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Effect of feeding *Moringa oleifera* leaves on performance of Pantja Goats of Uttarakhand (India)

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Abstract

The present study was conducted to find the effects of feeding *Moringa oleifera* leaves on the performance of Pantja goats of Uttarakhand (India) based on their body weight blood parameters and parasitic load. The study was carried out for two age groups of animals i.e., 3 and 6 months. Dietary treatment on both the age groups were carried out in the following order: T₀(Control group-3 months) ad libitum grazing + 100% concentrate/animal, T₁(Treatment group-3 months) ad libitum grazing + 80% concentrate + 20% moringa leaves on dry matter basis, T₂ (Control group- 6 months) ad libitum grazing + 100% concentrate/animal, T₃ (Treatment group- 6 months) ad libitum grazing + 60% concentrate + 40% moringa leaves on dry matter basis were fed. The study revealed that the animals fed with moringa leaves have significantly ($p < 0.05$) higher body weights than the control group at both 3 and 6 months of age groups. Blood parameters revealed that supplementation of moringa leaves in the feed of the animals increased haemoglobin concentration, PCV and total erythrocyte count significantly ($p < 0.05$) than the control groups for both the age groups. However, eosinophil and total leucocyte count reduced significantly ($p < 0.05$) in the treatment groups in comparison to the control groups. Other biochemical parameters like the neutrophil, ESR, lymphocyte and monocyte levels did not differ significantly in both the treatment and control groups irrespective of the age groups. Study on the mean faecal egg count per gram on 7th, 14th, 21st, 28th, and 60th days of feeding showed significantly ($p < 0.05$) reduced count in both the treatment groups compared to the control groups. The feed cost has reduced to a minimum in both the treatment groups compared to control by substitution of moringa leaves at 20% and 40% levels with the concentrate feed at 3 and 6 months age groups, respectively. Thus, it can be concluded that feeding of moringa leaves enhances overall blood parameters, which will result in better health thereby improving overall productivity and it will also lower the feed cost.

Keywords: *Moringa oleifera*, Pantja goats, blood parameters, faecal egg count

Introduction

India ranked second in terms of goat population (DAHD, 2019) this vast number of animals requires about 475 million tonnes of dry grain and 800 million tonnes of green grasses annually. Pantja is a newly registered medium sized, dual purpose goat breed found in the Tarai region of Uttarakhand, India. Though meat and milk of goat is highly preferred by cent per cent of Indians however, its farming is vital for the agro economy in India and other Indian subcontinents. Protein which is the most expensive feed ingredient in animal rations, seems to lack in the diet of the animals domesticated especially in the developing countries like India, where availability of protein has also decreased significantly due to lower production of animal protein and a lack of feeds and fodders specially during the dry months of the year, when crude protein content can be as low as 5%. During the dry season, farmers typically feed their animals crop residues and low-quality hay that are low in nitrogen, high in lignocellulose, and deficient in vitamins and minerals, resulting in poor productive traits (Gebregiorgis *et al.*, 2011) [5]. Moringa has a high nutritional value due to the presence of omega-3 and omega-6 fatty acids, palmitic acid, glycosides, saponins, stearic acid, gum and important vitamins like vitamin A, B1, B2, B3, C and rich source of crude protein (Penalver *et al.*, 2022) [13], therefore its leaves could be easily used to improve the growth and production of livestock. Its high nutrient content and low antinutrient content has aroused the interest of many scientists as an animal feed. Goats are extremely susceptible to internal parasite infection, which can lower fertility, lead to abortion, impoverishment, susceptibility to numerous diseases, severe anaemia and even death. Moringa leaves have also been found to have anti-parasitic effect (Cabardo *et al.*, 2017) [2] due to the presence of ethanolic extracts, which could be very advantageous in minimising the internal parasites.

Supplementation of moringa leaves has been thought to significantly reduce the protein shortage in leaves, thereby enhancing the efficiency in production. Considering the qualitative characteristics of moringa, it is strongly anticipated that it will be able to cope with the protein, other critical minerals, and vitamin deficits in feeding of goat. As moringa leaves are rich in nitrogen/protein source, they can be used effectively as substitute for conventional concentrate in the diet of growing goats. Therefore, viewing the practical importance, this study was undertaken to assess the effect on body weight gain, haematological parameters and parasitic load on Pantja goats by feeding moringa.

Materials and Methods

The present study was conducted at the Sheep and Goat Production Unit of the Department of Livestock Production Management, G.B.P.U.A.T, Pantnagar, Uttarakhand, India.

Selection and distribution of animals

Twenty-four Pantja goats were chosen from two age groups viz. 3 and 6 months old. After a week of acclimatisation, they were divided into four groups, each with six animals, based on their body weight and age. All the experimental animals were dewormed at the beginning of experiment by using Hevimac as an anthelmintic and were examined periodically for parasitic infestation. The following dietary treatment on both the age group was carried out: T₀ (Control group-3 months) ad libitum grazing + 100% (50gm) concentrate/animal, T₁ (Treatment group-3 months) ad libitum grazing + 80% (40 gm) concentrate + 20% (10gm) moringa leaves on dry matter basis, T₂ (Control group- 6 months) ad libitum grazing + 100% (100gm) concentrate/animal, T₃ (Treatment group- 6 months) ad libitum grazing + 60% (60gm) concentrate + 40% (40 gm) moringa leaves on dry matter basis was fed.

Preparation of dried moringa leaves

Raw moringa leaves were collected from the Pantnagar University campus. After removing the stalks and the stems, the leaves were sun dried over a newspaper for a period of 3-5 days. The dried leaves were then crushed with the help of the hand and were mixed with the concentrate feed which was to be replaced by moringa leaves in different percentage to be fed to the goats.

Body weight

Body weight gain of each goat was recorded at fortnightly interval during the 60 days of trial period, on a digital weighing balance.

Proximate analysis of Moringa leaves, concentrate feed and grassland pasture

The proximate composition viz. Dry Matter, crude protein, ether extract, total ash and crude fibre were analysed as per the procedure of AOAC (2015) [1]. Nitrogen content in the sample was calculated as follows: N % = Sample titre – Blank titre x Normality of HCL x 14 x volume made up ÷ Aliquot of digest taken x Weight of sample taken.

Collection of blood samples

2ml of blood samples were collected from the entire experimental animal on 0th and 60th day of study using 20 gauge needles from the jugular vein and placed in a clean

sterile test tube containing 1 mg/ml Ethylene Diamine Tetra Acetate (EDTA) as an anticoagulant.

Haematological Parameters

Haemoglobin (Hb), Packed Cell Volume (PCV), Erythrocytic Sedimentation Rate (ESR), Total Erythrocytic Count (TEC), Total Leucocytic Count (TLC), and Differential Leucocyte Count (DLC) were among the haematological parameters measured. The concentration of haemoglobin was determined using the method described by Sharma and Singh (2000). Micro haematocrit technique was used to calculate PCV. The PCV was measured and expressed in per cent using a citro cap micro haematocrit tube reader Sharma and Singh (2000). For estimation of erythrocytic sedimentation rate the calibrated Wintergreen tube was filled with well mixed anticoagulated blood by gentle mouth suction (30cm long with 3mm uniform diameter and total 200 divisions of 1mm interval, both ends open). By gently pressing the bottom of the tube against the rubber cork and tightening the matching screw at the top, the tube was mounted in the Westergren stand. For a set period of time, it was kept undisturbed and erect. After 30 minutes and one hour, the drop in erythrocyte column in mm as the ESR value was recorded. The total erythrocyte count was calculated using the Fudge (2000) [4] method. Differential leukocyte count was estimated by the technique described by Schalm (1975) [14].

Estimation of Internal parasitic load egg per gram

McMaster egg counting procedures were used to quantify the samples (MAFF, 1971) [10] on 0, 3, 7, 14, 21, 28, and 60th days of the experimental study.

Economics of feeding dried Moringa leaves in Pantja goats

The profit was computed by combining the cost of feeding dried moringa leaves in all treatment groups in all age groups of Pantja goats at varied levels with the cost of feeding concentrate.

Statistical Analysis

Origin 8 software was used to analyse the experimental data in this study (t-test). The statistical significance of the difference between the treatment means for each character was further investigated (Snedecor and Cochran, 1994).

Result and Discussion

The body weight (kg) gain of Pantja goats at fortnight intervals from 0th to 60th days of experimental feeding have been presented below in Table 1. As depicted in the Table 1, mean body weight of the Pantja goats at different age group was significantly ($p < 0.05$) higher in moringa leaves supplemented treatment groups. Similar observation were reported by Melesse *et al.* (2015) [12], who found increased in body weight on feeding air dried *Moringa stenopetala* leaves. Wandara *et al.* (2019) also studied the effect of substituting dried *Moringa stenopetala* leaves for concentrate mixture in Woyto-Guji goats and reported that there was increased in feed intake and body weight gain when compared to non-supplemented goats. Ghattas *et al.* (2021) [6] also observed that supplementing Barki ewes with *Moringa oleifera* leaves results in a significant ($p < 0.05$) change in final body weight. The effect of feeding *Moringa oleifera* leaves on blood parameters viz. Hb (g/dl), PVC, neutrophil (%), lymphocyte (%), monocyte (%), eosinophil (%), erythrocyte

sedimentation rate, total leucocyte count (103 / μ l) and total erythrocyte count (106 / μ l) are presented in Table 2. No significance ($p < 0.05$) difference was observed on 0th day among control and treatments groups on 3 months and 6

months age group on the blood parameters viz., Hb concentration, PCV, eosinophil per cent, total leucocyte count and total erythrocyte count.

Table 1: Effect of feeding *Moringa oleifera* leaves on body weight (kg) of Pantja goats on 3 and 6 months age group (Mean \pm SE)

Days	0 th	15 th	30 th	45 th	60 th
For three month age group					
Control (T ₀)	7.85 \pm 0.20	8.45 \pm 0.32	9.05 \pm 0.33	9.65 \pm 0.31	10.25 \pm 0.34
Treatment (T ₁)	8.01 \pm 0.18	9.23 \pm 0.20*	10.25 \pm 0.21*	11.37 \pm 0.29*	12.51 \pm 0.20*
For 6 months age group					
Control (T ₂)	12.21 \pm 0.16	12.75 \pm 0.16	13.29 \pm 0.16	13.83 \pm 0.17	14.37 \pm 0.17
Treatment (T ₃)	12.00 \pm 0.26	13.82 \pm 0.24*	14.04 \pm 0.23*	15.08 \pm 0.32*	16.05 \pm 0.25*

*Mean values in column differed significantly among specific age group at ($p < 0.05$)

At 60th day the Hb concentration of 3 months age group were 8.95 \pm 0.07 for T₀ and 10.51 \pm 0.15 for T₁ and 6 months age group the values were 7.65 \pm 0.32 for T₂ and 9.78 \pm 0.20 for T₃ respectively, which shows that Hb concentration significantly ($p < 0.05$) increased due to the inclusion of moringa leaves in the diet. Similar reports have been presented by Meel *et al.* (2018) [11] when moringa leaves were replaced with 100 percent concentrate feed, then a significant ($p < 0.05$) increase in the level of haemoglobin in Sirohi goat kids was found. Kumar *et al.* (2020) [9] also noticed an increase in haemoglobin levels after feeding moringa leaves instead of concentrates. There was a rise in haemoglobin concentration within the normal range in the experimental trial, indicating that feeding moringa leaves to Pantjagoats increases oxygen transfer into the body's various tissues. Increased haemoglobin also means the animal is more resistant to infection and has a higher nutritional status. The PCV on day 60th were T₀ (25.11 \pm 0.19) and T₁ (28.05 \pm 0.23) for 3 months age group and T₂(24.01 \pm 0.18) and T₃(27.55 \pm 0.17) for 6 months age group respectively. There was significant ($p < 0.05$) increase in PCV due to inclusion of moringa. Similarly Jiwuba *et al.* (2017) [7] found significant ($p < 0.05$) improvement in the PCV level while feeding moringa leaves. The concentrations of PCV and haemoglobin are directly proportional. If PCV and haemoglobin levels are below the usual reference range then there may be presence of some antinutritional agents such as tannin. The current result showed slightly higher PCV values, although it was within the reference range. As per the results, moringa leaves do not contain enough antinutritional elements to cause harm and can be added to the Pantja goat's regular diet. The neutrophil level at 0th day was 37.57 \pm 0.26 for T₀ and 37.65 \pm 0.26 for T₁ for 3 months age group and for T₂ was 37.60 \pm 0.21 and 37.67 \pm 0.19 for T₃ in the age group of 6 months. At 60th day for the age group of 3 months were 37.65 \pm 0.37 and 37.69 \pm 0.63 for T₀ and T₁ and 37.77 \pm 0.25 and 37.82 \pm 0.24 for T₂ and T₃. The values shows no significant ($p < 0.05$) different between control and treatments on both age group at 0th and 60th days of feeding. These results were in contrary with Ghattas *et al.* (2019) [6] who found significant ($p < 0.05$) difference in the neutrophil level on feeding different level of moringa leaves in the diet. Neutrophil level was found to be non-significant and within the usual reference range in the present study. Therefore, it can be stated that feeding moringa leaves has no negative impact on neutrophil levels. Lymphocytes per cent did not differ significantly ($p < 0.05$) for all control and treatments on 0th and 60th day of feeding trail for both age group of 3 month and 6 months. The findings were in contrast with the finding

of Ghattas *et al.* (2019) [6], who found a significant ($p < 0.05$) difference in lymphocyte count on feeding moringa leaves to goat. There was no substantial difference in lymphocyte levels, which were found to be within normal limits. As a result, it can be stated that including moringa leaves in the diet of Pantja goats has no influence on the animal's health. The monocyte level shows no significant ($p > 0.05$) difference among the respective age groups at 0th and 60th days of feeding trial among control and treatment. Monocytes are type of white blood cell that is essential for the immune system because they are involved in both humoral and cell-mediated immune responses. In contrast to the current study, it was discovered that consuming moringa leaves had no negative effects because monocyte levels were within the usual reference range. The eosinophil levels at 60th day was found to have significant ($p < 0.05$) among control and treatment on both the age groups. Similar changes in eosinophil levels have been observed by Kumar *et al.* (2020) [9] on feeding moringa leaves to Black Bengal goat. Higher eosinophil level indicates parasitic infection, fungal illnesses, allergies, and poisons. In the current study, however, the eosinophil level was found to be increasing, indicating that moringa leaves have a defensive action against foreign bodies. This may be due to the function of lysine found in moringa leaves, which aids in proper calcium absorption and antibody synthesis. As a result, it can be inferred that including moringa leaves in the Pantja goats basic diet is beneficial. No significance ($p < 0.05$) difference was observed in ESR in control and treatments at 0th and 60th day of feeding on both the age groups. Hence feeding of moringa leaves to the Pantja goats does not have any harmful effects since the ESR levels were found to be in normal range. TLC significantly ($p < 0.05$) decreased from 5.18 \pm 0.02 (T₀) to 3.75 \pm 0.04 (T₁) for 3 months age group and from 6.68 \pm 0.10 (T₂) to 5.31 \pm 0.12 (T₃) for 6 months age group. The result were in accordance with findings of Ghattas *et al.* (2019) [6], who also observed significant ($p < 0.05$) difference in feeding goats with moringa supplement. An elevated TLC count suggests the presence of microbial infection, foreign materials, or antigens in the blood. A drop in TLC was observed in the current study, which was within the normal range, indicating that the animal was free of any active infection. TEC significantly ($p < 0.05$) increased on 60th day in all the treatment supplemented with moringa leaves. In contrast to present study, Meel *et al.* (2018) [11] reported that supplementing Sirohi goat kids with moringa leaves resulted in a substantial ($p < 0.05$) rise in TEC level.

Faecal egg count

The mean value of total egg count (per gram of faeces) in Pantja goats fed at different age group at different level of moringa leaves are represented in the Fig.1. For three months age group the egg count for C₀ increased from 167.60 ±3.74 (0th day) to 287.93 ±7.45 (60th day). With supplement of moringa the faecal egg count initially did not differ, however from day 7th to day 60th it significantly (*p*<0.05) decreased from 168.35 ±7.35 to 101.42 ±7.53 whereas in C₀ the values range from 179.57 ±5.54 to 287.93 ±7.45 respectively. For six month age group also significant (*p*<0.05) difference has been observed from day 7th till day 60th. The values range from 255.44 ±9.25 to 349.07 ±19.29 for T₂ and 209.04 ±6.54 to 120.75 ±6.04 for T₃ respectively. In accordance to the present findings *Moringa oleifera* leaf supplements demonstrated anthelmintic effects on *Strongylus* and *Trichostrongylus*, *Coccidia*, *Monezia*, *Trichuris*, and *Strongyloides* Boer goats, according to Korsor *et al.* (2016)^[8]. Shanawany *et al.* (2019)^[15] also reported that inclusion of moringa leaves in sheep's feed reduced faecal egg count. The reduction in total egg count in their faeces could be related to the active ingredient of ethanolic extracts and anthelmintic effect found in moringa leaves (Cabardo *et al.*, 2017)^[2].

Table 2: Effect of feeding *Moringa oleifera* leaves on Blood Parameters of Pantja goats

Blood Parameters	Days →		0 th	60 th
	Haemoglobin (g/dl)	3 months age group	T ₀	9.20±0.06
T ₁			9.25±0.14	10.51±0.15*
6 months age group		T ₂	7.85±0.20	7.65±0.32
		T ₃	7.91±0.18	9.78±0.20*
Packed Cell Volume (PCV)	3 months age group	T ₀	25.31±0.17	25.11±0.19
		T ₁	25.22±0.16	28.05±0.23*
	6 months age group	T ₂	24.22±0.07	24.01±0.18
		T ₃	24.05±0.21	27.55±0.17*
Neutrophil (%)	3 months age group	T ₀	37.57±0.26	37.65±0.37
		T ₁	37.65±0.26	37.69±0.63
	6 months age group	T ₂	37.60±0.21	37.77±0.25
		T ₃	37.67±0.19	37.82±0.24
Lymphocyte (%)	3 months age group	T ₀	52.23±0.34	52.65±0.28
		T ₁	52.75±0.47	52.15±0.22
	6 months age group	T ₂	54.58±0.28	54.75±0.29
		T ₃	54.25±0.34	53.97±0.33
Monocyte (%)	3 months age group	T ₀	2.42±0.12	2.69±0.18
		T ₁	2.65±0.10	2.51±0.11
	6 months age group	T ₂	3.68±0.13	3.75±0.14
		T ₃	3.55±0.14	3.45±0.13
Eosinophil (%)	3 months age group	T ₀	2.58±0.23	2.95±0.11
		T ₁	2.89±0.02	1.15±0.08*
	6 months age group	T ₂	4.65±0.15	4.89±0.29
		T ₃	4.98±0.14	3.27±0.11*
Erythrocyte Sedimentation Rate (ESR)	3 months age group	T ₀	1.58±0.20	1.88±0.25
		T ₁	1.25±0.24	1.14±0.34
	6 months age group	T ₂	2.00±0.28	2.24±0.49
		T ₃	2.14±0.34	2.44±0.67
Total Leucocyte Count (10 ³ /µl)	3 months age group	T ₀	4.71±0.05	5.18±0.02
		T ₁	4.94±0.07	3.75±0.04*
	6 months age group	T ₂	6.38±0.06	6.68±0.10
		T ₃	6.41±0.12	5.31±0.12*
Total Erythrocyte Count (10 ⁶ /µl)	3 months age group	T ₀	12.92±0.14	12.28±0.12
		T ₁	12.61±0.09	13.88±0.04*
	6 months age group	T ₂	11.12±0.05	10.98±0.08
		T ₃	11.21±0.10	12.64±0.12*

*Mean values in column differed significantly among specific age group at (*p*<0.05)

T₀= ad libitum grazing + 100% concentrate, T₁= ad libitum grazing + 80% concentrate + 20% moringa leaves on dry matter basis, T₂=ad libitum grazing + 100% concentrate, T₃=ad libitum grazing + 60% concentrate + 40% moringa leaves on dry matter basis was fed.

T₀ and T₁ (for three months age group), T₂ and T₃ (for six months age group).

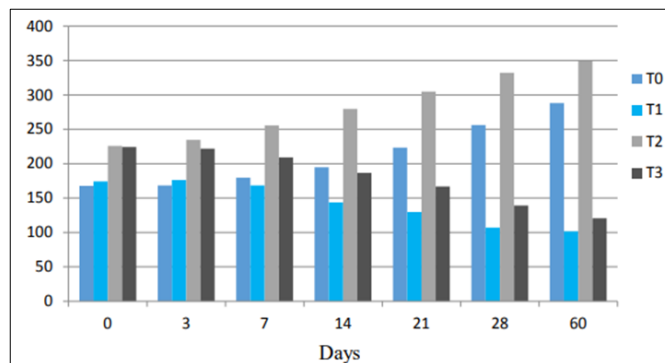


Fig 1: Effect on total egg count (per gram of faeces) on 3 and 6 months age group

Economics of feeding

The economics of feeding is presented on Table 3. The cost of fresh moringa leaves was estimated to be Rs. 9.5/kg. In the age group of 3 months, the cost of feed/day/goat was found to be 1.35 for T₀ and 1.17 for T₁, indicating that feeding moringa leaves has reduced feed costs. In the age group of 6 months, the cost of feed/day/goat was found to be 2.7 for T₂ and 2.00 for T₃, indicating that feeding moringa leaves has reduced feed costs to a minimum.

Table 3: Economics of feeding of Pantja goats

Items	Three months age group		Six months age group	
	T ₀	T ₁	T ₂	T ₃
Amount of ML consumed in 60 days (kg)	Nil	3.6	Nil	14.4
Amount of conc. Consumed in 60 days (kg)	18.0	14.4	36.0	21.6
Cost of ML @ rupees 9.5/kg	Nil	34.2	Nil	136.8
Cost of conc. @ rupees 27/kg	486.0	388.8	972.0	583.2
Total cost of concentrate + ML (rupees)	486.0	423.0	972.0	720.0
Cost of feed/day/goat	1.35	1.17	2.7	2.0

Conclusion

On the basis of the findings, it can be concluded that feeding moringa leaves at different levels (20% for 3 months and 40% for 6 months) can be highly advantageous in terms of body weight gain, haematological parameters (Hb, PCV, TEC, TLC, DLC and ESR), parasitic load and reduced feed cost. It may be inferred that feeding moringa leaves to animals would substantially reduce protein shortage in the feed, particularly during the dry season, consequently enhancing the animal's production and reproduction efficiency. Keeping in mind the importance of possessing those qualitative characteristics of this miracle tree, it is highly expected to cope up the protein and other essential minerals and vitamin deficiencies which are daily encountered in the diet of these small ruminants by the poor and marginal farmers. Moringa leaves, which are high in nitrogen and protein can be utilised as an alternative for conventional concentrate to some level in the diet of developing goats at the small-holder farmer level, where it

can be grown abundantly. As a result, this experimental study was carried out in order to lend a hand to Indian economy.

Reference

1. AOAC. Association of Official Analytical Chemists. Official Methods of Analysis. 13th edition. Washington, D.C., USA; c1990.
2. Cabardo DE Jr, Portugaliza HP. Anthelmintic activity of *Moringa oleifera* seed aqueous and ethanolic extracts against *Haemonchus contortus* eggs and third stage larvae. Int. J Vet Sci. Med. 2017;12;5(1):30-34. DOI: 10.1016/j.ijvsm.2017.02.001. PMID: 30255045; PMCID: PMC6137834.
3. Department of Animal Husbandry & Dairying under Ministry of Fisheries, Animal Husbandry & Dairying 20th Livestock Census-2019: All India Report.
4. Fudge AM. Laboratory Medicine: Avian and Exotic Pets. W.B. Saunders Company, Philadelphia; c2000.
5. Gebregiorgis F, Negesse T, Nurfeta A. Feed intake and utilization in sheep fed graded levels of dried moringa (*Moringa stenopetala*) leaf as a supplement to Rhodes grass hay. Tropical Animal Health and Production. DOI 10.1007/s11250-011-9927-9.
6. Ghattas TA, Hassan RAHG. Effect of *Moringa oleifera* supplementation on the reproductive performance in Barki ewes. Journal of the Egyptian Veterinary Medical Association. 2019;79(4):929-944.
7. Jiwuba CDP, Ahamefule OF, Okechukwu S, Ikwunze K. Feed intake, body weight changes and haematology of West African dwarf goats fed dietary levels of *Moringaoleifera* leaf meal. Agriculture. 2017;13(1):1-2, 71-77.
8. Korsor M, Ntahonshikira C, Kwaambwa HM, Bello HM. Antiparasitic effect of *Moringaoleifera* leaf supplement in Boer goats. Proceedings of 2nd ed International Conference on the African Association for the study of Indigenous Knowledge systems; c2016. p. 90-100.
9. Kumar M, Minj N, Prasad S, Kumar R, Kumar R, Himkar HK. Effect of feeding *Moringaoleifera* leaf powder on haemato-biochemical profile of growing female black Bengal goat under intensive system of management. Journal of Entomology and Zoological Studies; c2020. p. 46-48.
10. MAFF. Ministry of Agriculture, Fisheries and Food. Manual of Veterinary Parasitological Techniques, HMSO, London. 1971, 24.
11. Meel P, Gurjar M, Nagda RK, Sharma MC, Gautam L, Manju. Effect of *Moringa oleifera* leaves feeding on hemato - biochemical profile of sirohi goat kids. E-ISSN: 2320-7078 P-ISSN: 2349-6800 Journal of Entomology and Zoological Studies. 2018;6(5):41-48.
12. Melesse A, Banerjee S, Abebe A, Sisay A, Meskel D. The Effect of Supplementing air-dried *Moringa stenopetala* leaf to natural grass hay on feed intake and growth performances of Arsi-Bale Goats. Agriculture. 2015;5:1183-1194.
13. Penalver R, Martinez-Zamora L, Lorenzo JM, Ros G, Nieto G. Nutritional and Antioxidant Properties of *Moringa oleifera* Leaves in Functional Foods. Foods. 2022;2;11(8):1107. DOI: 10.3390/foods11081107. PMID: 35454694; PMCID: PMC9030530.
14. Schalm OW, Jain NC, Carrol EJ. Normal values in blood of laboratory, fur bearing and miscellaneous zoo and wild animals. 219-283. In: O. W. Schalm (Ed.) Veterinary Haematology, 3rd ed. Lea and Febiger, Washington square, Philadelphia, USA; c1975.
15. Shanawany El, Eman E, Fouad EA, Keshta HG, Hassan SE, Ahmed G, et al. Immunomodulatory effects of *Moringa oleifera* leaves aqueous extract in sheep naturally co-infected with *Fasciola gigantica* and *Clostridium novyi*. Journal of Parasitic Disease. 2019;43(4):583-591.
16. Sharma IJ, Singh HS. Students Laboratory Manual of Veterinary Physiology, Kalyani Publisher, New Delhi, India; c2000.
17. Snedecor GW, Cochran WB. Statistical methods. 8th Ed. The Iowa State University Press, Ames, IOWA, USA; c1994.