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Assessing the nutritional value of common tree leaves in eastern Uttar Pradesh for livestock feeding

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Abstract

The present study was planned to evaluate the nutritional value of commonly available tree leaves in Eastern Uttar Pradesh for their potential application in livestock feeding. Tree leaves were collected from Varanasi and Mirzapur districts during their peak growth season, followed by proximate and fiber fraction analyses. Results revealed that leaves of *Moringa oleifera* and *Leucaena leucocephala* had superior nutritional profiles, with crude protein content exceeding 20% and low indigestible fiber fractions, making them ideal for productive livestock. Other species, such as *Albizia lebbeck* and *Azadirachta indica*, also demonstrated favorable protein levels and energy-rich ether extracts. Moderate-protein species like *Bambusa vulgaris* and *Terminalia arjuna* may be utilized for maintaining non-productive livestock or during forage scarcity. While high fibre fractions in some species may limit their digestibility, strategic inclusion of nutrient-rich tree leaves in livestock diets can enhance feed quality, reduce costs, and mitigate nutritional deficiencies. This study underscores the potential of tree leaves as sustainable feed resources, recommending further research to address anti-nutritional factors and evaluate long-term effects on livestock productivity.

Keywords: Forage, nutrient, ration, scarcity, top feed

Introduction

India hosts the largest livestock population in the world, accounting for over 37% of cattle, 21% of buffalo, 26.4% of goats, and 12.17% of sheep globally (Sonavale *et al.*, 2020) ^[1]. This extensive livestock population necessitates a substantial quantity of feed to sustain production levels. However, current trends and the escalating demand for milk reveal that the availability of feed and fodder is insufficient and likely to become even more inadequate as the livestock population continues to grow. Key challenges hindering livestock production in the country include the shortage of quality fodder, the high cost of commercial feeds, and seasonal variability in forage supply. These issues are exacerbated during periods of scarcity. In addition to its diverse livestock population, India is also home to a wide variety of tree species, many of which hold the potential to contribute to the nutritional security and sustainable feeding of livestock, particularly small ruminants like sheep and goats (Tabhani *et al.*, 2019; Dhillon *et al.*, 2023) ^[2, 3]. In addition to their nutritional benefits, tree leaves are often more resilient to drought compared to grasses and crops, ensuring a consistent feed supply during lean seasons. Their ability to grow in marginal lands further supports livestock rearing in areas with limited agricultural potential. The leaves of these trees can serve as an important resource for livestock feeding (Lal *et al.*, 2023) ^[4], but their inclusion in animal diets requires a thorough understanding of their nutritional value. This knowledge is essential for appropriately classifying these leaves and incorporating them into livestock rations. Moreover, gaining insights into the nutritional profiles of locally available tree leaves can enhance the forage database for animal feeding and improve the nutritional quality of livestock rations (Parmar *et al.*, 2022) ^[5]. With these considerations in mind, the present study was undertaken to evaluate the nutritional value of commonly available tree leaves in Eastern Uttar Pradesh for their potential use in livestock feeding.

Materials and Methods

Samples of ten common tree leaves prevalent in Eastern Uttar Pradesh, identified for their potential use in livestock feeding (Datt *et al.*, 2008; Lal *et al.*, 2023) ^[6, 4], were collected

and analysed. These samples were procured from two districts, Varanasi and Mirzapur, including their adjoining areas. A minimum of five samples from various zones of each tree's canopy were collected during their peak growing season to ensure representative sampling.

The freshly plucked tree leaves packed in large polythene pouches were promptly transported to the laboratory and oven-dried to estimate their moisture content. The oven-dried samples were then processed following standard procedures for proximate and fiber fraction analysis.

The proximate principles (AOAC, 2005) [7] analysed included crude protein (CP), ether extract (EE), organic matter (OM), total ash (TA), crude fibre (CF) and nitrogen-free extract (NFE). Additionally, the fiber fractions were determined using neutral detergent fiber (NDF), acid detergent fiber (ADF), and hemicellulose, as per the methods outlined by Van Soest *et al.*, 199) [8].

Based on nutrient content, particularly the levels of highly digestible CP and EE, and the consideration of low-digestible fiber fractions, the top three tree leaves were identified as optimal for inclusion in livestock feeding programs to support sustainable production.

Results and Discussions

The results of the analysis revealed that the tree leaves under study possess nutrient levels ranging from good to fair, particularly in terms of crude protein (CP) and ether extract (EE) (Table 1). Among these, the leaves of *Moringa oleifera* and *Leucaena leucocephala* were exceptionally rich in protein, containing more than 20% CP. Additionally, the leaves of *Albizia lebbbeck* and *Azadirachta indica* also exhibited good protein levels, making them excellent alternative fodder choices for productive animals, especially fast-growing kids and lambs.

Table 1: Proximate composition of common tree leaves

Botanical name	Common name	DM	% , dry matter basis					
			TA	OM	EE	CP	CF	NFE
<i>Azadirachta indica</i>	Neem	32.35	10.36	89.64	3.42	15.28	17.89	53.05
<i>Moringa oleifera</i>	Drumstick	26.48	9.87	90.13	3.42	24.53	13.58	48.60
<i>Ficus religiosa</i>	Peepal	24.56	11.52	88.48	3.14	11.25	16.25	57.84
<i>Leucaena leucocephala</i>	Subabul	32.15	7.85	92.15	4.67	23.11	20.28	44.09
<i>Albizia lebbbeck</i>	Siris	35.88	9.75	90.25	4.52	16.53	28.02	41.18
<i>Ficus benghalensis</i>	Banyan	38.45	11.25	88.75	3.54	9.95	30.58	44.68
<i>Madhuca indica</i>	Mahua	23.25	7.85	92.15	2.88	9.15	21.35	58.77
<i>Terminalia arjuna</i>	Arjun	32.54	7.86	92.14	3.54	10.56	29.35	48.69
<i>Bambusa vulgaris</i>	bamboo	52.35	11.87	88.13	2.16	14.25	32.52	39.20
<i>Ziziphus mauritina</i>	Ber	48.62	10.32	89.68	2.98	13.22	17.65	55.83

These findings are consistent with reports by (Simbaya *et al.*, 2020) [9], who documented protein levels exceeding 24% in *Moringa oleifera* and *Leucaena leucocephala* and recommended their inclusion in livestock rations as superior alternatives to mulberry and grass hay. A more or less comparable composition have been reported by earlier researcher for *Ficus benghalensis* (Tabhani *et al.*, 2019) [2], *Albizia lebbbeck*, *Terminalia arjuna* (Patel *et al.*, 2020) [10] and *Bambusa vulgaris*, *Leucaena leucocephala*, *Azadirachta indica* (Parmar *et al.*, 2022) [5]. The variations observed in the composition of leaves could be attributed to biological factors like topographical and climatic attributes (Pugnaire *et al.*, 2019) [11]. The inclusion of *Leucaena leucocephala* in

maize silage has been found to enhanced the protein content of the feed (Joy *et al.*, 2024) [12].

In addition to their protein content, the analysed leaves contained considerable levels of energy-rich ether extract, ranging from 3.42% to 4.67%, further enriching their nutritional profile. Leaves from *Bambusa vulgaris*, *Ziziphus mauritiana*, *Ficus religiosa*, and *Terminalia arjuna* were found to have moderate levels of protein and ether extract. While these can be cautiously included in animal feeding programs, they are more suitable for maintaining low- to non-productive livestock or during periods of scarcity, such as droughts or floods.

Table 2: Fibre fractions of common tree leaves

Botanical name	Common name	NDF	ADF	HC
<i>Azadirachta indica</i>	Neem	42.35	31.25	11.10
<i>Moringa oleifera</i>	Drumstick	28.38	18.51	9.87
<i>Ficus religiosa</i>	Peepal	48.56	33.25	15.31
<i>Leucaena leucocephala</i>	Subabul	42.35	23.65	18.70
<i>Albizia lebbbeck</i>	Siris	52.34	32.56	19.78
<i>Ficus benghalensis</i>	Banyan	46.59	33.88	12.71
<i>Madhuca indica</i>	Mahua	40.25	21.35	18.90
<i>Terminalia arjuna</i>	Arjun	60.35	48.35	12.00
<i>Bambusa vulgaris</i>	bamboo	68.35	38.25	30.10
<i>Ziziphus mauritina</i>	Ber	36.52	24.35	12.17

However, some species exhibited high levels of less digestible fiber fractions. For instance, the leaves of *Terminalia arjuna* and *Bambusa vulgaris* showed considerably high neutral detergent fiber (NDF, >60%) and acid detergent fiber (ADF, >35%) levels (Table 2). In contrast, the leaves of *Moringa oleifera* displayed reduced

fiber fractions, reaffirming their superiority as a high-quality forage option for livestock feeding. Over and above, integrating tree leaves into the diets of livestock can lead to a reduction in feed expenses and an enhancement in nutrient absorption, especially for small-scale farmers. The combination of tree leaves with various feed resources can

address nutritional deficiencies and improve the overall quality of the diet. Incorporating these tree leaves into livestock diets can reduce feed costs and improve nutrient intake, particularly for small-scale farmers (Vandermeulen *et al.*, 2018) ^[13]. Combining tree leaves with other feed resources can balance nutrient deficiencies and enhance overall diet quality.

Conclusion

Based on the current analysis, tree leaves such as *Moringa oleifera* and *Leucaena leucocephala* emerge as excellent alternative feed resources for livestock in Eastern Uttar Pradesh. Their high crude protein and ether extract content, coupled with low fiber fractions, make them ideal for enhancing livestock productivity. On the other hand, tree leaves with lower protein and higher fiber content should be utilized judiciously, considering their biological implications and the specific needs of livestock.

Further research is recommended to address potential anti-nutritional factors and assess the long-term impacts of incorporating these tree leaves into livestock diets on animal health and performance.

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