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Effect of Replacement of Concentrate Mixture with Mulberry (*Morus indica*) Variety V-1 on Blood Parameters and Economics of Feeding

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Abstract: ***The present research was undertaken to study the nutritional evaluation of Mulberry (Morus indica) leaves variety V-1 in Osmanabadi kids. Thirty Osmanabadi weaned kids of 5 to 6 months of age were randomly selected and divided into five groups, six in each group on the basis of body weight and age. The individual feeding with 50:50 concentrate mixture and Mulberry leaves increased DM intake than rest of all treatments. The DCP and TDN intake was significantly lower in group fed with 100% Mulberry leaves. The gain in body weight, height at withers, body length, chest girth and belly girth was significantly higher in kids fed with 50:50 concentrate mixtures and Mulberry leaves. The blood parameters viz.., blood glucose, TSP, BUN and haemoglobin were within a normal range in all treatment groups including control. Cost of feeding reduced from control (`-127.07) by replacing 50% DCP from concentrate mixtures to (`-63.32) in T2 by improving the weight gain. It concluded that the non- conventional feed stuffs like Mulberry leaves could be incorporated in the diet of Osmanabadi kids up to 50 % replacement of DCP from concentrate mixture with Mulberry leaves.***

Keywords: Goat, Mulberry leaves, Blood, Parameter, Efficiency

1. Introduction

The increase in the cost of conventional feed stuffs with their irregular supply pose a great threat to future livestock industry including small ruminants. Most of feeds such as energy and protein sources namely Mulberry leaves, sorghum and groundnut cake used in the production of livestock feed are also used for human consumption. It is therefore, necessary to seek alternative sources such as non-conventional feed resources and incorporate them in the preparation of animal feed (Anonymous, 1976). Chronic shortage of protein and energy rich feed, shrinkage of grazing lands thrown a serious challenge to meet the feed and fodder requirement of 512.05 million livestock population (Anonymous, 2012) of our country. The liberalized export policies and diversion of conventional animal feeds for human consumption aggravates the shortage of digestible crude protein and total digestible nutrients. Hence, matter of imbalance between supply and demand for concentrate feed (23 vs. 53 million tonnes dry matter) is of great concern (Anonymous, 2013). Animal nutritionists are therefore, in constant search of alternate feed resources for economical livestock feeding.

Mulberry (Morus indica), as the one among other protein plant sources in the region, which can grow well under variable climatic conditions, ranging from temperate to tropical area. Due to its high digestibility and excellent level of crude protein, mulberry foliage can be a comparable source to commercial concentrates for feeding and production in ruminant. V1 (Victory one) variety of Mulberry developed by Central Sericultural Research and Training Institute (CSRTI); which is under the control of (CSRTI) in Mysore. Leaves have high protein content (18 to 25% in DM) and high (75 to 85%) in vivo DM digestibility (Ba *et al*. 2005).

2. Material and Methods

Animal, housing and feeding management

Thirty healthy, Osmanabadi weaned male kids (5-6 months of age) were allotted to five groups (T_0, T_1, T_2, T_3 and T_4) of six kids each in a Completely Randomized Block Design. Experimental kids were drenched with anthelmintic (Fenbendazole 5 mg per kg BW) at the beginning of experiment and allowed to adapt for 10 days before experimental feeding. Experimental kids were housed in a clean, well-ventilated shed with facilities of individual feeding and watering. All the kids were fed individually. The kids of T_0, T_1, T_2 and T_3 treatment group were fed with concentrate, concentrate plus Mulberry leaves and T_4 treatment group were fed with only Mulberry leaves, respectively at 8.15 am daily. In the afternoon session, at 4.00 pm ad libitum sorghum kadbi was fed to all groups. Daily feed intake and weekly body weights for two consecutive days before feeding and watering were recorded throughout the 182 days of experimental period. Quantity of concentrates, Mulberry leaves and Sorghum kadbi to be offered daily was adjusted fortnightly as per body weight. Fresh and clean drinking water was provided ad libitum. The shed and surrounding area was sprayed with Blutox and Diptraz at an interval of one month. The kids were regularly groomed and cleaned. The kids were regularly checked for their healthy condition by veterinary doctor. Healthy and hygienic condition was maintained in the shed throughout experimental period.

Feeds

The nutrient requirement of the experimental kids was considered as per the ICAR standard (Anonymous, 1998) for growing kids. The concentrate mixture (DCP- 17.40%, TDN-70.55%) was fed to experimental kids prepared from 30 per cent maize grains, 30 per cent groundnut cake, 20 per cent gram chuni, 17 per cent wheat bran, 2.5 per cent mineral mixture and 0.5 per cent salt and experimental treatments were as T_0 included 100 per cent DCP from concentrate mixture + *ad lib*. Sorghum kadbi; T_1 included 75 per cent DCP from concentrate mixture + 25 per cent DCP from Mulberry leaves + *ad lib* sorghum kadbi; T_2 included 50 per cent DCP from concentrate mixture + 50 per cent DCP from Mulberry leaves + *ad lib* sorghum kadbi; T_3 included 25 per cent DCP from concentrate mixture + 75 per cent DCP Mulberry leaves + *ad lib*. sorghum kadbi and T_4 included 100 per cent DCP from Mulberry leaves.

Blood parameter study

The blood sample were collected from experimental kids at three times i.e. 0 (initial stage), 91th (middle stage) and 182th (final stage) days of experiment and analyzed for blood glucose, blood urea nitrogen, total serum protein and haemoglobin content to see the changes in blood parameter due to the treatment feed. Analysis of blood constituents : Blood glucose was estimated as per the method described by Dubowski (1962), total serum protein content as per the modified biuret and dumas method described by Varley (1980), haemoglobin content was estimated as per the method described by Shastry (1971) and blood urea nitrogen as per the Urease Nesslerization method described by Varley (1980).

Statistical analysis

The observations of blood parameter were subjected to test of significance using Completely Randomized Design (Snedecor and Cochran, 1967).

3. Results and Discussion

Blood parameter study

The blood glucose content in experimental kids was within range of 37.84 to 55.36 mg/dl (Table 1). Although, differences in the mean average values of blood glucose of experimental kids at 0, 91 and 182 days of experiment period under T_0, T_1, T_2 ,T_3 and T_4 were observed progressively increased up to T_2. Further replacement of concentrate mixture with Mulberry leaves showed decrease in blood glucose level in T_3 and T_4. The differences in the mean values of blood glucose content in all treatments were statistically non-significant at 0, 91 and 182 days. From the Table, it was observed that the different treatment groups feed had no significant effect on blood glucose content of Osmanabadi kids at 0, 91 and 182 days of experimental period. The present results were agreement with the Musalia *et al*. (2000) reported non-significant differences in mean values of blood glucose in all treatment groups male lambs (Mandya x Merino) fed with 2.5 per cent urea treated neem seed kernel cake. Naqvi *et al.* (2013) conducted the study to assess the effect of concentrate supplementation during summer months on growth, reproductive performance, and blood metabolites in Malpura ewes. Twenty adult Malpura ewes were used in the present study. The ewes were divided into two groups viz, group-1 (n=10; control) and group-2 (n=10; concentrate supplementation). It was observed that the plasma glucose (mg/dL) in group-1 was 46.18 + 1.67 and in group-2 was 53.29 + 1.45. It was concluded that on concentrate supplementation significantly influenced plasma glucose. Korake *et al*. (2015) reported that the treatment feed had no significant effect on blood glucose content of Osmanabadi male kids. Dutta *et al*. (2012) who reported that there were non-significant differences in mean values of blood glucose content in all treatment groups kids fed with three iso-nitrogenous diets containing 0 (CT-0), 1.0 (CT-1) and 2.0 (CT-2) per cent condensed tannins through a dried and ground leaf meal mixture *of Ficus infectoria, Psidium guajava* and *Ficus bengalensis.*

The blood urea nitrogen content in experimental kids was within range of 45.93 to 31.03 mg/dl (Table 1). The average values of blood urea nitrogen of experimental kids at 0, 91 and 182 days of experiment period under T_0, T_1, T_2 T_3 and T_4 were observed progressively increased up to T_2. Further replacement of concentrate mixture with Mulberry leaves showed decrease in blood urea nitrogen level in T_3 and T_4. The differences in the mean values of blood urea nitrogen content in all treatments were statistically non-significant at 0 and 91 days and at 182 days of experiment under treatment T_2 and T_1 was significantly ($P<0.05$) higher over T_3 and T_4 while at par with T_0**.** From the table, it was observed that the different treatment groups feed had no significant effect on blood urea nitrogen content of Osmanabadi kids at 0 and 91 days of experimental period. The results were in comparable with Ganai *et al.* (2010) evaluated nutritional value of green Mulberry (*Morus multicaulis*) leaves in sheep. They reported that the blood parameters studied were within normal range. Blood urea level reduced from 42.85 to 35.55 mg/dl after feeding indicating that tannins of leaves might have protected the soluble protein from degradation in the rumen by microbes, so reaching the lower gut where it was made available to sheep resulting in low blood urea level. Korake *et al.* (2015) reported that blood urea nitrogen content were significantly ($P<0.05$) lower in treatments groups (T_1 and T_3) than control (T_0) and treatment group (T_2). The control (T_0) and treatment group (T_2) didn't differ significantly from each other; whereas, T_1 and T_3 differed significantly from each other at middle and final stage of experiment.

Total serum protein content in experimental kids was in the range of 5.76 to 8.52 g/dl (Table 1). The average values for total serum protein in the experimental kids at 0, 91 and 182 days of experiment period under T_0, T_1, T_2 T_3 and T_4 were observed progressively increased up to T_2. Further replacement of concentrate mixture with Mulberry leaves showed decrease in blood total serum protein level in T_3 and T_4. The present results were agreement with the Patra *et al*. (2002) studied leaf meal as protein supplement in goats. Serum urea concentration in SBM group was significantly ($p<0.05$) higher in comparison to the LMAM group.

This could be due to lower dietary density of ME (kcal/g) relative to the rumen degradable protein (RDP) in the SBM supplement as compared to LMAM. Korake *et al*. (2015) reported that total serum protein content in treatments groups (T_0, T_1, T_2 and T_3) were statistically non-significant at initial, middle and final state of experiment but higher values of total serum protein content was observed in treatment group (T_2) fed with salt sprinkled neem leaves individually and lowest in T_1 at middle and final stage of experiment. From the results, it was observed that experimental feed treatment had no significant effect on total serum protein content of Osmanabadi male kids. The present results were higher than the Manat *et al.* (2016) reported that the hematological profile in Surti goats during the post-partum period for total serum protein (g/dl) in the treatment groups on 0, 7, 14, 21, 30, and 45 days post kidding and once from the control group was 5.35 ± 0.12, 6.16 ± 0.03, 6.77 ± 0.10, 7.11 ± 0.14, 7.19 ± 0.17, 7.36 ± 0.11, 6.84 ± 0.13, respectively. Radhakrishnan (2005a) who reported non-significant differences in the mean values of total serum protein content in experimental group kids fed with complete diet plus neem leaves and 10 per cent Stylo hammata hay (N + S), 10 per cent tapioca leaves (N + T) and 10 per cent groundnut haulms (N + G). Verma *et al*. (1995) reported that feeding of water washed neem seed cake decreased total serum protein content non-significantly (P<0.01) in growing kids. Mohammed *et al.* (2016) reported that the total serum protein content in White Aardi, Black Aardi, Damascus and Barbari does were 6.44 ± 0.80, 6.76 ± 0.34, 6.17 ± 0.52 and 6.98 ± 1.07 g/dl, respectively.

The blood haemoglobin content in experimental kids was in the rage of 7.90 to 9.02 mg/dl (Table 1). The average values for haemoglobin content of the blood in experimental kids at 0, 91 and 182 days of experiment period under T_0, T_1, T_2 T_3 and T_4 were observed progressively increased up to T_2. Further replacement of concentrate mixture with Mulberry leaves showed decrease in blood haemoglobin level in T_3 and T_4. The differences in the mean values of blood haemoglobin content in all treatments were statistically non-significant at 0, 91 and 182 days. From the tables, it was observed that the different treatment groups feed had no significant effect on blood haemoglobin content of Osmanabadi kids at 0, 91 and 182 days of experiment period.

The present results were agreement with the Korake *et al*. (2015) reported that blood haemoglobin content in treatments groups (T_0, T_1, T_2 and T_3) were statistically non-significant at initial, middle and final state of experiment but higher values of blood haemoglobin content was observed in treatment group (T2) fed with salt sprinkled neem leaves individually and lowest in T1 at middle and final stage of experiment. From the results, it was observed that experimental feed treatment had no significant effect on blood haemoglobin content of Osmanabadi male kids. Radhakrishnan (2005[a]) who reported non-significant differences in the mean values of haemoglobin content in experimental group kids fed with complete diet plus neem leaves and 10 per cent Stylo hammata hay (N + S), 10 per cent tapioca leaves (N + T) and 10 per cent groundnut haulms (N + G). Verma *et al*. (1995) reported that feeding of water washed neem seed cake decreased blood haemoglobin content non-significantly (P<0.01) in growing kids. The present study results were slightly higher than Manat *et al* (2016) reported that the hematological profile in Surti goats during the post-partum period for Hb (g/dl) in the treatment groups on 0, 7, 14, 21, 30, and 45 days post kidding and once from the control group was 6.10 ± 0.13, 7.32 ± 0.07, 8.09 ± 0.09, 8.52 ± 0.07, 9.16 ± 0.06, 9.54 ± 0.08 and 10.18 ± 0.22, respectively.

Mohammed *et al*. (2016) reported that the haemoglobin content in White Aardi, Black Aardi, Damascus and Barbari does were 9.97 ± 2.73, 8.43 ± 0.38, 10.65 ± 0.35 and 6.97 ± 0.26 (g/dl), respectively. Sahu *et al*. (2015) reported that the feeding regimens viz. (T_1): Control; normal browsing at range system; (T_2): Control with daily supplementation of 200.00 g concentrate mixture & (T_3): Control with daily supplementation of 300.00 g concentrate mixture. The haemoglobin level in the present study ranged from 8.39 ± 0.18, 8.36 ± 0.24 and 8.41 ± 0.29 g/dl at 0 day, respectively and at 60 days it was 7.52 ± 0.25, 7.58 ± 0.20 and 7.49 ± 0.23 g/dl in above respective groups. There was no effect of supplementation of concentrate on haemoglobin but there was significant decrease in haemoglobin from 0 day to 60 days of treatment which might be due to pregnancy in the above mentioned study.

Feed conversion efficiency

Feed conversion efficiency (FCE) of Osmanabadi kids for DM, DCP and TDN for one kg live body weight gain in T_0, T_1, T_2, T_3 and T_4 were as 10.03, 10.49, 10.84, 10.15 and 10.46 kg; 0.67, 0.69, 0.71, 0.68 and 0.70 kg and 5.04, 5.10, 5.61, 4.79 and 4.72 kg, respectively. From the results, it was observed that treatment group fed with 50 % Mulberry leaves (T_2) showed highest FCE for DM, DCP and TDN. Bamikole *et al.* (2005) reported nutritive value of Mulberry (*Morus spp.*) leaves in the growing Rabbits in Nigeria. They reported that weight gain and FCE were only significantly depressed below the level achieved with an all concentrate ration when mulberry leaves comprised more than 50% of the ration as the portion of Mulberry leaves increased, reduction in weight gain and FCE might have resulted from the combination of lower DM intake content of leaves because of its low DM content (262 g/kg vs. 925 g/kg in the concentrate) and lower intake and digestibility of NFE and possibly digestible energy. With comparable DM intake, digestibility and weight gain as in all concentrate rations achieved with up to 50 % substitution of concentrate in ration, rapid growth rate of rabbits can be achieved at less cost. The results of FCE for DM were in agreement with those of Verma *et al.* (1995) i.e. 11.40 ± 0.63 to 14.60 ± 1.68 in growing kids fed with concentrate mixture containing WWNSC at 15 and 25 per cent, Radhakrishnan (2005[b]) reported FCE in non-descript make kids (13.49 ± 0.68 to 16.37 ± 0.53) fed with complete ration containing neem leaves at 0, 20, 40 and 60 per cent level as a roughage source and Radhakrishnan (2005[a]) reported FCE in Madras Red lambs (12.22 ± 0.70 to 15.47 ± 1.42) fed with ration (T_1) contained 60 per cent of green fodder hay while experimental ration (T_2) contained 60 per cent of Neem:SS: GNH 25:37.5:37.5, (T_3) Subabul : GNH: RS 25:37.5:37.5 or (T_4) Gliricidia:GNH:RS 25:37.5:37.5.

The results of FCE for DCP were in agreement with those of Nawale (1979) i.e. 0.837 to 0.987 kg in Osmanabadi growing kids fed with 100, 120 and 80 per cent DCP as per NRC. The results of FCE for TDN were in agreement with those of Sarode (1984) i.e. 8.90 to 11.22 kg in Osmanabadi kids fed with diet 100:100, 100:80, 80:100 and 80:80 of protein and energy combinations.

Table 1: Effect of feed treatment on blood parameters viz., blood glucose, total serum protein, haemoglobin and blood urea nitrogen content under different treatment groups

Particulars	Treatments														
	T_0			T_1			T_2			T_3			T_4		
	0 day	91^{th} day	182^{th} day	0 day	91^{th} day	182^{th} day	0 day	91^{th} day	182^{th} day	0 day	91^{th} day	182^{th} day	0 day	91^{th} day	182^{th} day
Blood glucose	45.89 ± 6.26	44.20± 5.11	43.11± 4.20	51.85 ± 3.51	51.73± 6.98	51.38± 4.20	55.36 ± 6.65	55.09± 0.83	54.63± 0.75	41.67 ± 4.03	40.72± 3.15	40.36± 2.11	40.04 ± 4.40	38.53 ± 2.56	37.84 ± 4.54
Blood urea nitrogen	43.17 ± 2.25	41.62± 2.17	35.22 ± 1.19	44.61 ± 2.39	43.35 ± 0.97	38.25± 1.30	45.93 ± 3.08	45.37 ± 2.68	39.12 ± 1.94	42.32 ± 3.24	41.59 ± 2.19	32.12 ± 1.31	40.05 ± 3.01	38.46 ± 2.81	31.03 ± 2.21
Total solid protein	6.16± 0.39	7.21± 0.52	8.41 ± 0.35	6.34 ± 0.26	7.25 ±0.32	8.46 ± 0.09	6.47 ± 0.36	7.35 ±0.25	8.52 ± 0.09	6.11 ± 0.17	6.89 ± 0.15	8.00 ± 0.19	5.76 ± 0.34	6.79 ± 0.12	7.96 ± 0.12
Haemoglobin	8.81± 0.16	8.60± 0.16	8.42 ± 0.04	8.87 ± 0.14	8.62 ± 0.10	8.47 ± 0.07	9.02 ± 0.26	8.77 ± 0.24	8.58 ± 0.16	8.66 ± 0.30	8.17 ± 0.30	8.10 ± 0.29	8.40 ± 0.08	7.96 ± 0.24	7.90 ± 0.22

Table 2: Effect of feed treatment on feed conversion efficiency and economics of feeding of Osmanabadi kids

Particulars	T_0	T_1	T_2	T_3	T_4
Feed conversion efficiency					
DM	10.03	10.49	10.84	10.15	10.46
DCP	0.678	0.697	0.719	0.684	0.709
TDN	5.05	5.11	5.61	4.8	4.72
Economics of feeding					
Total feed cost (Rs.)	1124.54	847.91	583.85	275.53	163.67
Total live wt. gain	8.85	8.98	9.22	8.4	7.96
Cost per kg live wt. gain (Rs.)	127.07	94.42	63.32	32.8	20.56

4. Economics of Feeding

The feeding cost of T_4 and T_3 (`.20.56 and 32.80) treatment group as comparatively less than $T_0$, $T_1$ (`.127.07, 94.42) and T_2 (`.63.32). The present results were agreement with the Liu *et al*. (2001) studied the effects of Mulberry leaves to replace rapeseed meal on performance of sheep feeding on ammoniated rice straw diet. 45 Huzhou lambs were divided into five equal groups according to their body weight and gender. Lambs in each groups were kept in three pens (male, female and mixed (one male and two female)), and received one of the following dietary treatments: 100g RSM (A), 75 g RSM plus 60g Mulberry leaves (B), 50g RSM plus 120g Mulberry leaves (C), 25g RSM plus 180g Mulberry leaves (D) and 240g Mulberry leaves (E). All animals were gives ABRS ad libitum along with 100 g ground corn pre head per day. Feed efficiency was higher in diet A; concentrate consumption per kilogram of weight gain was lower when higher level of mulberry leaves was supplemented (diets D and E). Feed cost per kilogram gain was lower in diets E and A compared to other treatments. The benefits results from supplementation with Mulberry leaves included an increases intake of basal diet, less consumption of concentrate and an increased income. Bamikole *et al*. (2005) evaluated nutritive value of Mulberry (*Morus* spp.) leaves in the growing Rabbits in Nigeria. They reported that weight gain and FCE were only significantly depressed below the level achieved with an all concentrate ration when mulberry leaves comprised more than 50% of the ration as the portion of Mulberry leaves increased, reduction in weight gain and FCE might have resulted from the combination of lower DM intake content of leaves because of its low DM content (262 g/kg vs. 925 g/kg in the concentrate) and lower intake and digestibility of NFE and possibly digestible energy. With comparable DM intake, digestibility and weight gain as in all concentrate rations achieved with up to 50 % substitution of concentrate in ration, rapid growth rate of rabbits can be achieved at less cost. Alpizar-Naranjo *et al*. (2017) studied the partial or total replacement of commercial concentrate with on-farm-grown mulberry forage: effect on lamb growth and feeding costs. They reported that basal roughages and concentrate cost were progressively reduced as the level of Mulberry forage increased in the diets. Korake *et al*. (2015) reported that feeding cost per kg live weight gain in T_0, T_1, T_2 and T_3 were 164.08, 183.10, 150.73 and 157.55, respectively. From the results, it was observed that treatment group fed with salt sprinkled neem leaves (T_2) showed lowest feeding cost per kg live body weight gain and highest in treatment group fed with WWNSC (T1). The results were in agreement with those of Radhakrishnan (2005[a]) who conducted experiment with weaned male kids fed with complete ration containing neem leaves at 0, 20, 40 and 60 per cent level as a roughage source and reported lower feeding cost per kg live weight gain in treatment group as compared to control. Radhakrishnan (2005[b]) conducted experiment in Madra red lamb fed with ration (T_1) contained 60 per cent of green fodder hay while experimental ration (T_2) contained 60 per cent of Neem: SS: GNH 25: 37.5: 37.5, (T_3) Subabul: GNH: RS 25:37.5:37.5 or (T_4) Gliricidia: GNH: RS 25:37.5:37.5 and recorded lower feeding cost per kg live weight gain in treatment groups as compare to control. Madhavi *et al*. (2006) noted comparable feeding cost in Nellore lambs of control and experimental group fed with complete diet formulated with 15 per cent level of water washed and 4 per cent of urea-ammoniated neem seed cake, 28.5 per cent Bajra (*Pennisetum americanum*) straw and 10 per cent groundnut (Araches hypogaea L.) haulms. Rashid *et al*. (2016) reported that the cost per kg live body weight gain were `. 121.13 ± 1.351, 183.09 ± 41.096 and 143.46 ± 7.1 on feeding three different complete compound pellets containing different levels of energy, viz. SE (standard energy, ME content 10.28 MJ/kg DM as per NRC, 1981), LE (low energy, ME content 9.25 MJ/kg DM) 10.00 per cent less ME and HE (high energy, ME content 11.30 MJ/kg DM) 10.00 per cent high ME than SE respectively,

From the overall results it could be concluded that the non-conventional feed stuffs like Mulberry leaves could be incorporated in the diet of Osmanabadi kids up to 50 % replacement of DCP from concentrate mixture with Mulberry Leaves.

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