RESEARCH ARTICLE
Open Access

Journal of Veterinary and Animal Sciences
ISSN (Print): 0971-0701, (Online): 2582-0605
https://doi.org/10.51966/jvas.2022.53.4.522-528

Effect of feeding *Moringa oleifera* leaves on growth, haematobiochemical profiles and puberty in Malabari doelings#

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Citation : Aravind , A ., Simon, S., Jayakumar, C., Abhilash ,R.S .,Venkatachalapathy,R.T ., Raji,K. and Ajith, K.S. 2022. Effect of feeding *Moringa oleifera* leaves on growth, haematobiochemical profiles and puberty in Malabari doelings. *J. Vet. Anim. Sci.* **53**(4): 522-528
DOI: https://doi.org/10.51966/jvas.2022.53.4.522-528

Received: 26.03.2022 *Accepted: 27.04.2022* *Published: 31.12.2022*

Abstract

The study was conducted to assess the effect of supplementation of Moringa oleifera leaves on reproductive performance in Malabari doelings. Apparently healthy Malabari kids (n= 32) of age three months were selected and randomly allocated to two different treatment groups. Control group (T1, n= 16) was fed with complete feed as pellets and experimental group (T2, n=16) was given complete feed pellets in which 50 per cent of concentrate was replaced with M. oleifera leaves on dry matter (DM) basis. The mean initial and final body weight and dry matter intake did not differ significantly but showed a linear increase in both the groups. Haematological parameters (Hb, Haematocrit, TEC, TLC) did not vary significantly between groups, however, mean total protein was significantly higher (p< 0.05) and mean ALT was significantly lower in T2. Post weaning mean progesterone profile remained less than 1ng/mL until fifth month of age, showed significant increase during sixth month (T1- 0.24 ng/mL, T2- 0.44ng/mL; p< 0.5) and was elevated more than 1ng/mL during seventh month in T2 (T1- 0.72 ± 0.22 ng/mL, T2- 1.14 ± 0.29 ng/mL). First behavioural oestrus was observed during sixth month age without any significant variation. The present study revealed safe and effective means of replacing 50 per cent concentrate feed with in M. oleifera leaves in Malabari doelings in advancing puberty without affecting the growth performance.

Key words: *Malabari doelings, M. oleifera leaves, haematobiochemical profiles, puberty*

#Part of Ph.D thesis submitted to Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala

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In Kerala, the total goat population showed 9.08 per cent increase (DAHD, 2019) in the latest census than the previous one and contribute to a major share of livestock in the state. Malabari goat is one of the promising breeds in Kerala having good adaptability and prolificacy. Majority of goat farming is practiced mainly by small scale farmers and economically weaker section of the society. Hence under nutrition induced poor growth rate leading to reduced reproductive performance is common among goats. Inadequate concentrate and green fodder during growth phase of kids can result in delayed onset of puberty and poor reproductive performance lifelong. *Moringa oleifera* being a perennial, tropical, draught resistant, fast growing tree producing high biomass is a potential source of non conventional feed material for goats. Since the leaves are rich in protein, carbohydrate, vitamin, minerals and aminoacids, it can be used for partial or complete replacement of conventional concentrates (Sultana *et al*., 2015). The tree leaves also contain biologically active compounds such as polyphenols, flavonoids and carotenoids having favourable effect on reproduction (Zeng *et al*., 2018). However, the tree leaves also contains some antinutritive factors like tannin and saponins which severely affects palatability and acceptance by the small ruminants. Hence, the present study was carried out to evaluate the growth performance, haematobiochemical parameters and attainment of puberty in Malabari kids fed with *M. oleifera* leaves by replacing 50 per cent of concentrate in complete feed.

Materials and methods

Experimental animals and ration

The experiment was conducted at the University Goat and Sheep Farm, Mannuthy under Kerala Veterinary and Animal Sciences University. Apparently healthy weaned Malabari kids of three months old were utilised for the study. After routine vaccination and deworming, these kids were randomly allocated to control (T1, n=16) and experimental groups (T2, n=16). Kids were housed individually in well ventilated, clean and dry sheds with facilities for feeding and watering. T1 kids were fed with complete feed containing concentrate and dry roughage in pellet form, whereas, T2 kids were fed with complete feed in which 50 per cent of concentrate was replaced with *Moringa oleifera* leaves. All the animals in control and experimental groups were fed as per the ICAR (2013) recommendations. The complete feed was weighed and given to the kids individually twice a day, at 9 am and 4 pm. Clean drinking water was provided throughout the day. Daily quantity of feed offered to each kid was recorded individually. Daily portions of leftover feed were weighed and the moisture content of the feed was estimated for calculation of dry matter intake. Feeding trial was carried out until the doelings exhibited first behavioural oestrus. Oestrus was detected using a breeding buck and oestrus intensity was evaluated based on behavioural and physiological changes associated with oestrus (Joseph, 2003).

Proximate analysis of *M. oleifera* leaves and experimental rations were done as per the standard procedure (AOAC, 2016). Both rations were made isonitrogenous and isocaloric (CP- 16 %, TDN- 68 %). The ingredient composition is given in Table 1 and proximate composition of complete feed and Moringa leaves are given in Table 2. Body weight, daily dry matter intake, haemato-biochemical and serum progesterone analysis was carried out at fortnightly intervals. Haematological and biochemical analysis were carried out using automatic haematology analyser (Orphee Mythic 18 Vet, Switzerland) and biochemical analyser (Master T, Hospitex Diagnostics, Italy) using standard kits. Serum progesterone was analysed by standard protocol using ELISA kit (Calbiotech Inc., CA, USA). Data collected were statistically analysed using SPSS software version 24.0.

Result and discussion

Proximate composition of experimental diets and M. oleifera leaves

The proximate composition of experimental rations and *M. oleifera* leaves are depicted in Table 2. The crude protein (CP) content in Moringa leaves was found to be 22.60 per cent. The result of this study was comparable with Choudhary *et al*. (2018) and Meel *et al*. (2018) who observed 21.37 and

Table 1. Ingredient composition of control and experimental feed (%)

Ingredient	Per cent composition	
	T1	T2
Maize	30	17
Tapioca starch waste	15	17.5
Soya bean meal	10	1
Rice polish	6	3
CGF	6	3
Mineral mixture	2	2
Salt	1	1
Alfalfa hay	30	22
Moringa	0	33.5

23.31 per cent CP, respectively. However, the mean value was lower than the values reported by Damor *et al*. (2017) and Mataveia*et al*. (2019) who observed CP content in Moringa leaves as 26.3 and 28 per cent, respectively and higher than Priya *et al*. (2020) and Afzal *et al*. (2021) who observed 18.08 and 18.2 per cent, respectively. The variations in CP content of *Moringa oleifera* leaves in the present study could be due to the soil type, stage of procurement of leaves and climate of different geological zones from which the leaves were collected (Meireles *et al*., 2020).

Body weight

The mean initial body weights were 8.00±0.50 kg and 7.89±0.55 kg and final body weights at tenth fortnight were 18.73±0.89 kg and 19.95±0.89 kg, in T1 and T2 respectively. Both the groups showed an increase in mean body weight having a linear growth pattern per fortnight till the end of experiment, however significant difference could not be observed between the groups (Table 3). The result obtained in the present study is in agreement with Sarwatt *et al*. (2002) who could not observe any difference between various inclusion levels (0, 25, 75 and 100 %) of *M. oleifera* leaves in goat feed in terms of growth rate in East African goats and also with Ali *et al*. (2018), who observed no significant difference in body weight of kids fed with zero and 50 per cent replacement of *M. oleifera* leaves in concentrate mixture. However, Damor *et al*. (2017), Choudhary *et al*., (2018) and Meel *et al*. (2019) observed higher body weight gain with partial or complete replacement of concentrate feed with *M. oleifera* leaves in Mehsana, Bengal and Sirohi breeds of goats, respectively and opined that the higher growth rate might be due to high protein in the diet. Since the present study observed a mean body weight comparable to Verma *et al*. (2009) and Venkatachalapathy *et al*. (2016) in Malabari kids, 50 per cent of concentrate in complete feed can effectively be substituted with *M. oleifera* leaves.

Daily dry matter intake (DMI)

The mean initial and final daily dry matter intake in kg for T1 were 0.29±0.02 and 0.67±0.03 and for T2 were, 0.29±0.02 and 0.71±0.03, respectively. There was no significant difference between T1 and T2 from first to final fortnight (Table 3). The result obtained in this study was in concurrence with Damor *et al*. (2017), Ali *et al*. (2018) and Yusuf *et al*. (2018) who reported no significant effect on DMI among the treatment groups. On the contrary, Sarwatt *et al*. (2002) and Meel *et al*. (2018) reported a significant increase in daily DMI on inclusion of *M. oleifera* leaves.

Table 2. Proximate composition of experimental rations and Moringa leaves (%) on dry matter basis.

Parameters	T1	T2	Moringa leaves
Dry matter	89.32	89.31	91.97
Crude protein	17.61	16.69	22.60
Crude fibre	6.71	7.76	7.03
Ether extract	2.43	2.58	4.93
Total ash	7.79	10.43	9.10
Nitrogen free extract	65.46	62.54	56.34
Calcium	1.47	1.96	2.17
Phosphorus	1.38	1.03	0.29

Table 3. Body weight (kg) and daily dry matter intake (kg) in control and experimental animals

Fortnight	Body weight (kg)		Dry matter intake (kg)	
	T1	T2	T1	T2
1	8.00±0.50	7.89±0.55	0.29±0.02	0.29±0.02
2	9.04±0.63	9.62±0.64	0.32±0.02	0.35±0.02
3	10.49±0.71	10.80±0.58	0.38±0.03	0.39±0.02
4	12.22±0.72	12.55±0.69	0.44±0.03	0.46±0.03
5	13.01±0.70	13.54±0.67	0.47±0.03	0.49±0.02
6	13.70±0.72	14.41±0.70	0.48±0.03	0.53±0.03
7	14.57±0.69	15.71±0.74	0.51±0.02	0.58±0.03
8	15.42±0.71	16.68±0.75	0.55±0.03	0.59±0.03
9	16.87±0.82	18.48±0.88	0.60±0.03	0.66±0.03
10	18.73±0.89	19.95±0.89	0.67±0.03	0.71±0.03

Table 4. Haematobiochemical profiles of Malabari kids fed with *M. oleifera* leaves.

Profile	Initial		Final	
	T1	T2	T1	T2
Haemoglobin(g/dL)	9.84 ± 0.20	9.71 ± 0.21	10.17± 0.27	10.59 ±0.23
Haematocrit (per cent)	28.61 ±1.25	27.79 ±1.00	28.04 ± 0.96	26.13 ±0.84
Total Erythrocyte count (10^6/µL)	8.02 ± 0.33	7.75 ±0.28	9.08 ± 0.39	9.14 ±0.38
Total Leucocyte count (10^3/µL)	7.16 ± 0.37	7.03 ±0.44	10.05 ± 0.72	9.45 ±0.63
Total protein (g/dL)	6.46±0.14	6.43±0.19	6.48^a ±0.14	7.00^b ±0.14
Creatinine (mg/dL)	0.81 ± 0.04	0.8 ±0.06	0.80± 0.02	0.84 ±0.03
Blood urea nitrogen (mg/dL)	14.53 ± 0.52	13.8±0.43	13.14 ± 0.26	13.70 ±0.40
Aspartate transaminase (AST) (IU/L)	40.20 ±1.66	41.47±1.82	62.41 ± 2.78	58.91 ± 1.09
Alanine transaminase (ALT) (IU/L)	17.81 ±0.33	17.55±0.23	22.67^a ± 0.36	20.17^b±0.42
Total cholesterol (mg/dL)	125.99± 4.01	114.33±3.77	68.04 ± 3.11	66.23 ± 1.81

Figures with different superscripts differ significantly (p< 0.05) between columns

Haematobiochemical profiles

Haematobiochemical profiles of Malabari kids during initial and final period of feeding trial are depicted in Table 4. The two groups did not show significant difference with regard to haemoglobin, haematocrit, total erythrocytes, total leucocytes, creatinine, blood urea nitrogen, AST and total cholesterol. But Moringa fed group showed significantly higher total protein level at the end of experimental period ($p < 0.05$). A higher total protein level could be due to the higher protein content in Moringa leaves which was also reported by Damor *et al*. (2017) in Mehsana goats, while Ali *et al.* (2018) and Yusuf *et al*. (2018) observed a non significant difference between control and Moringa fed animals. Mean ALT values were significantly lower ($p < 0.05$) in Moringa supplemented group which indicates normal hepatic functions assuring the absence of hapatotoxic effects of Moringa. In the present study, the observed Haematobiochemical values were within the normal range for goats (Jackson and Cockcroft, 2002; Weiss and Wardrop, 2010).

Age at first observed oestrus

The age and mean body weight at first observed oestrus are represented in Table 5. Age at first observed oestrus ranged between six to nine months in control and experimental animals with higher percentage observed in seventh month of age. Although first observed oestrus did not show any statistically significant difference between the two treatment groups, a higher percentage of animals belonging to T2 group (31.30%) exhibited behavioural oestrus during sixth month of age than control group (12.50%).The mean body weight at the time of puberty was also recorded and found to be 17.76 ± 0.63 and 18.93 ± 0.62 kg in control and experimental animals, respectively. The

Table 5. Age (Months) and mean body weight (kg) at first observed oestrus in control and experimental groups

Group	Per cent of animals exhibited first oestrus at different age (Month)				Mean body weight (kg)
	6	7	8	9	
T1(n=16)	12.50 (2)	62.50 (10)	18.80 (3)	6.30 (1)	17.76 ± 0.63
T2(n=16)	31.30 (5)	50.00 (8)	12.50 (2)	6.30 (1)	18.93 ± 0.62
Overall	21.90 (7)	56.30 (18)	15.60 (5)	6.30 (2)	18.35 ± 0.63
p value	0.394	0.722	1.00	1.00	0.198

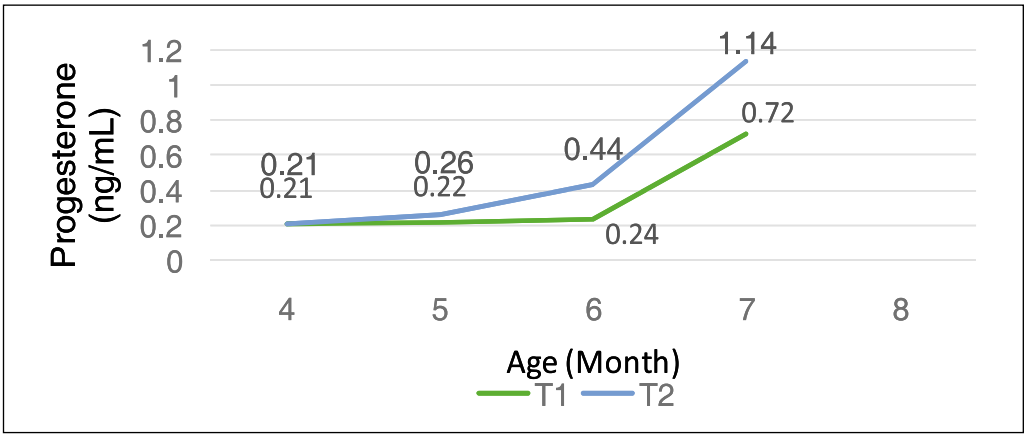

Fig. 1 Mean serum progesterone concentration (ng/mL) during post weaning period of Malabari kids fed with *M. oleifera* leaves

two treatment groups did not show significant difference in bodyweight at the time of puberty. The observation in the present study was in agreement with Venkatachalapathy *et al*., (2016), who reported the average age for first oestrus in Malabari goats as 7.10± 0.02 months. The age of puberty in goats can vary depending upon the body weight, level of nutrition, breed and season of kidding.

Serum progesterone

The mean progesterone levels remained below1 ng/mL until fifth month of age in both the groups and showed no significant difference between them. The mean values started elevating during six months of age with significantly higher concentration in T2 group ($p < 0.05$) (T1- 0.24 ± 0.03; T2- 0.44 ± 0.08 ng/dL). The mean progesterone above 1 ng/mL was also observed in the same group (T1- 0.72± 0.22 ng/mL and T2- 1.14 ± 0.29 ng/mL) during seventh month of age, but no significant difference could be observed between groups subsequently (Fig 1).Significant elevation of progesterone at sixth month and increase in level above 1 ng/mL at seventh month of age in Moringa substituted goats compared to the whole concentrate diet fed goats signifies that feeding Moringa leaves by replacing 50 per cent of concentrate could improve reproductive performance in Malabari doelings by advancing the age of puberty as indicated by the concentration of progesterone above 1 ng/mL (Duricic*et al*., 2016).

Conclusion

Inclusion of *M. oleifera* leaves in complete feed of Malabari kids did not alter body weight, dry matter intake and haematobiochemical profiles. However, significant increase in serum total protein and lower ALT level signifies the beneficiary effect of

incorporating *M. oleifera* leaves by replacing 50 per cent of concentrate. The supplementation also favoured the reproductive performance by advancing the age of puberty in Malabari doelings.

Conflict of interest

The authors declare that they have no conflict of interest.

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