

Evaluation of Forage Cowpea and Hay as a Feed Resource for Ruminant Production: A Mini-Review

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Abstract: Livestock are the bestowed factories by nature to convert dry and green roughages into valuable products such as milk and meat. Among green roughages, forages occupy central position due to their economics of production and palatability. But in Pakistan, these are deficient during May-June and again in November-December during which productivity of large ruminants is hit the hardest. However, if excessive forage is preserved as hay which is the air dried forage has the potential to bridge the gap between forage supply and demand during lean periods. Forage cowpea is one of the leguminous crops holding a rich treasure of crude protein. Cowpea hay also contains a fairly high quantity of crude protein in the range of 20-22% which is almost double in comparison with cereal forages. Cowpea hay is simple and convenient to prepare with little requirement of basic infrastructure. However, dairy farmers have ignored this valuable forage preservation technique and the net result is the significant reduction in ruminant's performance. Provincial livestock departments should strive to make dairy farmers aware of hay making technique to ensure milk and meat production on sustainable basis. It will not only increase farmer's income but also increases milk and meat production for skyrocketing population.

Key words: Dairy Animals • Forages • Green Roughages • Hay • Silage • Milk and Meat

INTRODUCTION

Mixed crop-livestock farming system is an integrated and dominant farming system in rural areas of Pakistan. Ruminant particularly large ruminant (cattle and buffalo) serve as a shock absorber in the wake of crops failure [1]. The provision of milk and meat is not the only advantage associated with livestock, but they also provide income to farmers and enable them to purchase farm inputs for successful crop production [2-4]. Nili Ravi (known as black gold of Pakistan) and Kundi are considered to be the best buffalo breeds in world [5]. Sahiwal, Cholistani Dajal, Dhanni and Lohani breeds of cattle are known to have high potential for milk production [6]. Because of these cattle and buffalo breeds, Pakistan occupies third slot among the largest milk producing countries in the world with gross milk production of 51 million tons during 2013-2014 [7]. But it is a matter of grave concern that productivity and performance of large ruminants is underutilized in terms of milk production due to undernourishment. Forages are

referred to be the most palatable animal feed resource and in combination with crop residues provide a major proportion of animal feed resource [8]. But in Pakistan, the area under forage crop is decreasing at the rate of 2% per decade due to a variety of reasons such as non-availability of forage seed and water shortage [9, 10]. The result is that ruminants face two forage scarcity periods during May-June and again in November-December [11-15]. So in order to bridge the gap between forage supply and demand, forage preservation as hay gets the central stage in animal feeding strategy. Hay is the air dried fodder and may become an integral component of animal feed resource during forage scarcity periods [16]. Excessive green forages preserved as hay have the potential to supply nutritious feed to ruminants. Generally crops with thin stem are deemed to be most suitable for hay making than thick-stemmed crops like cereal forages. In addition, cereal forages are deficient in crude protein which is required for maintenance of ruminants particularly of large ruminants (cattle and buffalo). Thus leguminous forages hold the dual

advantage of being rich in crude protein [17-19] as well as these are thin stemmed and thus can be preserved as hay efficiently and conveniently. Forage cowpea gives a fairly high yield of green forage even in the face of drought like conditions. It adapts very well to unfavorable soil conditions (low soil fertility and moisture status) and climatic conditions particularly high temperature [20- 24]. Being a shade tolerant crop, it can be intercropped with cereal forages particularly with sorghum and maize to improve the quality attributes of mixed forage [25-29]. Furthermore, the productivity of cropping system gets improved due to nitrogen fixing ability of cowpea [30- 35]. Farmers in different countries feed their animals on mixed forage of cowpea and cereal forages such as sorghum and maize in order to increase their income.

The objective and aim of this review study was to analyze forage cowpea as a feed resource for ruminant production and its preservation as hay to be fed to animals during forage scarcity periods in order to maintain milk production on sustainable basis and to bridge the gap between forage supplies and demand.

Nutritional Profile of Forage Cowpea: Being a leguminous crop, cowpea is the rich source of crude protein for ruminants [36]. Historically, as its name shows, it has been grown as a forage crop for cattle. Dairy animals particularly need substantial quantities of protein in their feed for necessary maintenance of body [37]. The crude protein (CP) contents are in the range of 18-19.5% in forage cowpea. It is worth mentioning that leaves contain more protein in the range of 28-30% than other plant parts [38]. Forage cowpea enhances the intake of other roughages when these are fed in combination with forage cowpea and ultimately productivity and performance of animals get increased. Ash content (which shows mineral constituents) of cowpea is usually 13-15%, while neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents are in the range of 58-61% and 51-57% respectively [38]. Acid detergent lignin (ADL) contents are found to be between 10-13%. It is also interesting to note that cowpea samples gave 87-89% dry matter (DM), while the organic matter was 84-86.5%. The quality attributes of cowpea are greatly influenced by the stage at which these are harvested [39]. Baloye *et al.* [40] reported that cowpea leaves contain the highest protein at pre-anthesis stage, while it is reduced significantly at anthesis and post-anthesis stages as shown in Table 1. They reported that other quality attributes such as ash, acid detergent fiber and neutral detergent fiber contents increase from pre-anthesis to

Table 1: Effect of harvesting stage on chemical composition of Cowpea measured in g kg⁻¹ adapted from Baloye *et al.* [40].

Harvesting stage	Part of plant	DM	Ash	CP	NDF	ADF	P
Pre-anthesis	Leaf	902	139	202	288	190	5.2
	Stem	907	118	87	550	414	3.3
Anthesis	Leaf	910	130	181	462	195	3.9
	Stem	912	85.4	115	537	290	2
Post-anthesis	Leaf	893	142	165	310	215	2.3
	Stem	912	80.1	118	588	301	1.3

Dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and Phosphorous (P)

post-anthesis stages. It was also described by them that higher dry matter was recorded at anthesis stage as compared to pre-anthesis stage, but it declined again at post-anthesis stage. As far as neutral detergent fiber (NDF) is concerned, pre-anthesis stage harvesting of forage cowpea results in comparatively less quantities than anthesis and post-anthesis stages. Similarly, acid detergent fiber (ADF) is present in fewer quantities in both leaves as well as stem of forage cowpea if it is harvested at pre-anthesis stage. Small quantities of phosphorous are required by ruminants in their feed for necessary metabolic processes. Phosphorous in safe limits was present in leaves and stem of forage cowpea at pre-anthesis stage and it continued to decline as the crop got mature until minimum quantity was present at post-anthesis stage as demonstrated in Table 1.

Suitability of Forage Cowpea Preservation as Hay:

Forage cowpea is known to have a fairly good potential for green forage yield up to 20 tons per hectare [41]. It may be preserved as hay to be fed to animals during forage scarcity periods. As hay is simply the air dried forage which is prepared by reducing moisture contents of plants which make its preservation as hay quite convenient. Loss of nutrients is the greatest risk associated with hay making, but if air drying of forage is done under shade then the loss of nutrients is minimized. Another risk associated with green forage preservation as hay is the leaching losses, but climatic conditions of Pakistan are excellent as far as hay making is concerned. Hay making becomes an uphill task where there are frequent rains [42]. In Pakistan, not only forage cowpea growing conditions are favorable, but climatic conditions are excellent for hay making. Leaves of forage cowpea contain more protein (22-30%) than stem [41], so if leaf shattering is avoided then forage cowpea hay forms an excellent animal feed resource to be fed during forage scarcity periods.

Table 2: Comparison of cowpea and sorghum hay chemical composition measured in percentage as reported by Gwanzura *et al.* [16]

Parameters %	Cowpea	Sorghum
Dry matter (DM)	90	94
Organic matter (OM)	83	90
Crude protein (CP)	22	13
Neutral detergent fiber (NDF)	38	64
Acid detergent fiber (ADF)	32	52
Condensed tannins	0.03	0.06

Cowpea hay contains 22% protein (Table 2) which makes it excellent feed because the minimum recommended protein content in animal feed is 6-8% [43]. Sorghum hay contains half of the protein as compared to cowpea hay which shows the superiority of cowpea over cereals hay. Similarly, cowpea hay contains significantly less neutral detergent fiber (NDF) and acid detergent fiber (ADF) than sorghum. The obvious reason behind low fiber content in cowpea is the absence of lignified midrib which develops as a supporting structure in cereal forages leaves. Cowpea hay holds advantage over cereals forages hay because of absence of thick cuticle and lignified epidermis which increase the fiber contents in stem parts of cereals forages. Tannins are undesirable compounds which deteriorate green forage as well as hay quality and making them less palatable for dairy animals. It is interesting that tannins are present in fewer quantities in cowpea hay as compared to cereal forages. Despite the fact that tannins are chemical barriers against a variety of pathogens, herbivores and harsh environmental factors, but their presence significantly reduces the palatability of green forage as well as hay. Another advantage of forage cowpea is that average digestible nutrients of green forage are 500 g kg⁻¹ for mature animals and 800 g kg⁻¹ for dairy animals [43]. Thus high digestibility of cowpea hay is another associated benefit along with other advantages. It is worth mentioning that forage preservation as silage requires certain technical skills and expertise but hay making is comparatively an easy task. Most of dairy farmers in Pakistan are following traditional techniques and are not aware of latest technologies regarding feeding stuffs. Despite of this fact, hay making is simple and convenient to carry on even by illiterate farmers. Dairy farmers need to be realized that cowpea hay has the potential to improve the lactation of ruminants even during green forage scarcity periods. Provincial livestock departments should shoulder the responsibility of conducting a widespread campaign making dairy farmers aware of this forage preservation technique. Cowpea hay has the potential to bridge the gap between forage supply and demand during forage scarcity period and its inclusion in animal feed resource base will not only

ensure milk and meat production on sustainable basis but will help dairy farmers to improve the productivity of their herds. If cowpea hay is fed with other non-conventional feed resources such as moringa leaves which are rich in nutrients [44-49], then milk production gets improved. So in order to reduce the drastic effects of forage scarcity periods, new feed production and forage production technologies need to be adopted.

CONCLUSION

Nutritious animal feed resource base is vital to improve the productivity and performance of animals particularly of lactating ruminants. Green forages are deemed to be the most palatable animal feed stuff, but their scarcity hampers their use during lean periods. If excessive forage is preserved as hay has the potential to maintain the productivity and performance of animals. Cowpea is leguminous crop with fairly high crude protein contents. Forage cowpea preservation as hay is one the most convenient way to maintain all the year round animal feed supply chain. Cowpea hay is simple to prepare by dairy farmers and that too with little infrastructure requirements. Thus cowpea hay has potential to maintain milk production and may increase the performance of dairy animals if fed in combination with moringa leaves.

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