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## Efficacy of *Moringa oleifera* leaves powder as a haematinic preparation in helminth infected anaemic goats

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### Abstract

In the present study leaves powder of *M. oleifera* have been evaluated as an oral herbal haematinic along with effective anthelmintic drug (closantel) to evolve cheaper, effective, eco-friendly, easily available haematinics in helminth infected anaemic goats. Total 18 adult helminth infected anaemic goats of either sex were selected based on pale conjunctival mucous membrane, haemoglobin concentration below 8 gm%. Another 6 normal healthy goats were selected as a normal control group (C) for comparison. Above 18 helminth infected anaemic goats were randomly divided into 3 equal treatment groups. Group T<sub>1</sub> of six helminth infected anaemic goats was treated with single dose of closantel @ 10mg/kg bwt orally without any haematinic preparation. Group T<sub>2</sub> of six helminth infected anaemic goats was treated with single dose of closantel @ 10 mg/kg bwt orally along with leaves powder of *Moringa oleifera* @ 50gm orally daily as a herbal haematinic preparation for 30 days. Group T<sub>3</sub> of six helminth infected anaemic goats was treated with single dose of closantel @ 10 mg/kg bwt orally along with standard haematinic preparation @ 10 ml daily orally for 30 days. All goats were subjected for EPG, clinical and haematological study before (‘0’ day) and 15<sup>th</sup> and 30<sup>th</sup> day after treatment. The clinical study revealed high FAMACHA score and slight increase in respiratory and heart rate in helminth infected anaemic goats. All anaemic goats had low body weight before treatment. Haematological study revealed decrease in Hb, PCV, TEC, eosinophil % and MCHC in helminth infected anaemic goats. The helminth infected anaemic goats showed microcytic hypochromic anaemia. All the treatments showed 100 per cent reduction in FEC with improvement in altered clinical and haematological parameters within the study period, indicated effectiveness of all the treatment to alleviate anaemia due to helminth infection in goats. However, the group treated with standard haematinic preparation along with single dose of Closantel was found superior than the group treated with *Moringa oleifera* leaves powder along with single dose of Closantel based on the better improvement in haematological parameters in anaemic goats.

**Keywords:** Anaemia, *Moringa oleifera*, goats, haematinic, haematology

### Introduction

Herd health management practices are the crucial factor in order to increase the profitability and success of goat farming. One of the common condition affecting the productability of goats is anaemia. There are multiple factors responsible for anaemia. Anaemia due to helminth infestation is one of the serious cause of anaemia in goats reported by many workers [1]. GI helminths especially *Haemonchus contortus* penetrate into the mucosa and submucosa of goat GI tract mainly abomasum causes continuous loss of blood leading to anaemia, emaciation, hypoproteinaemia, weakness, weight loss, etc. The pallor of conjunctival mucosa, debility, depression, weakness, tachycardia, increased pulsation, stunted growth, etc. are the signs observed in clinical form of anaemia. Several researchers reported alteration in haemato-biochemical parameters in helminths infestation in goats [2].

It is very important to treat anaemia caused by helminths by administering effective anthelmintic drug along with haematinic preparation in order to achieve quick recovery in helminth infected anaemic goats. Many oral haematinics preparations are available for treatment of anaemia in animals. However, it should be effective, cheaper, eco-friendly, easily available and without any side effects. In recent years there have been tremendous increase in the use of herbal health products. One of the multipurpose evergreen trees which has both nutritional and medicinal properties is *Moringa oleifera*. Leaves of *M. oleifera* reported to be the most powerful supplier of iron due to presence of several phytochemicals compounds which are essential for iron uptake by the animal body.

*Moringa oleifera* leaf meal contains iron (23mg/100g) which proved necessary for many functions in the body including the formation of haemoglobin and myoglobin [3]. One study revealed that the *Moringa oleifera* leaves in the diet could be used to improve hemato-biochemical profile in goats without any adverse effect [4].

Thus, in the present study leaves powder of *M. oleifera* have been evaluated as an oral herbal haematinic along with effective anthelmintic drug such as closantel to evolve cheaper, effective, eco-friendly, easily available haematinics in helminth infected anaemic goats.

### Materials and Methods

The proposed study was carried out in the Department of Veterinary Clinical Medicine, Ethics & Jurisprudence, Post Graduate Institute of Veterinary and Animal Sciences, Akola. The leaves of *Moringa oleifera* were collected from the campus of the institute. The collected material was identified and authenticated from expert taxonomist, Akola (M.S.). Freshly collected leaves of *Moringa oleifera* were shade dried and processed to get fine powder with the help of pulverizing machine.

For this study total 18 adult helminth infected anaemic goats of either sex were selected based on pale conjunctival mucous membrane, haemoglobin concentration below 8 gm%. Another 6 normal healthy goats were selected as a normal control group (C) for comparison. Above 18 helminth infected anaemic goats were randomly divided into 3 equal treatment groups comprising of 6 animals in each group. Group T1 of six helminth infected anaemic goats was treated with single dose of closantel @ 10mg/kg bwt orally without any haematinic preparation. Group T2 of six helminth infected anaemic goats was treated with single dose of closantel @ 10mg/kg bwt orally along with leaves powder of *Moringa oleifera* @ 50gm orally daily as a herbal haematinic preparation for 30 days. Group T3 of six helminth infected anaemic goats was treated with single dose of closantel @ 10mg/kg bwt orally along with standard haematinic preparation @ 10ml daily orally for 30 days.

All the selected goats were subjected for EPG of faeces on '0' day (before treatment) and on 30<sup>th</sup> day post treatment. by Stoll's dilution method [33]. The clinical and haematological parameters (automated haematology analyzer ABAXIS Vet Scan HM5) were studied on '0' day (before treatment) and 15<sup>th</sup> and 30<sup>th</sup> day after treatment. The collected data was analysed by using standard statistical methods.

### Results and Discussion

The faecal sample examination study revealed *haemonchus spp.* and *Trichuris spp.* as the most predominant parasites in

anaemic goats. In comparison to healthy goats, helminth-infected goats were anaemic, weak, emaciated, looked dull, had a rough body coat, intermittent appetite, pale mucous membranes (pale conjunctiva), and soft pasty faeces as compared to normal healthy goats (Control group) [5, 6]. The single dose of closantel eliminated worm burden on 15<sup>th</sup> day after treatment, indicating effectiveness of Closantel as an anthelmintic drug in helminth infected anaemic goats. Many researchers also reported effectiveness of closantel in helminth infected goats and sheep [7, 8, 9, 10].

The statistical analysis revealed non-significant variation in rectal temperature and heart rate between control and treatment groups (T1, T2 and T3) before treatment ('0' day), whereas, respiratory rate was significantly elevated in anaemic goats (T1, T2 and T3) as compared to normal control group before treatment ('0' day) (Table 1). Many workers also reported non-significant alteration in rectal temperature in helminth infected anaemic goats [5, 11, 12, 13]. In anaemic goats (T1, T2, and T3) heart rate was elevated as compared to normal control group, although it was non-significant (Table 1). The elevated heart rate in anaemia might be due to hypoxia-stimulated chemoreceptors and increased sympathetic activity i.e., it could be due to hyperactivity of heart to compensate the demand of tissue perfusion. As a result of reduced haemoglobin concentration, tissue perfusion was reduced due to hampered or reduced capacity of the blood to carry oxygen [14]. The improvement in heart rate in anaemic goats after administration of *Moringa oleifera* leaves powder and haematinic preparation might be because of response of erythropoietic system. Thus, there is reduction in efforts by heart to meet up with the tissue perfusion demand as the capacity of blood to carry adequate oxygen is regained. This helped in the reduction in heart rates in treatment groups. The mean values of respiratory rate in anaemic goats (T1, T2, and T3) were elevated significantly as compared to normal control group before treatment ('0' day) (Table 1). The increase in respiratory rate in anaemic goats were also reported by other workers [13, 15, 16, 17]. In anaemia there is reduction in oxygen carrying capacity of blood. Therefore, the lungs overcompensate in order to bring in more oxygen which causing increased respiratory rate [18]. The mean respiratory rate in all treatment groups (T1, T2, and T3) was significantly improved on 15<sup>th</sup> and 30<sup>th</sup> day post treatment as compared to mean respiratory rate on '0' day (before treatment) of corresponding groups. However, early improvement in respiratory rate was observed in group treated with only anthelmintic drug (T1) and group treated with anthelmintic drug along with *Moringa oleifera* powder (T2) as compared to the group treated with anthelmintic drug along with readymade haematinic preparation (T3).

**Table 1:** Mean  $\pm$  SE of Temperature ( $^{\circ}$ F), Heart rate (per minute), Respiratory rate (per minute), Body Weight (Kg) and FAMACHA Score in different groups before treatment ('0' day) and at different intervals after treatment (15<sup>th</sup> and 30<sup>th</sup> day)

Parameter	Intervals	Treatment			
		Control	T1	T2	T3
Temperature ( $^{\circ}$ F)	'0' day	100.90 $\pm$ 0.30	101.50 $\pm$ 0.36	100.88 $\pm$ 0.36	100.78 $\pm$ 0.32
	15 <sup>th</sup> day	100.73 $\pm$ 0.36	100.80 $\pm$ 0.31	100.90 $\pm$ 0.28	100.98 $\pm$ 0.32
	30 <sup>th</sup> day	100.78 $\pm$ 0.20	100.78 $\pm$ 0.25	101.38 $\pm$ 0.36	101.15 $\pm$ 0.32
Heart rate (beats per minute)	'0' day	73.00 $\pm$ 1.53	114.67 $\pm$ 3.96	114.00 $\pm$ 3.69	115.33 $\pm$ 4.31
	15 <sup>th</sup> day	73.67 $\pm$ 1.41	91.67 $\pm$ 1.20	97.83 $\pm$ 2.46	90.83 $\pm$ 1.80
	30 <sup>th</sup> day	73.00 $\pm$ 1.13	90.83 $\pm$ 1.80	88.67 $\pm$ 1.91	84.33 $\pm$ 1.31
Respiratory rate (per minute)	'0' day	19.67 $\pm$ 0.95 <sup>a</sup>	37.33 $\pm$ 0.99 <sup>c</sup>	40.33 $\pm$ 1.20 <sup>d</sup>	37.33 $\pm$ 0.99 <sup>c</sup>
	15 <sup>th</sup> day	20.00 $\pm$ 1.15 <sup>a</sup>	32.67 $\pm$ 0.99 <sup>b</sup>	37.33 $\pm$ 0.99 <sup>c</sup>	37.33 $\pm$ 0.99 <sup>c</sup>

	30 <sup>th</sup> day	19.33±1.12 <sup>a</sup>	31.67±1.20 <sup>b</sup>	34.00±1.15 <sup>b</sup>	33.00±1.13 <sup>b</sup>
Body Weight (Kg)	'0' day	34.17±2.39	32.08±2.12	35.53±1.75	31.73±2.29
	15 <sup>th</sup> day	35.45±2.60	35.17±1.79	38.38±1.61	34.80±2.33
	30 <sup>th</sup> day	34.68±2.48	38.18±1.74	40.87±1.31	36.78±2.28
FAMACHA Score	'0' day	2.17±0.17 <sup>a</sup>	4.50±0.22 <sup>d</sup>	4.33±0.21 <sup>cd</sup>	4.50±0.22 <sup>d</sup>
	15 <sup>th</sup> day	2.50±0.22 <sup>a</sup>	3.83±0.17 <sup>bc</sup>	3.83±0.17 <sup>bc</sup>	3.67±0.21 <sup>b</sup>
	30 <sup>th</sup> day	2.17±0.17 <sup>a</sup>	3.33±0.21 <sup>b</sup>	3.33±0.21 <sup>b</sup>	2.67±0.21 <sup>b</sup>

The mean body weight was low in helminth infected anaemic goats before initiation of treatment ('0' day) as compared to body weight of goats in normal healthy control group (Table 1). Similar reduction in body weight in body weight in helminth infected anaemic goats [12, 16, 19, 20, 21]. The reduction in body weight in helminth infected anaemic goats might be due to poor absorption of food as result of helminth infection and poor appetite. The analysis of variances showed significant variation in body weight between different intervals. In all treatment groups (T1, T2 and T3), there were apparent improvement in body weight on 15<sup>th</sup> and 30<sup>th</sup> day after treatment as compared to initial body weight ('0' day) in respective treatment groups.

The analysis of variances revealed significantly high

FAMACHA Score (pale) in helminth infected goats as compared to normal control group (Table 1). These findings indicated anaemia in helminth infected goats [22, 23, 24]. The paleness of conjunctival mucous membrane could be attributed to loss of blood due to blood sucking nature of helminths particularly *Haemonchus spp.*, resulting into loss of blood leads to anaemia. The mean FAMACHA Score was significantly improved on 15<sup>th</sup> and 30<sup>th</sup> day post treatment in all treatment groups (T1, T2, and T3) as compared to score on '0' day (before treatment) in corresponding treatment groups. The improvement in FAMACHA score might be because of elimination of worm load and obvious increase in haemoglobin after treatment with anthelmintic drug and haematinic therapy.

**Table 2:** Mean ± SE of Haematological parameters in different groups before treatment ('0' day) and at different intervals after treatment (15<sup>th</sup> and 30<sup>th</sup> day)

Parameters	Intervals	Treatment			
		Control	T1	T2	T3
Haemoglobin (gm/dl)	'0' day	11.87±0.46 <sup>f</sup>	7.15±0.35 <sup>ab</sup>	6.30±0.38 <sup>a</sup>	6.97±0.43 <sup>ab</sup>
	15 <sup>th</sup> day	11.38±0.33 <sup>f</sup>	8.92±0.44 <sup>de</sup>	7.80±0.32 <sup>bc</sup>	8.72±0.26 <sup>cd</sup>
	30 <sup>th</sup> day	11.50±0.33 <sup>f</sup>	9.62±0.48 <sup>de</sup>	8.95±0.49 <sup>de</sup>	9.98±0.18 <sup>c</sup>
PCV (%)	'0' day	31.67±1.44	21.51±0.51	19.50±0.71	18.63±1.02
	15 <sup>th</sup> day	30.73±1.06	24.77±1.35	21.40±0.63	21.67±0.76
	30 <sup>th</sup> day	31.18±0.85	25.68±1.52	22.92±0.81	24.93±1.02
TEC (x10 <sup>6</sup> /µl)	'0' day	14.50±0.46 <sup>d</sup>	6.69±0.28 <sup>a</sup>	6.12±0.13 <sup>a</sup>	6.53±0.21 <sup>a</sup>
	15 <sup>th</sup> day	13.99±0.37 <sup>d</sup>	8.11±0.29 <sup>b</sup>	6.76±0.13 <sup>a</sup>	7.75±0.25 <sup>b</sup>
	30 <sup>th</sup> day	14.55±0.25 <sup>d</sup>	8.78±0.21 <sup>cb</sup>	7.67±0.29 <sup>b</sup>	8.75±0.19 <sup>cb</sup>
TLC (x10 <sup>3</sup> /µl)	'0' day	10.90±1.26 <sup>a</sup>	12.09±0.59 <sup>ab</sup>	10.73±0.47 <sup>a</sup>	14.47±0.50 <sup>b</sup>
	15 <sup>th</sup> day	10.96±1.32 <sup>a</sup>	16.92±1.19 <sup>bc</sup>	10.90±0.40 <sup>a</sup>	10.73±0.47 <sup>a</sup>
	30 <sup>th</sup> day	10.97±1.33 <sup>a</sup>	19.35±1.94 <sup>c</sup>	11.07±0.75 <sup>a</sup>	17.45±1.86 <sup>c</sup>
Neutrophils (%)	0 day	44.43±2.37 <sup>abc</sup>	46.58±2.07 <sup>bc</sup>	39.83±2.02 <sup>a</sup>	41.00±2.39 <sup>ab</sup>
	15 <sup>th</sup> day	42.05±2.04 <sup>ab</sup>	40.17±2.12 <sup>a</sup>	44.82±1.24 <sup>abc</sup>	40.43±1.87 <sup>a</sup>
	30 <sup>th</sup> day	42.38±1.79 <sup>ab</sup>	49.70±1.98 <sup>c</sup>	44.25±1.45 <sup>abc</sup>	48.93±2.09 <sup>c</sup>
Lymphocyte (%)	'0' day	48.13±2.89 <sup>abc</sup>	44.85±2.11 <sup>ab</sup>	50.67±2.03 <sup>bc</sup>	51.50±1.82 <sup>c</sup>
	15 <sup>th</sup> day	52.68±2.45 <sup>c</sup>	50.95±2.35 <sup>bc</sup>	47.25±1.26 <sup>abc</sup>	50.70±2.03 <sup>bc</sup>
	30 <sup>th</sup> day	51.87±3.34 <sup>c</sup>	41.68±1.99 <sup>a</sup>	47.70±1.48 <sup>abc</sup>	42.25±2.15 <sup>a</sup>
Monocyte (%)	'0' day	4.15±0.34	4.23±0.35	5.17±0.31	3.67±0.99
	15 <sup>th</sup> day	3.58±0.27	4.32±0.81	5.02±0.36	4.70±0.32
	30 <sup>th</sup> day	3.37±0.31	4.17±0.28	4.70±0.42	4.48±0.29
Eosinophils (%)	'0' day	3.28±0.49	4.33±0.56	3.83±0.40	3.83±0.54
	15 <sup>th</sup> day	3.52±0.43	4.57±0.38	4.07±0.21	4.17±0.48
	30 <sup>th</sup> day	4.05±0.41	4.45±0.30	4.18±0.16	4.33±0.33
MCV (fl)	'0' day	21.81±0.47	32.58±1.98	31.84±0.90	28.52±1.21
	15 <sup>th</sup> day	21.97±0.56	30.61±1.54	31.65±0.53	28.01±0.94
	30 <sup>th</sup> day	21.42±0.32	29.31±1.80	29.95±0.82	28.54±1.23
MCH (pg)	'0' day	8.18±0.09	10.86±0.87	10.28±0.55	10.62±0.43
	15 <sup>th</sup> day	8.14±0.10	11.02±0.50	11.54±0.40	11.26±0.16
	30 <sup>th</sup> day	7.90±0.11	10.98±0.59	11.68±0.49	11.43±0.24
MCHC (gm/dl)	'0' day	37.55±0.52 <sup>bc</sup>	33.18±1.16 <sup>a</sup>	32.21±1.03 <sup>a</sup>	37.53±1.96 <sup>b</sup>
	15 <sup>th</sup> day	37.10±0.60 <sup>bc</sup>	36.06±0.40 <sup>b</sup>	36.43±0.90 <sup>b</sup>	40.31±0.80 <sup>de</sup>
	30 <sup>th</sup> day	36.88±0.22 <sup>bc</sup>	37.54±0.47 <sup>bc</sup>	38.93±0.88 <sup>cd</sup>	40.25±1.06 <sup>c</sup>

The haematological study revealed significant decrease in Hb and TEC and apparent decrease in PCV in helminth infected anaemic goats as compared to normal healthy control group before the initiation of treatment ('0' day) (Table 2). The low Hb, PCV and TEC in helminth infected anaemic goats were also reported by other scientists [7, 25, 26, 27, 28, 29, 30, 31, 32]. The

low Hb, PCV and TEC in helminth infected anaemic goats could be due to acute loss of blood by blood-sucking nature of parasites like *Haemonchus spp.* resulted into reduction in Hb, PCV and TEC in helminth-infected goats [32, 33]. All the treatments (T1, T2 and T3) improved altered Hb, PCV and TEC on 15<sup>th</sup> and 30<sup>th</sup> day after treatment (Table 2). The

statistical analysis revealed non-significant variation in TLC between control group and treatment groups before treatment ('0' day). The DLC study revealed non-significant variation in neutrophils (%), lymphocytes (%), monocyte per cent and eosinophil per cent between normal control and treatment groups (T1, T2 and T3) before treatment (Table 2). The erythrocyte indices study revealed non-significant variation in MCV and MCH, whereas significant decrease in MCHC between control and different treatment groups (T1, T2, and T3) on '0' day (before treatment), indicated microcytic hypochromic anaemia in helminth infected goats [30, 32, 34]. The microcytic hypochromic anaemia might be due to decrease in Hb, PCV and TEC in helminth infected goats. The altered MCHC was significantly improved in all treatment groups on 15<sup>th</sup> and 30<sup>th</sup> day post treatment as compared to MCHC before treatment ('0' day) in respective groups.

The statistical analysis revealed non-significant variation in TLC before treatment ('0' day) between control group and treatment groups (T1 and T2). However, the mean TLC in helminth infected anaemic goats (T1, T2 and T3) were higher before treatment as compared with TLC of control group (Table 2) [7, 26, 27, 29, 31]. The increase in TLC could be attributed to increased local immune responses by eosinophils and monocytes [28].

The goats infected with helminths were anaemic, weak, emaciated, appeared dull and had rough body coat, intermittent appetite, pale mucous membranes (pale conjunctiva), soft pasty faeces as compared to normal healthy goats (Control group). The group (T1) treated with single dose of oral anthelmintic drug showed improvement in general condition of goats within 30<sup>th</sup> day post treatment, while the groups (T2) and (T3) treated with *Moringa oleifera* leaves powder with anthelmintic drug and standard haematinic preparation along with anthelmintic drug showed clinical improvement within 15 days of post treatment. These findings suggested that oral haematinic preparations along with anthelmintic drug resulted in faster clinical recovery than only using an oral anthelmintic preparation.

The group treated with *Moringa oleifera* leaves powder along with anthelmintic drug Closantel (T2) and standard haematinic preparation along with anthelmintic drug Closantel (T3) demonstrated improvement in altered clinical and haematological parameters within the study period, indicated effectiveness of both the treatment to alleviate anaemia due to helminth infection in goats. However, better improvement in haemato-biochemical parameters was observed in group (T3) treated with standard haematinic preparation along with anthelmintic drug Closantel as compared to group (T2) treated with *Moringa oleifera* leaves powder along with anthelmintic drug Closantel. Leaves of *M. oleifera* are very rich supplier of iron and reported to be effective in improvement of haemato-biochemical profile [3, 4]. However, in the present investigation, the improvement in anaemic goats brought about by administration of *M. oleifera* leaves powder as an herbal haematinic preparation was not found promising as compared with standard haematinic preparation. It might be because of improper take-up and absorption of iron through intestine as many factors play an important role in the absorption of iron in the body [35]. At the other hand the administration of standard haematinic preparation brought about remarkable improvement in anaemic goats which might be due to activation of erythropoietic system and thus increase in the circulating

erythrocytes after administration of readymade haematinic preparations containing multi minerals and vitamins (Ferrous Fumarate, Calcium Lactate, Copper Sulphate, Niacinamide, Cobalt Sulphate, Ascorbic Acid, Pyridoxine, Folic Acid, Vit. B12 and Biotin) [17, 36, 37, 38, 39, 40, 41].

Overall study concluded that *Moringa oleifera* leaves powder (50gm daily orally for 30 days) along with single dose of closantel (T2) and standard haematinic preparation (10 ml daily orally for 30 days) along with single dose of closantel (T3) demonstrated improvement in altered clinical and haematological parameters within the study period, indicated effectiveness of both the treatment to alleviate anaemia due to helminth infection in goats. However, the group (T3) treated with standard haematinic preparation along with single dose of Closantel was found superior than the group (T2) treated with *Moringa oleifera* leaves powder along with single dose of Closantel based on the better restoration of haematological values in anaemic goats.

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