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Short Communication

Evaluating mulberry fodder-based silages in various proportions as animal feed

H.B. Roghan[1], I. Sekar[1*], M. Sivaprakash[1] and B. Karthick Mani Bharathi[2]

[1]Forest College and Research Institute, Mettupalayam- 641301, India
[2]Central Silk Board, Bangalore-560068, India
[*]Corresponding author email: roghanbalu@gmail.com

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Abstract

A study was carried out to assess the physical characteristics (colour, odour, pH, mould growth, dry matter content, and palatability for ruminants) and palatability of various silages made from 25 to 75% mulberry leaves with fodder crops like maize and napier grass (75–25%) in six combinations. All silages had acidic pH ranging from 5.35 to 4.32 with light green to dark green colour and had a sweetish scent odor. Silage with 75% mulberry leaves and 25% maize had the highest palatability (87%), whereas the lowest palatability was observed with sole mulberry silage (45%). The present study indicates that mulberry leaves can be utilized as an excellent substrate for silage making in conjunction with other fodder crops for feeding the ruminant animals.

Keywords: Animal feed, Mulberry, Palatability, Ruminant animals, Silage.

In modern livestock management, the quality of animal feed plays a pivotal role in determining the overall health, productivity and economic viability of animal husbandry enterprises (Ganai *et al.*, 2010). Among the numerous sources for alternative feed resources, mulberry (*Morus* spp.) has garnered significant interest due to its nutritional profile and environmental benefits (Jiang *et al.*, 2017). Mulberry trees are known for their fast growth and high biomass yield, which can contribute to sustainable feed production (Acsah Rose, 2018). Traditionally, mulberries have been cropped for sericulture purposes, as their leaves are a comfortable food source for silkworms (Tikader and Kamble, 2008). However, recent research has highlighted the potential of mulberry leaves as a valuable feed ingredient for livestock. These leaves are rich in essential nutrients, including proteins, fibre, vitamins and minerals, which made them a promising candidate for enhancing animal feed quality (Dibala *et al.*, 2019).

One effective method of utilizing mulberry leaves as animal feed is through the process of ensiling, which involves fermenting the leaves to produce silage. Evaluating mulberry-based silages involves assessing how well this feed ingredient can be preserved and utilized compared to more traditional silage sources (Saini *et al.*, 2023). Understanding the nutritional profile of mulberry-based silages will provide insights into their potential benefits and limitations as a feed resource. Secondly, the economic feasibility of incorporating mulberry-based silages into existing feeding systems must be evaluated. Economic analyses will help determine whether mulberry-based silages are a viable alternative in terms of both cost and return on investment (Saddul *et al.*, 2004). In the present study, the physical characteristics and palatability of various silages made from 25 and 75% mulberry leaves with fodder crops like maize and napier grass (75–25%) were assessed.

The study was conducted in 2022-2023 to assess the mulberry-based silages under laboratory conditions at Forest College and Research Institute, Tamil Nadu Agricultural University, Coimbatore district, Tamil Nadu, India. A total of nine silages (Table 1), either as a sole or in combination with maize or napier was formulated with three replications in a completely randomized design. The resulting silages were analysed for pH and other physical characteristics, dry matter content, odor, mould growth and palatability. The prepared silages were sampled, randomly fed to ruminants and allowed to focus only on feeding in order to visually observe the animal's reactions and determine taste preferences (Campanili *et al.*, 2017). Every animal in every treatment

Table 1. Different fodder ratios used for preparation of silages

Treatment	Proportion	Silage combinations
T_1	50:50	Mulberry: Maize
T_2	50:50	Mulberry: Napier grass
T_3	25:75	Mulberry: Maize
T_4	25:75	Mulberry: Napier grass
T_5	75:25	Mulberry: Maize
T_6	75:25	Mulberry: Napier grass
T_7	100	Napier grass
T_8	100	Maize
T_9	100	Mulberry

group received the same amount of silage and the amount of feed consumed and leftover feed were expressed as a percentage of palatability.

Mulberry-based silage varied in colour from pale green to dark green. The silages containing 100% mulberry (T_9), 75% mulberry leaves + 25% maize (T_5), 75% mulberry leaves + 25% napier grass (T_6), 50% mulberry leaves + 50% maize (T_1), and 25% mulberry leaves + 75% maize (T_3) were dark green, whereas the silages containing 100% napier grass (T_7), 50% mulberry leaves + 50% napier grass (T_2), and 25% mulberry leaves + 75% napier grass (T_4) were light green in colour (Table 2).

The difference in colour might be because napier grass has less chlorophyll than mulberry and maize. The silage made entirely of maize had a fresh green colour as proposed by Raj *et al.* (2019). The taste of the silage made from 100% maize was sweeter than that of the silage made from 100% napier, 75% mulberry leaves plus 25% maize, 50% mulberry leaves along with 50% napier grass and 25% mulberry leaves mixed with 75% maize. Conversely, the silages made of 25% mulberry leaves + 75% napier grass, 50% mulberry leaves along with 50% maize, and 25% mulberry leaves + 50% napier grass were quite sweet. The silages made from 100% mulberry; 75% mulberry leaves and 25% napier grass exhibited a slightly peculiar bitter flavour (Table 2).

Table 2. Mulberry-based silages in different proportions with physical parameters and palatability

Treatments	pH	Mold growth	Dry matter (%)		Palatability (%)	Color	Odor
			Fodder	Silage			
T_1	4.32	Nil	28.30	26.20	70	Dark green	Moderately sweet
T_2	5.30	Nil	26.80	23.40	56	Pale green	Sweet
T_3	4.82	Nil	37.60	34.33	68	Dark green	Sweet
T_4	5.05	Medium	46.75	41.40	52	Pale green	Moderately sweet
T_5	4.52	Nil	36.25	31.80	87	Dark green	Sweet
T_6	5.35	Low	31.50	28.25	72	Dark green	Lightly odd
T_7	5.25	High	29.20	25.35	45	Pale green	Sweet
T_8	4.48	Nil	35.20	31.80	75	Fresh green	Sweet
T_9	4.45	Low	30.33	28.60	82	Dark green	Lightly odd
Mean	4.83	-	-	-		-	-
CD (P<0.01)	0.28	-	-	-		-	-

Table 3. Chemical composition of sole and the combination of mulberry-based silage

Treatments	Total ash (%)	Ether extract (%)	Crude fiber (%)	Crude protein (%)
T_1	12.34	6.25	4.35	15.48
T_2	10.65	6.33	1.03	9.42
T_3	12.45	4.36	2.87	9.35
T_4	9.43	3.48	4.52	10.27
T_5	10.25	5.32	2.10	10.74
T_6	12.82	4.63	1.65	7.43
T_7	10.52	2.33	3.58	3.72
T_8	9.68	3.56	1.54	11.42
T_9	9.12	3.18	1.38	16.55
Mean	10.80	4.38	2.55	10.48
CD (P<0.01)	0.97	0.97	0.92	2.71

This could be due to the fermentation process, which releases organic acids and also due to the higher moisture content of the mulberry leaves (Sharma and Zote, 2010). The odour of the silages with fewer or no mulberry leaves was rather sweet. Silages containing 100% mulberry, and 75% mulberry and 25% napier grass showed less mould formation. Silages having 25% mulberry and 75% napier grass had moderate mould growth, 100% napier grass registered a high mould growth rate. No evidence of any mould or fungus growth was observed in silages having 100% maize, 75% mulberry leaves plus 25% maize, 75% mulberry leaves plus 25% napier, 50% mulberry plus 50% maize, 50% mulberry plus 50% napier mixed and 25% mulberry plus 75% maize silage. The pH of mulberry silage ranged from 5.35 to 4.32, which was found to be acidic (Table 2)

Higher acidity value registered in the silage *i.e.*,75% mulberry leaves mixed with 25% napier (5.35) followed by 50 per cent mulberry mixed with 50 per cent napier grass (5.30) 25% mulberry leaves mixed with75% nappier fodder, 25% mulberry mixed with 75% maize (4.82), 100% maize silage (4.48) and all the other silages were relatively less acidic.

Silage made with 75% mulberry and 25% maize had the best palatability (87%), followed by silage made with 100% mulberry (82%), while silage made with 100% napier grass had the lowest palatability (45%). The palatability of silages varied from 45 to 87%. The silage's different tastes, odour and physical appearance could contribute to their variations in palatability. The investigation findings are consistent with those of Doran *et al*. (2007), who found that animals preferred silage material that had a sweetish taste, no odour and no mould growth. Dry matter per cent in fodder ranged from 26.80 to 46.75%, whereas the dry matter (DM) content of silages varied from 23.40 to 41.40% and did not considerably decrease. Pandey and Dhar (2013) reported minimal dry matter losses, ranging from 2 to 4%. Conversely, silage that has a high level of unfavourable microbial activity might have substantially higher dry matter losses.

Total ash content of the silage was maximum in mulberry: napier grass (75%: 25%) and lowest in sole mulberry (100%). Ether extract per cent was recorded high for 50% mulberry + 50% napier grass combination (6.33%) and lowest recorded in sole napier grass (2.33%). 25% mulberry + 75% napier grass combination had the highest (4.52%) crude fibre (%), whereas the lowest was noticed in 50% mulberry + 50% napier grass combination (1.03%). Mulberry (100%) recorded the highest crude protein content of 16.55%, followed by 50% mulberry + 50% maize fodder combination (15.48%) and napier grass (100%) registered the lowest crude protein content (Table 3). These results were in accordance with the findings of Chandrasekhar and Divyashree (2020), which were done with the same mulberry crop.

The evaluation of mulberry-based silages reveals a promising alternative and satisfies the nutritional requirements of animal feed with significant implications for sustainable livestock management. The positive outcomes observed in terms of nutrient preservation and feed quality suggest that mulberry-based silages can effectively support livestock health and productivity. However, challenges remain in optimizing the preparation and processing of mulberry-based silages to achieve consistent and high-quality results. Variability in mulberry leaf composition with differences in fermentation conditions and the need for further research on long-term effects on animal performance highlight areas requiring additional investigation.

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