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Research Article

Haematological Changes in Sheep Naturally Infected with Gastrointestinal Nematodosis

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ABSTRACT

Present study was conducted to evaluate haematological changes in sheep of Kashmir valley infected naturally with gastrointestinal nematodes. For the study, animals (N=30) suffering from gastrointestinal nematodosis were taken and divided into five groups with each group comprising of six animals. Each infected group was treated with a different antihelmenthic except for one group kept as untreated infected control. An additional group apparently free from any infection comprising of six healthy animals was taken as healthy control. In all infected groups haematological studies revealed significant ($p<0.05$) decrease in haemoglobin, packed cell volume (PCV) and total erythrocyte count (TEC) at the beginning of study (day 0) compared to healthy control .Compared to other groups, significantly ($p<0.05$) better results for Hb, TEC and PCV were observed in ivermectin treated group on day 7, 7 and 14 post treatment respectively. In ivermectin treated group the Hb, TEC and PCV values recorded were 10.50±0.19g/dl, 8.72±0.58×106/µl and 31.29±0.15% compared to 7.82±0.44g/dl, 7.62±0.05×106/µl and 26.62±0.55% respectively in untreated infected control group. Significant ($p<0.05$) decrease in TLC values in ivermectin treated group on 7th day post treatment recorded was 7.68±0.11 ×103/ µl that was observed to be comparable to healthy control (7.35±0.03 ×103/ µl). For eosinophils, in case of closantel treated group, results post-treatment were significantly better than other groups. There was significant ($p<0.05$) decrease in eosinophil percentage (5.50±0.0.92%) post treatment by day 7 compared to infected control group (7.39±0.12%) and was comparable to healthy control (2.23±0.07%). Post treatment there was significant ($p<0.05$) decrease in basophil percentage values in all infected groups except the one treated with Closantel.In all infected groups, on day 0 the neutrophils were non-significantly (>0.05) higher as compared to healthy control group. Neutrophil percentage decreased significantly ($p<0.05$) in all groups however the results were better in group treated with Fenbendazole and Artemesia.

Keywords: *Gastrointestinal Nematodosis, Haematolgy ,Kashmir Valley, Sheep.*

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INTRODUCTION

Gastrointestinal nematodes pose a paramount threat to small ruminant productivity and the economic losses caused by these parasites is quite considerable throughout the world (Larsen et al., 1995; & Campos et al., 2009). Estimated losses due to the treatment in India alone for *Haemonchus contortus* is around $103 million (Waller & Chandrawathani, 2005). Majority of the gastrointestinal nematodes that infect ruminants belong to the family Trichostrongylidae including Haemonchus spp., Trichostrongylus spp., Cooperia spp., *Nematodirus* spp., *Oesophagostomum* spp., *Chabertia* spp., *Bunostomum* spp., *Trichuris* spp. *Haemonchus contortus* among all other gastrointestinal nematode parasites affecting sheep, is prevalent in tropical, subtropical and temperate regions mostly under warm and wet conditions (Jabbar et al., 2008; & Khan et al., 2010). It is a unquenchable blood-sucking parasite affecting abomasum of sheep/goat and leads to significant losses in production because of a general malaise, anorexia, haemorrhages, depression, severe chronic anaemia, loss of condition and eventually leading to death of the animal (van Wyk & Malan, 1988; Gauly et al., 2002; & Notter et al., 2003). The incidence of gastrointestinal nematodosis in ruminants of India since past few years as per reports of Bandyopandhyay et al. (2010) has increased upto 25-78%.

Parasitism affects animal health directly as well as indirectly. Blood sucking action leads to direct blood loss causing anaemia and other associated changes.Indirectly, parasitism diverts energy required for normal physiological activities to synthesize various immune mediators and cytokines that are needed for clearing up the established infection within host. General symptoms include anorexia, dullness, weight loss and increased susceptibility to other pathogens (Sykes & Coop, 2001; & Moreau et al., 2010). Changes in the levels of various haematological parameters have been observed in clinical haemonchosis. Ijaz et al. (2009) reported decreased values of hemoglobin, haematocrit (PCV), TEC, RBC level, serum protein and albumin in affected animals. As per reports of Sarkar et al. (2005), the Hb, TEC and PCV levels of Haemonchus contortus infected anaemic sheep were altered compared to healthy animals and were as 8g/dl, 5.82×10^6/µl and 26% respectively. Sheep infected naturally with strongyloids show various hematological changes including normochromic anaemia and eosinophilia (Abdel Ali, 1992). Gastrointestinal nematodosis leads to lowering of haemoglobin and packed cell volume in both young and adult small ruminants and also decreased total erythrocyte count in older animals (Jas et al., 2008). Treatment of sheep naturally infected with gastrointestinal nematodosis using anthelmintics like Ivermectin leads to significant improvement in total erythrocyte count (TEC), haemoglobin levels, packed cell volume and also significant reduction in total leucocyte count (TLC) (Yousif et al., 1988; & Khalid et al., 2004)

MATERIALS AND METHODS

To study haematological changes in sheep of Kashmir valley infected naturally with gastrointestinal nematodosis, the infected animals (N=30) were taken and divided into five groups with each group comprising of six animals. Each group was treated with a different anthelmintics presented in Table 1. An additional group apparently free from any infection comprising of six healthy animals was taken as control group. For haematolgy, blood was collected from each animal of all groups in clean sterilized EDTA glass vials. Initially the samples were collected on day 0 and eventually after 7, 14, 21, 28 days post treatment. 10 ml blood collected in sterile centrifuge tubes was kept in slanting position for about an hour

at room temperature for separation of serum. The blood clot was broken and subsequently centrifuged at 2000 rpm for 30 minutes to yield clean clot free serum. Haematological studies included the determination of haemoglobin by Sahli's method, packed cell volume (PCV) by microhaematocrit method, total erythrocyte count (TEC) and total leucocyte count (TLC) using haemocytometer as per methods of Schalm et al. (1986). Differential leucocyte count (DLC) was carried out by standard procedure.

Table 1: Schedule of treatment dosage and route of administration of various antihelminthics

Group	Anthelmintic drug	No. of animals	Dosage	Route	No. of treatments
I	Fenbendazole	06	5mg/kg body weight	Oral	One
II	Ivermectin	06	0.2 mg/kg body weight	S/C	One
III	Closantel	06	10mg/kg body weight	Oral	One
IV	Artemesia absinthium	06	10g/animal	Oral	One
V	Untreated infected control	06	-	-	-
VI	Healthy control	06	-	-	-

RESULTS AND DISCUSSION

The experimental findings obtained with respect to the haematological studies revealed that in all the infected groups the Mean ± SE value of haemoglobin (g/dl) for the 0^{th} day were significantly ($P<0.05$) lower compared to healthy control (10.65±0.39g/dl) as presented in Table 2. The drop in haemoglobin value might be due to blood sucking action of Haemonchus contortus and Bunostomum spp. leading to anaemia that has also been reported by Ahmad et al. 1989 and Abdel Ali, 1992. In Ivermectin treated group there was significant ($p<0.05$) increase in Hb values on 7th day post treatment and the values recorded were 10.50±0.19g/dl which were significantly higher than the infected control group (7.82±0.44g/dl) but comparable to that of healthy control group (10.54±0.35g/dl). The findings are in accordance with the study reported by Khalid et al. 2004. In group treated with fenbendazole, there was significant ($p<0.05$) increase in Hb values on 21^{st} day post treatment with the recorded values of 10.03±0.55g/dl which were significantly higher than that of infected control group (7.73±0.44g/dl) while comparable to the healthy control (10.52±0.32g/dl). The findings are in agreement with Srivastava et al. 1983 and Padmanabun et al. 1984 who reported improved Hb values post treatment. By 28^{th} day post treatment in closantel treated group the Hb values were significantly ($P<0.05$) higher (8.75±0.17g/dl) than untreated infected control group (7.80±0.46g/dl) but still lower than healthy control group (10.48±0.32g/dl). Also in Artemesia treated group, the Hb values recorded (9.62±0.40g/dl) on 21^{th} day post treatment were significantly ($P<0.05$) higher than infected control group (7.73±0.44g/dl) and comparable to healthy control (10.52±0.32g/dl). Thus the said values indicate significantly ($P<0.05$) better results in Ivermectin treated group for increase in haemoglobin values.

Table 2: Mean±SE of Haemoglobin (g/dl) in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	10.65 ± 0.39^{Aa}	10.54 ± 0.35^{Aa}	10.56 ± 0.35^{Aa}	10.52 ± 0.32^{Aa}	10.48 ± 0.32^{Aa}
Infected control	7.81 ± 0.45^{Ab}	7.82 ± 0.44^{Ab}	7.73 ± 0.42^{Ab}	7.73 ± 0.44^{Ab}	7.80 ± 0.46^{Aa}
Fenbendazole	8.14 ± 0.71^{Ab}	8.56 ± 0.69^{Ab}	9.02 ± 0.71^{ABc}	10.03 ± 0.55^{ABa}	10.64 ± 0.57^{Ba}
Ivermectin	9.68 ± 0.19^{Aac}	10.50 ± 0.19^{Ba}	11.63 ± 0.71^{Ca}	12.00 ± 0.12^{Cc}	12.48 ± 0.12^{Dc}
Closantel	7.92 ± 0.10^{Ab}	8.08 ± 0.13^{Ab}	8.27 ± 0.14^{ABbc}	8.52 ± 0.13^{BCb}	8.75 ± 0.17^{Cb}
Artemesia	8.90 ± 0.35^{Abc}	9.02 ± 0.33^{Ab}	9.32 ± 0.37^{Ac}	9.62 ± 0.40^{Aa}	10.03 ± 0.41^{Aa}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly ($p>0.05$)

The effect of treatment on packed cell volume (PCV) during the study period is presented in Table 3. In all the infected groups there was significant ($p<0.05$) decrease in PCV percentage ranging from 26.43±0.53 to 26.78±0.58 % as compared to healthy group (34.15±0.33%) on day 0 and the similar observations were repoterd by Kumar et al. 2010 as per whom reduced PCV values were observed in sheep infected with fenbendazole resistant Haemonchus contortus. Other workers also reported similar observations which include Choudhary et al. 2007; Mir et al. 2007 and Jas et al. 2008. The ivermectin and artemesia group showed comparatively better results than other groups in terms of increase in PCV values. In Ivermectin group, there was significant ($p<0.05$) increase in PCV percentage and on day 14 post treatment the values recorded were 31.29±0.15% which were significantly higher than infected control (26.62±0.55%) but comparable to healthy control (34.08±0.33%). Yousif et al. 1988 in sheep; Islam et al. 1999 in goats and Islam et al. 2003 in buffaloes reported post treatment improvement in PCV using Ivermectin. In group Artemesia on 14th day post treatment the PCV values recorded were 31.75±1.30% which were significantly ($p<0.05$) higher than infected control (26.62±0.55%) and comparable to healthy control (34.08±0.33%).

Table 3: Mean±SE of Packed Cell Volume (PCV %) in affected sheep pre and post treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	34.15 ± 0.33^{Aa}	34.10 ± 0.34^{Aa}	34.08 ± 0.33^{Aa}	34.08 ± 0.36^{Aa}	34.03 ± 0.42^{Aa}
Infected control	26.43 ± 0.54^{Abc}	26.55 ± 0.56^{Ab}	26.62 ± 0.55^{Ab}	26.63 ± 0.54^{Ab}	26.78 ± 0.58^{Ab}
Fenbendazole	25.16 ± 1.98^{Ab}	26.68 ± 1.89^{Abc}	28.13 ± 1.81^{ABb}	30.53 ± 1.32^{ABc}	32.22 ± 1.52^{Ba}
Ivermectin	28.66 ± 0.15^{Ac}	29.50 ± 0.18^{Bcd}	31.29 ± 0.15^{Cac}	32.06 ± 0.17^{Dac}	33.48 ± 0.14^{Ea}
Closantel	26.58 ± 0.51^{Abc}	27.78 ± 0.35^{ABbcd}	29.37 ± 0.65^{BC}	30.55 ± 0.99^{Cc}	31.83 ± 1.45^{Ca}
Artemesia	28.63 ± 1.10^{Ac}	30.13 ± 1.08^{ABd}	31.75 ± 1.30^{ABCac}	33.42 ± 1.32^{BCa}	34.85 ± 1.20^{CA}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly ($p>0.05$)

The results of total erythrocyte count (TEC $\times10^6$/µl) estimated at different stages in the healthy and infected animals are represented in Table 4. In all infected groups the TEC values (Mean±SE) on the 0th day varied from 7.35±0.04 to 7.64±0.01$\times10^6$/µl and were significantly lower as compared to healthy control group (9.48 ±0.07s$\times10^6$/µl) and similar findings have been previously reported by Sarkar et al. 2005; Mir et al. 2007 and Kumar et al. 2010. In group treated with Ivermectin there was significant ($p<0.05$) increase in TEC values and on 7th day post treatment, the values recorded were 8.72±0.58$\times10^6$/µl which were significantly ($p<0.05$) higher than infected control (7.62 ±0.05$\times10^6$/µl) but comparable to healthy control (9.48 ±0.07$\times10^6$/µl) and hence indicating better results compared to other groups.

Table 4: Mean±SE of Total Erythrocyte Count (TEC$\times10^6$ /µl) in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	9.48 ± 0.07^{Aa}	9.48 ± 0.07^{Aa}	9.48 ± 0.07^{Aa}	9.50 ± 0.08^{Ac}	9.49 ± 0.73^{Aa}
Infected control	7.64 ± 0.10^{Ab}	7.62 ± 0.05^{ABb}	7.54 ± 0.03^{ABb}	7.40 ± 0.04^{Abc}	7.35 ± 0.04^{ACb}
Fenbendazole	8.02 ± 0.78^{Ab}	8.39 ± 0.58^{Abc}	8.66 ± 0.47^{Aacd}	8.94 ± 0.48^{Aac}	7.29 ± 0.44^{Aac}
Ivermectin	8.53 ± 0.08^{Aab}	8.72 ± 0.58^{Aac}	9.02 ± 0.09^{ABac}	9.28 ± 0.04^{ACa}	9.79 ± 0.07^{ADa}
Closantel	7.65 ± 0.66^{Ab}	7.81 ± 0.09^{Ab}	8.03 ± 0.13^{ABbd}	8.20 ± 0.16^{BCbc}	8.54 ± 0.14^{Cc}
Artemesia	7.99 ± 0.47^{Ab}	8.18 ± 0.40^{Abc}	8.27 ± 0.44^{Abcd}	8.3 ± 0.47^{Ac}	8.49 ± 0.52^{Ac}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly ($p>0.05$)

The results of total leucocyte count (TLC×10 ^{3}/µl) at different stages of experiment trial are represented in Table 5. In all the gropps infected with gastrointestinal neamatodosis the total leucocyte values (Mean±SE) ranged between 7.26 ±0.13×10^3/µl to 8.50±0.28 ×10^3/µl on day 0 Ivermectin treated group showed significantly (p<0.05) better results compared to other groups. In Ivermectin treated group significant (p<0.05) decrease in TLC values on 7th day post treatment recorded were 7.68±0.11 ×10^3/ µl and was comparable to healthy control (7.35±0.03 ×10^3/ µl). which was significantly (p<0.05) higher as compared to healthy control (7.35 ±0.34×10^3/µl) and the observations are in line with reports of Bhat et al. 2004 and Khalid et al. 2004. Post treatment the Ivermectin treated group showed significantly (p<0.05) better results compared to other groups. In Ivermectin treated group significant (p<0.05) decrease in TLC values on 7th day post treatment recorded were 7.68±0.11 ×10^3/ µl and was comparable to healthy control (7.35±0.03 ×10^3/ µl).

Table 5: Mean±SE of Total Leucoocyte Count (TLC×10^3/µl) before & after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	7.35±0.34^{Aa}	7.35±0.03^{Aab}	7.35±0.03^{Aa}	7.33±0.20^{Aab}	7.33±0.03^{Aa}
Infected control	8.38±0.32^{Ab}	8.35±0.03^{ABc}	8.32±0.31^{ABb}	8.27±0.04^{ABc}	8.25±0.05^{Bb}
Fenbendazole	8.50±0.28 ^{Ab}	8.24±0.29^{ABc}	7.94±0.27^{ABCb}	7.66±0.24^{BCae}	7.35±0.18^{Ca}
Ivermectin	7.81±0.13^{Ac}	7.68±0.11^{Aa}	7.41±0.15^{ABa}	7.16±0.14^{BCbd}	6.92±0.21^{Ca}
Closantel	8.72±0.06^{Ab}	8.47±0.07^{ABc}	8.09±0.19^{BCab}	7.95±0.19^{Cce}	7.84±0.23^{Cb}
Artemesia	7.26±0.13^{Aa}	7.21±0.12^{Ab}	7.15±0.15^{ABa}	6.86±0.13^{ABd}	6.80±0.10^{Bc}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly (p>0.05)

The eosinophil percentage in sheep suffering from gastrointestinal nematodosis ranged between 5.47±0.18 to 5.97±0.12 % and varied significantly (p<0.05) from healthy control group (2.12±0.08%). The current findings are in accordance with earlier reports by Costa et al. 1986; Pal et al. 2001; Bhat et al. 2004 who observed eosinophilia in sheep affected with gastrointestinal nematodosis.. For eosinophils, in case of Closantel treated group, results were significantly better than other groups (Table 6). There was significant (p<0.05) decrease in eosinophil percentage (5.50±0.0.92%) post treatment by day 7 compared to infected control group (7.39±0.12%) and was comparable to healthy control (2.23±0.07%). There was significant (p<0.05) decrease in basophil percentage values in all infected groups post-treatment except the one treated with Closantel as depiceted in Table 7.Monocyte percentage on day 0 varied non-significantly (p>0.05) between 1.33±0.0.21 to 3.00±0.0.25% compared to healthy control (1.67±0.17%) as depicted in Table 8. In all infected groups treated with anthelminthics the lymphocytes percentage showed a marked increase along course of treatment as depicted in Table 9. Group treated with Ivermectin and Artemesia showed significantly (p<0.05) better results compared to rest of the groups. In all infected groups, on day 0 the neutrophils were non-significantly (>0.05) higher as compared to healthy control group. Neutrophil percentage decreased significantly (p<0.05) in all groups however the results were better in group treated with Fenbendazole and Artemesia as presented in Table10.

Table 6: Mean±SE of eosinophil percentage in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	2.12±0.08^{Aa}	2.23±0.07^{Aa}	2.54±0.09^{Aa}	2.10±0.08^{Aa}	2.10±0.08^{Aa}
Infected control	7.16±0.14^{Ac}	7.39±0.12^{ABb}	7.55±0.10^{Bcb}	7.75±0.07^{Cc}	7.87±0.42^{Cd}
Fenbendazole	5.47±0.18^{Db}	4.02±0.25^{Cb}	2.90±0.14^{Bb}	2.21±0.13^{Aa}	2.01±0.05^{Aa}
Ivermectin	5.74±0.13^{Db}	4.03±0.20^{Cb}	3.00±0.23^{Bb}	2.23±0.08^{Aa}	2.03±0.07^{Aa}
Closantel	5.67±0.67^{Ab}	5.50±0.92^{Aa}	6.50±0.50^{Aab}	6.67±0.61^{Aac}	6.67±0.84^{Aa}
Artemesia	5.97±0.12^{Dc}	4.55±0.20^{Cb}	3.14±0.28^{Bb}	2.33±0.07^{Aa}	6.67±0.84^{Aa}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly (p>0.05)

Table 7: Mean±SE of basophil percentage in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	2.00±0.36^{Aab}	2.17±0.30^{Aa}	1.17±0.17^{Aa}	1.67±0.33^{Aa}	1.50±0.34^{Aa}
Infected control	2.17±0.40^{Aabc}	1.83±0.54^{Aa}	2.17±0.48^{Aab}	2.00±0.44^{Aa}	1.67±0.49^{Aa}
Fenbendazole	3.00±0.26^{Acd}	3.00±0.36^{Aa}	2.50±0.22^{ABb}	2.83±0.40^{ABab}	1.83±0.40^{Ba}
Ivermectin	3.17±0.17^{Ad}	2.33±0.21^{Ba}	2.17±0.17^{Bab}	1.67±0.33^{Bca}	1.67±0.17^{Ca}
Closantel	1.50±0.34^{Aa}	3.00±0.58^{ABCa}	2.33±0.61^{ABab}	3.50±0.67^{BCab}	4.16±0.40^{Cab}
Artemesia	2.67±0.21^{Abcd}	1.83±0.30^{Ba}	1.83±0.30^{Bab}	1.50±0.22^{BCa}	1.00±0.00^{Ca}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly (p>0.05)

Table 8: Mean±SE of monocyte percentage in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	1.67±0.17^{Aa}	1.00±0.00^{Aa}	1.33±0.21^{ABa}	1.33±0.21^{ABa}	1.83±0.17^{Ba}
Infected control	1.33±0.21^{Aa}	1.33±0.21^{Aa}	2.00±0.45^{ABab}	2.33±0.71^{ABa}	3.17±0.70^{Bb}
Fenbendazole	2.33±0.21^{Ab}	2.50±0.22^{Ab}	1.67±0.33^{Aab}	2.00±0.26^{Aa}	1.83±0.40^{Aa}
Ivermectin	2.33±0.21^{Ab}	1.00±0.00^{Ba}	1.83±0.31^{abB}	2.17±0.17^{Aa}	1.17±0.17^{Ba}
Closantel	3.00±0.25^{Ab}	3.17±0.30^{Ab}	2.67±0.21^{ABb}	2.00±0.26^{BCa}	1.67±0.21^{Ca}
Artemesia	2.67±0.21^{Ab}	2.50±0.50^{Ab}	2.17±0.40^{ABab}	1.83±0.31^{ABa}	1.17±0.17^{Ba}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly (p>0.05)

Table 9: Mean±SE of lymphocyte percentage in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	54.00 ±0.81^{Aa}	51.67 ±0.88^{Ba}	51.00 ±0.52^{Ba}	51.00 ±0.52^{Ba}	50.50 ±0.76^{Ba}
Infected control	51.17 ±0.48^{Ab}	49.83 ±0.70^{ABab}	49.00 ±0.58^{Bb}	47.00 ±0.36^{Cb}	45.33 ±0.33^{Db}
Fenbendazole	48.00 ±0.58^{Ac}	49.33 ±0.42^{Ab}	51.33 ±0.49^{Ba}	53.00 ±0.63^{Cc}	54.33 ±0.80^{Dc}
Ivermectin	47.83 ±0.48^{Ac}	50.17 ±0.47^{Bab}	51.50 ±0.56^{BCa}	53.00 ±0.63^{CDc}	54.33 ±0.80^{Dc}
Closantel	56.50 ±1.02^{Ad}	57.00 ±0.77^{Ac}	57.50 ±0.76^{Ac}	58.00 ±0.77^{Ad}	58.33 ±0.99^{Ad}
Artemesia	50.17 ±0.40^{Ab}	51.50 ±0.22^{Ba}	52.17 ±0.31^{BCa}	52.67 ±0.33^{Cc}	54.33 ±0.43^{Dc}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly (p>0.05)

Table 10: Mean±SE of neutrophil percentage in affected sheep before and after treatment

Treatment	Day 0	Day 7	Day 14	Day 21	Day 28
Healthy control	37.17 ±1.01^{Aab}	39.50 ±0.99^{Aa}	39.67 ±1.05^{Aa}	38.33 ±1.01^{Aa}	38.67 ±1.08^{Aa}
Infected control	39.50 ±0.56^{Aa}	39.50 ±0.76^{Aa}	39.00 ±0.26^{Aab}	38.50 ±0.56^{Aa}	39.50 ±0.62^{Aa}
Fenbendazole	38.33 ±0.42^{Aa}	37.33 ±0.33^{ABab}	37.00 ±0.45^{Bab}	35.83 ±0.30^{Ca}	35.67 ±0.21^{Db}
Ivermectin	34.83 ±1.68^{Abc}	35.33 ±1.45^{Ab}	36.30 ±1.58^{Ab}	37.00 ±1.73^{Aa}	37.50 ±1.43^{Ac}
Closantel	32.33 ±0.67^{Ac}	31.33 ±0.84^{Ac}	32.33 ±1.23^{Ac}	31.67 ±1.08^{Ab}	31.33 ±0.76^{Aab}
Artemesia	38.83 ±0.48^{Aa}	38.67 ±0.67^{ABa}	37.67 ±0.33^{ABCab}	37.17 ±0.48^{BCa}	36.83 ±0.54^{Cab}

Values with same superscript in a column (small letters) and same superscript in rows (capital letters) do not vary significantly (p>0.05)

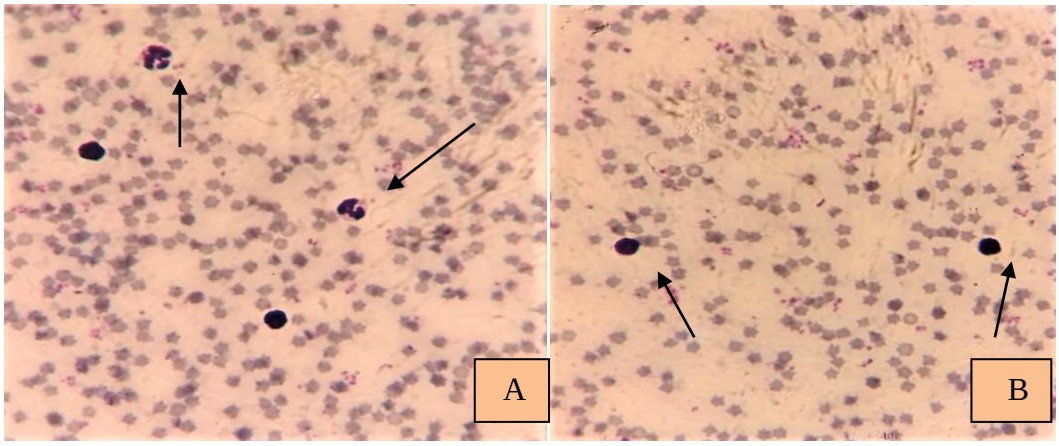

Figure 1: A) Neutrophils (arrow) B) Lymphocytes (arrow) in blood smear of sheep affected with GI nematodosis

CONCLUSION

The study revealed significant (p<0.05) improvement in haematlogical parameters to normal values in infected animals after treatment with different anthelmintics.

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