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Venkatesh Kumar R
Department of Applied Animal Sciences, Babasaheb Bhimrao Ambedkar University Vidya Vihar, Raebareli Road, Lucknow, Uttar Pradesh, India

Chhatrapal Gautam
Department of Applied Animal Sciences, Babasaheb Bhimrao Ambedkar University Vidya Vihar, Raebareli Road, Lucknow, Uttar Pradesh, India

Shobha N
Department of Biochemistry, Maharani's Science College for Women, Mysuru, Karnataka, India.

Rohith L Shankar
Department of Sericulture, Yuvaraja's College, University of Mysore, Mysuru, Karnataka, India.

Correspondence
Rohith L Shankar
Department of Sericulture, Yuvaraja's College, University of Mysore, Mysuru, Karnataka, India.

Use of mulberry leaves as supplementary food in cow and goat to improve milk production

Venkatesh Kumar R, Chhatrapal Gautam, Shobha N, Rohith L Shankar

Abstract
The nutritional value of mulberry leaves is greatly considered not only the food for silkworm but also regarded as a best supplementary food for cattle's. The present study was aimed to determine the changes in protein, carbohydrate and fat contents in cow and goat milk before and after mulberry leaves feeding for different intervals (Number of days). After 60 days of feeding of mulberry leaves the milk protein content was enhanced up to 36.75% in both cow and goat whereas the carbohydrate content in milk of cow and goat was 56.46% and 59.26% respectively. Further the lipid content in cow milk was enhanced by 4.5% and in goat milk 4.9% were recorded after 60 days of mulberry leaves feeding. On the basis of current investigation results, the mulberry has been proved to be excellent and un-convention food stuff for small ruminants in general, goat and cow in particular.

Keywords: Mulberry, Nutrition, silkworm, cattle's, milk.

1. Introduction
Mulberry being a perennial plant distributed worldwide and adopted well to varied agroclimatic conditions and grown largely in all the sericulture practicing countries (FAO, 1999) [6] especially tropical countries like India where it can be grown throughout the year unlike temperate countries where mulberry forage production is limited to spring to autumn season of the year. Mulberry (Morus spp.) leaves have been the traditional feed for the silk worm (Bombyx mori L.), its production can be easily manipulated with the varied cultural practices. The growth and development of the silkworm larvae and subsequently cocoon production are greatly influenced by nutritional quality of mulberry leaves. Mulberry leaves are rich in protein (15-35%), minerals (2.42-4.71% Ca, 0.23-0.97% P) and metabolizable energy (1,130-2,240 kcal/kg) with absence of or negligible anti-nutritional factors (Omar *et al*., 1999; Sanchez, 2002; Saddul *et al*., 2004; Srivastava *et al*., 2006) [13, 18, 17, 19] and characterized by high digestibility and higher effective degradation potential (Kamatalit *et al*., 1992), which makes it comparable to commercial concentrates for dairy cattle. Variations in chemical composition are due to age, leaf position within the branch and fertilisation level (Benavides *et al*., 1995) [4], at the same time deficiency of certain nutrients or an imbalance of nutrients in leaves cause changes in the composition or metabolic activity of silkworm larval body (Jin, 2002) [8].
The nutritive value of mulberry is one of the highest found in products of vegetable origin and is far superior to traditional forages (Benavides *et al*., 1994) [3]. The foliage of the mulberry is highly digestible and of excellent crude protein (CP) content reaching levels of 20- 24% (Gonzalez and Milera, 2000) [7]. After evaluating the nutritive value of this plant Boschini (2002) [5] concluded that leaf and cell wall contents, together with structural carbohydrate and ash indicate that mulberry is an excellent feed for high yielding animals and can be offered fresh or dried in compound feeds. Sanchez (2002) [18] also came to conclusion and proffered that mulberry foliage can be used as a supplement to poor quality forage based diets or as the main component of ration in livestock production systems (Prasad and Reddy, 1991) [14]. The main use of mulberry globally is as feed for the silkworm, but depending on the location, it is also appreciated for its fruit (consumed fresh, in juice or as preserves), as a delicious vegetable (young leaves and stems), for its medicinal properties in infusion (mulberry leaf tea), for landscaping and as animal feed. There are several places where mulberry is utilized traditionally as a feed in mixed forage diets for ruminants, in

certain areas of India, China and Afghanistan. In Italy there have been several studies on the use of mulberry for dairy cows and other domestic animals and in France there was a research project to introduction mulberry in livestock production (Armand, 1995) [2]

Although the feeding value of mulberry for dairy cattle has been recognized for some time in Italy (Vezzani, 1938; Maymone *et al*., 1959) [20, 12] and it has been traditionally used in Himalayan region, the research on mulberry for ruminants has been rather limited. Jayal and kehar (1962) [9], based on the high digestibility value of *M. indica* leaves, suggested that they could be used as supplements for lower quality forages. Mulberry was used to replace grain based concentrates in lactating cows with excellent result. In this background the potentiality of mulberry apart from feed for silkworm has been exploited in this study. The results obtained from the present experiment determine the changes in protein, carbohydrate and fat content in cow and goat milk before and after mulberry feeding is discussed.

2. Materials and Methods

Milk samples were collected from experimental cow and goat for protein, carbohydrate and fat estimation during experimental period with following interval; before feeding of mulberry, after 30 days of feeding and after 60 days of feeding.

2.1 Protein estimation

Milk of cow and goat were analyzed by Pyne's method. In the first titration 10 ml of milk was taken in a beaker and mixed with 1 ml of phenolphthalein as an indicator and titrated against N/10 NaOH solution to get pink colour. Again 2-3 drop of potassium oxalate and 2 ml of neutral formaldehyde were added for the second titration to get pink colour.

2.2 Lipid estimation

Milk of cow and goat are analyzed by Gerber Method (Kovacs and Marton, 1962) [10] following AOAC (1990) [1]. Fat content of milk sample was measured with the help of butyrometer. Taken 10.75 ml of milk (cow and goat) in butyrometer and 10 ml of concentrated sulpuric acid was added along with 1ml of amyl alcohol. Locked the butyrometer stopper and stopper key. Orange colour was appeared in the solution. Shaken the butyrometer properly and mixed the solution. Brown color was formed and sample kept in the centrifuge for 4-5 minutes at the 1500 rpm. Fat content of milk sample was measured with the help of butyrometer.

The amount of protein, carbohydrate, fat and SNF were calculated using the following formula.

Protein = volume of N/10 NaOH X 1.75 /10

SNF = CLR/4 + 2 × Fat + 0.29

SNF protein = Volume/ SNF ×100 Carbohydrate = 100- SNF protein

Where CLR is correct lactometer reading

3. Results and Discussion

3.1 Protein

The protein content present in the milk of cow and goat before feeding of mulberry leaves were 31.3% and 19.20% while after the 30 days of feeding the milk protein content in cow and goat recorded 33.25% and 31.50 % respectively. After 60 days of mulberry feeding the milk protein content was enhanced up to 36.75% in both cow and goat (Table 1). Similar trend was observed in both SNF (Table 4) and SNF Protein (Table 5).

3.2 Carbohydrate

The Carbohydrate content in milk of cow and goat before feeding of mulberry leaves were 63.80% and 73.99% respectively. Whereas after 30 days of feeding, Carbohydrate content in milk of cow and goat was recorded 63.20% and 64.29% respectively and after 60 days of feeding of mulberry leaves, carbohydrate content in milk of cow and goat were 56.46% and 59.26% respectively (Table 2)

3.3 Fat

The lipid content in milk of cow and goat before feeding of mulberry leaves was 3.30% and 1% respectively. But after 30 days of feeding of mulberry leaves lipid content in cow and goat milk was increased up to 4.90% and 4.8%, While after 60 days of feeding of mulberry leaves, lipids content in cow milk (4.5%) and goat milk (4.9%) were recorded (Table 3).The effect of mulberry feed supplement on various nutrients in Milk of Cow and Goat is represented in the Fig. 1 and Fig. 2 respectively.

3.4 Total Quantity of Milk

The total quantity of the milk in both Cow and Goat also increased tremendously after the Mulberry feed supplement as shown in the Table 6 and Fig. 3. The result of the present study clearly indicates that the protein, fat and milk production were increased drastically in both cow and goat due to supplement feed of mulberry support the findings of Rojas *et al*. (1994) [16]. However there was no increase of carbohydrate content in both cow and goat, rather it showed slight decrease. In the present investigation it is proved that mulberry leaves are good nutritional fodder for cattle since it can increase the Total Protein and the quantity of milk in both the cattle under study. Gonzaler and Milera (2000) [7] observed a similar trend with goat fed on Guinea grass supplemented with mulberry. Malamsha *et al*. (1997) [11] fed goats Napier grass supplemented with mulberry leaves was also obtained similar results.

4. Conclusion

On the basis of current results, mulberry proved to be excellent and un-convention food stuff for small ruminants in general, goat and cow in particular. Further it is clarified that the foliage of mulberry could be used as a protein supplement. Therefore, the future prospective of mulberry leaves in diets of cows, goats can give a new opportunity to dairy science and can improve economic condition of rural farmers by enhancing quality and quantity of their milk.

In Indian sub-continent mulberry plants primarily grown as food for silkworm for the production silk in all the major sericulture practicing states. Majority of sericulture farmers in are rural based and small land holders as well as economically poor. Though the sericulture is a highly remunerative industry, the production cost and income keeps fluctuating and farmers are getting affected very often because of so many factors. That made the sericulture farmers to stop practicing sericulture continuously and take up other activities or even discontinuing of mulberry production sometime. Instead mulberry leaves can be efficiently made used as alternate food supplement to improve the cattle's milk production especially cow and goat as discussed above.

Tables and Figures

Table 1: Protein content of Cow and Goat before and after feeding the mulberry leaves.

S.I	Feeding duration	Protein %	
		Cow	Goat
1	Before feeding	31.30	19.20
2	After 30 days of feeding	33.25	31.50
3	After 60 days of feeding	36.75	36.75

Table 2: Carbohydrate content of Cow and Goat before and after feeding the mulberry leaves.

S.I	Feeding duration	Carbohydrate%	
		Cow	Goat
1	Before feeding	63.8	73.99
2	After 30 days of feeding	57.81	58.34
3	After 60 days of feeding	56.46	59.26

Table 3: Lipid content of Cow and Goat before and after feeding the mulberry leaves.

S.I	Feeding duration	Fat %	
		Cow	Goat
1	Before feeding	3.3	1
2	After 30 days of feeding	4.9	4.8
3	After 60 days of feeding	4.5	4.9

Table 4: SNF content of Cow and Goat before and after feeding the mulberry leaves.

S.I	Feeding duration	SNF %	
		Cow	Goat
1	Before feeding	8.7	7.38
2	After 30 days of feeding	7.88	7.56
3	After 60 days of feeding	8.44	9.02

Table 5: SNF Protein of Cow and Goat before and after feeding the mulberry leaves.

S.I	Feeding duration	SNF Protein %	
		Cow	Goat
1	Before feeding	36.20	26.01
2	After 30 days of feeding	42.19	41.66
3	After 60 days of feeding	43.54	40.74

Table 6: Effect of mulberry feed on enhancement of milk quantity.

S.I	Feeding duration	Milk quantity %	
		Cow	Goat
1	Before feeding	4	1
2	After 30 days of feeding	4.3	1.4
3	After 60 days of feeding	4.8	1.9

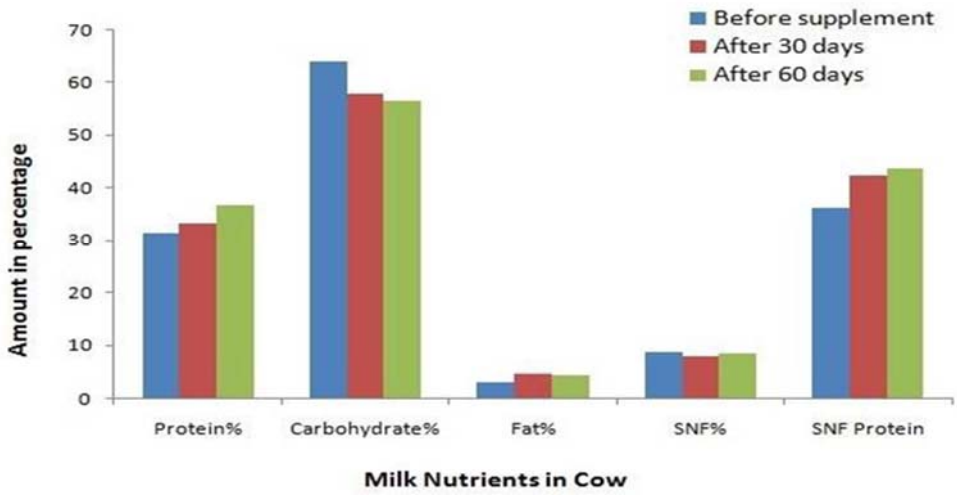

Fig 1: Effect of mulberry feed supplement on various nutrients in the milk of cow

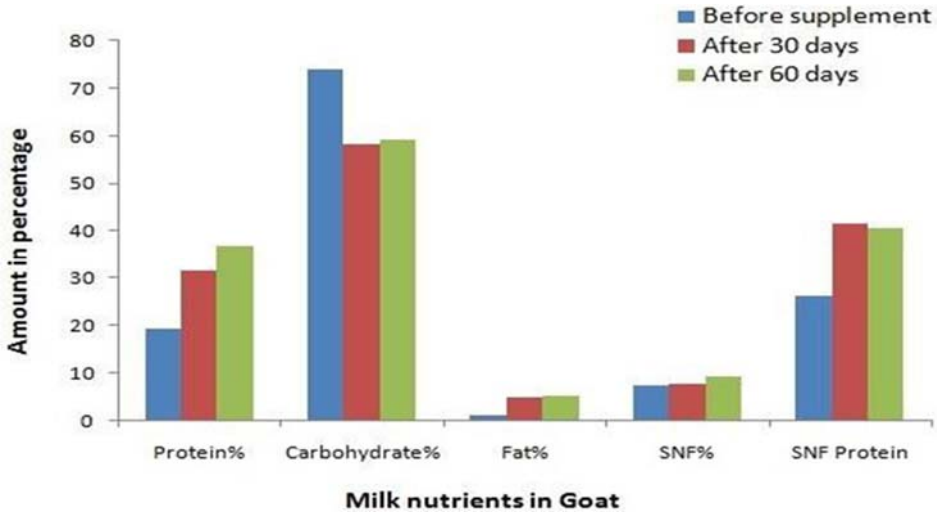

Fig 2: Effect of mulberry feed supplement on various nutrients in the milk of goat

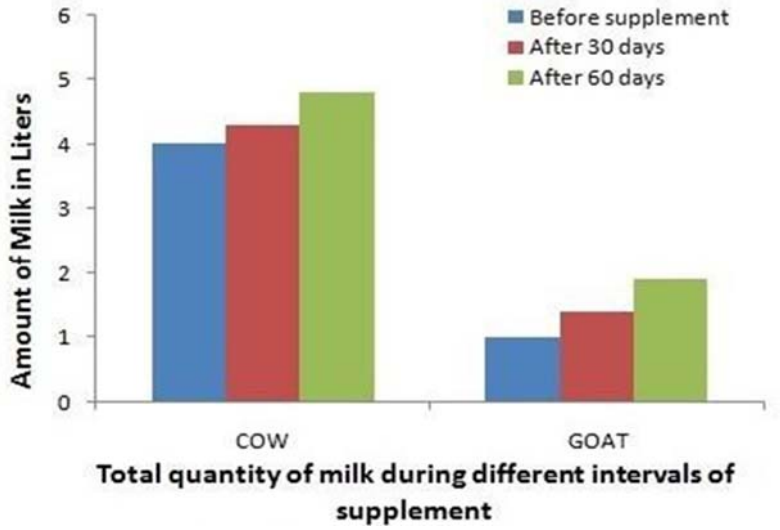

Fig 3: Effect of mulberry feed supplement on the total quantity of milk

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