added @ 0.5%, 1% and 1.5%, respectively in the preparation of base material. Additives like *L. plantarum*, *L. fermentum* and enzyme Xylanase were used @ $1x10^6$cfu/g, $2x10^6$cfu/g and 1500 IU/gram in the preparation of silage in different treatment groups. The different treatments were Control (only green maize), WS (green maize and wheat straw in 7:3 ratio), X (WS added with Xylanase), LP (WS added with *L. plantarum*), LF (WS added with *L. fermentum*), LPLF (WS added with both bacterial inoculants) and XLPLF (WS added with Xylanase and both bacterial inoculants). Different additives were used as per their application rate in different treatments and mixed thoroughly. Fodder mass along with different additives were packed in plastic jar having the capacity of 3 kg and designed with valve at the lid of the jar. Air from the jars was removed with the help of vacuum pump. Jars of different treatments were stored at room temperature for 45 days. The store house was disinfected and appropriate measures were taken to avoid the entry of rats, mice and birds.

Economics of silage production

In the present experiment, farm or market prevailing price of maize, wheat straw, salt, molasses, urea, Xylanase and bacterial inoculants were taken into consideration to calculate cost of silage production. Maize was purchased from local market of Junagadh city @ 5 ₹ / kg. Wheat straw is generally not utilised as a feed by the farmer and thrown as a waste material in a large quantity in India. Hence, utilisation of wheat straw in silage production can minimize cost of silage production. But, for calculation of economics, farm prevailing price of wheat straw is considered which is 1.25₹ /kg. Other supplements used in silage production were salt, urea and molasses which were procured from cattle breeding farm, Junagadh. Hence, purchasing price of cattle breeding farm was taken into consideration, prices were 3 ₹ /kg, 5.35 ₹ /kg and 9 ₹ /kg, respectively.

Enzyme Xylanase was procured from the standard manufacture company @ 100 ₹ /kg. *Lactobacillus plantarum* and *Lactobacillus fermentum* were procured from National Collection of Dairy Cultures (NCDC), National Dairy Research Institute (NDRI), Karnal. As, *Lactobacillus plantarum* and *Lactobacillus fermentum* are culture media, it can be grown in laboratory for subsequent uses, but for calculating cost production price of LP and LF was decided in the consultation with Department of Veterinary Microbiology, College of Veterinary Science and A. H., Kamdhenu University, Junagadh, Gujarat @ 0.80 ₹ /kg silage.

Statistical analysis

The data were analyzed for descriptive statistics (mean and standard error). Treatment effects on different parameters were analyzed by one way analysis of variance (ANOVA) according to Snedecor and Cochran (1994). Pair wise mean difference between groups were compared by Duncan's New Multiple Range Test (DNMRT) as modified by Kramer (1957).

RESULTS AND DISCUSSION

The production cost of different experimental silages is represented in Table 1 and cost obtained as 5.20, 4.07, 4.82, 4.87, 4.87, 5.67, 6.42 rupees per kg for C, WS, X, LP, LF, LPLF and XLPLF, respectively. Statistical analysis revealed nonsignificant difference among treatment groups in terms of cost of production. However, cost of production was numerically reduced in WS and was

1.13 rupees followed by xylanase, LP, LF, and cost reduce was 0.38, 0.33 and 0.33 rupees respectively. Whereas, non-significant increase in cost of production was observed in LPLF with 0.47 rupees and XLPLF with 1.22 rupees. In terms of percent profit or loss in cost of silage production as compared to control was noted as 21.73, 7.30, 6.34, 6.34, -9.03 and -23.46 for WS, X, LP, LF, LPLF and XLPLF, respectively per kg. Higher production cost of 9.03 and 23.46 percent occurred in LPLF and XLPLF additives inoculated experimental silage are due to either combinations of both bacterial inoculant or Xylanase and both bacterial inoculants used for production of silage.

Table 1. Economics of different experimental silage production

Items	Price (Rs./kg or Rs./dose/kg)	Treatments						
		C (10:0)	WS (7:3)	X (7:3)	LP (7:3)	LF (7:3)	LPLF (7:3)	XLPLF (7:3)
Green maize(kg)	5	50	35	35	35	35	35	35
Wheat straw(kg)	1.25	0	3.75	3.75	3.75	3.75	3.75	3.75
Salt(kg)	3	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Urea(kg)	5.35	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Molasses(kg)	9	1.35	1.35	1.35	1.35	1.35	1.35	1.35
LP (dose)	0.80	-	-	-	8	-	8	8
LF (dose)	0.80	-	-	-	-	8	8	8
Xylanase (dose)	100	-	-	7.5	-	-	-	7.5
Total Price (Rs. for 10 kg)	-	52.0	40.8	48.3	48.8	48.8	56.8	64.3
Total Price (Rs. per kg)	-	5.20	4.07	4.82	4.87	4.87	5.67	6.42
Cost Saving (Rs. /kg)	-	-	+1.13	+0.38	+0.33	+0.33	-0.47	-1.22
Cost Saving (%)	-	-	+ 21.73	+7.30	+6.34	+6.34	-9.03	-23.46

X: Xylanase, LP: *Lactobacillus plantarum*, LF: *Lactobacillus fermentum*, LPLF: *Lactobacillus plantarum* + *Lactobacillus fermentum*, XLPLF: Xylanase + *Lactobacillus plantarum* + *Lactobacillus fermentum*

The most crucial factor in any business, including animal husbandry is cost of production. However, present investigation is on the silage production so, fodder cost is the most important factor to be taken into consideration. Also, different silage additives and exogenous fibrolytic enzyme like Xylanase enhance the quality parameters of silage like it reduces silage pH, NH_3-N and water soluble carbohydrate (WSC) content in silage which means that more water soluble carbohydrates are utilized for higher lactic acid production for better silage quality. It will also increase Total volatile fatty acid & Total nitrogen content of silage and thus, additives and Xylanase improve the silage fermentation characteristic. Similar findings were perceived by Kansagara et al. (2022).

The main function of the exogenous fibrolytic enzymes is to release maximum amount of nutrients from the digestible, potentially digestible and indigestible fractions of the cell wall (Suryanarayana and Kavitha, 2017). Fibrolytic enzymes degrade the cell wall at a faster rate and additionally water soluble carbohydrate are pooled to provide growth fermentation substrate for lactic acid bacteria (LAB) (Ebrahimi et al., 2014). In current investigation as

compared to other additives fibrolytic enzyme like Xylanase significantly improves *in vitro* dry matter degradability, *in vitro* organic matter degradability, *in vitro* total gas production and total volatile fatty acids production which will subsequently improve the quality of silage and *in vitro* rumen fermentation. The result of current study is in agreement with Belim et al. (2022) Kansagara et al. (2023). Though the cost of silage production was low in wheat straw silage but as compared to other feed additives nutritive values of silage is poor and also, *in vitro* nutrient utilization are not optimum in wheat straw silage. Further, significantly higher nutritive value and nutrients utilization was observed in Xylanase added silage as compared to others. So, it can be inferred that Xylanase is best silage additive with lower cost of production when green maize and wheat straw are added in 7:3 proportion.

CONCLUSION

As Xylanase is being most cost effective feed additives as compared to other additives and considering beneficial effects on Xylanase on silage quality on nutrient utilization it can be concluded that Xylanase can be used as feed additives in silage production when maize and wheat straw used in 7:3 proportion to enhance health and productivity of animals for overall benefits.

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