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Efficacy and Safety of Albendazole against *Haemonchus Contortus* Infestation in Goats

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Abstract A field study was aimed to evaluate the efficacy and safety of albendazole administered orally at different dose regimens in goats naturally infested with *Haemonchus contortus*. Nineteen male goats' allocated to five groups (N= four, control N= three) were used. The first group served as the untreated control. Albendazole was given as a single dose for the second and third group at dose 5 and 10 mg/kg body weight (BW) respectively. The fourth group received 2.5 mg/kg BW repeated for four days while the fifth group given 1.25 mg/kg BW repeated for eight days. Faecal and blood samples were collected at zero, one, three, seven, 15, 30, 45 and 60 days of drug administration. The results of faecal egg count reduction% revealed that, the group received 5 mg/kg BW as a single dose had ≥ 95 % on the day three and seven, the group received 10 mg/kg BW as a single dose had ≥ 95 % on day three, the group received 2.5 mg/kg BW repeated for four days had ≥ 95 % on the day three, seven and 15, group received 1.25 mg/kg BW repeated for eight days had ≥ 95 % on the day three, seven, 15 and 30. The results of PCV % revealed a significant ($P < 0.05$) increase in the group received 1.25 mg/kg BW repeated for eight days on day 30 and 45. The results of the total leukocyte count revealed a significant ($P < 0.05$) decrease in treated groups when compared to control on day seven, 15 and 30. The results of biochemical analysis revealed a significant ($P < 0.05$) increase in the level of albumin in the group received 1.25 mg/kg BW repeated for eight days on day 45. It was concluded that, administration of albendazole at small repeated doses proved to have a satisfactory efficacy and safety in the treatment and control of *H. contortus* in goats.

Keywords Albendazole, *Haemonchus contortus*, Male Goats

1. Introduction

Infestation of gastrointestinal nematodes remains one of the major constraints in ruminant production. Among the gastrointestinal nematodes, *H. contortus* is the species with the greatest pathologic and economic importance. This nematode is a blood feeding abomasal parasite of sheep and goats but can circulate in other ruminant species such as cattle and reindeer[1, 2]. Treatment and control of *H. contortus* infestation could result in improving performance of the farm animals specially goats[3].

Albendazole, a benzimidazole derivative, is authorized for use in veterinary medicine, and has been used for decades in the treatment and control of gastrointestinal nematodes as well as liver flukes[4]. Albendazole was highly efficacious in the removal of mono-specific and mixed infection of *H. contortus* and other gastrointestinal nematodes in sheep and goats[5]. Furthermore, Craig and Shepherd[6] reported that, albendazole produced an effect more than 98% against *H. contortus* infestation. Additionally, Theera et al.[7] reported that, albendazole was proven to have a satisfactory efficacy in the treatment and control of *H. contortus* infestation in ruminant, particularly in a herd with no history of albendazole uses.

This study attempted to determine the optimal therapeutic regimen of albendazole for treatment and control of *H. contortus* infestation in goats. Furthermore, to evaluate the effect of albendazole at different doses and regimens on hematological and some serum biochemical parameters of goats.

2. Materials and Methods

2.1. Experimental Drug

Albendazole 2.5% suspension® (Pharma Swede, Egypt).

2.2. Study Area and Study Animals

This study was performed on the farm of the Faculty of Veterinary Science, University of Nyala, Nyala, South Darfur State, Sudan. A total of 19 male goats, five to ten

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months old, 15-19 Kg BW, were purchased from *Almawashi* marked (Nyala). Before purchased, the animals were examined to provide infestation with *H. contortus* using the flotation technique as described by Soulsby[8]. *H. contortus* eggs were identified on the basis of their morphological features[9]. Furthermore, before starting the study, some faecal samples were cultured to confirm the identified eggs by recognizing *H. contortus* larvae (L_3), using the method described by Litchenfels[10]. Experimental animals maintained free (untie) in locally made pen and allowed free to graze during the day and provided with additional feed at night with free access to water. Study animals treated with a broad spectrum antibacterial drug enrofloxacine (Avitryl®-5) at dosage 2.5 mg/kg BW subcutaneously repeated for three days as umbrella treatment against bacterial infection. The animals kept for two weeks before starting the study to be adapted to environment.

2.3. Experimental Design, Treatments and Sampling

Experimental animals were divided into five groups each of four animals and control group had three animals. The first group served as the untreated control. Albendazole suspension was given orally as a single dose for the second group at dose 5 mg/kg BW, which reported by manufacturer [11] and for the third group at 10 mg/kg BW[12]. The fourth group received 2.5 mg/kg BW repeated for four days while the fifth group given 1.25 mg/kg BW repeated for eight days.

Faecal and blood samples were collected at zero, one, three, seven, 15, 30, 45 and 60 days of drug administration. Blood samples were divided into two parts, anticoagulant ethylene diamine tetra acetic acid (EDTA) was added to the first part which used for the determination of hematological parameters. The second part of blood samples left to clot at room temperature then centrifuge for ten minutes at 3000 r.p.m to obtain clear sera. The sera were labelled and stored at −20 C° until used for biochemical analysis.

2.4. Assessing the Efficacy of Albendazole

Modified McMaster technique[13] was followed for the faecal egg count. The egg count was expressed in egg per gram (EPG). The faecal egg count reductions (FECR %) based on averages were calculated using the following formula;

FECR % =[1 – (EPG treatment / EPG control)] × 100

2.5. Hematological Assay

Hematological examination such as Packed cell volume (PCV %), haemoglobin (Hb), total erythrocyte count (RBC), blood indices[mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC)], total white blood cells count (WBC) and differential cells count were calculated manually[14].

2.6. Biochemical Assay

Total proteins, albumin, globulins, serum aspartate amino transferase (AST), urea and creatinine were determined[14] using ready-made kits of BioSystem®, Spain and Crescent diagnostics®, Saudi Arabia.

2.7. Statistical Analysis

Statistics were calculated with SPSS version 20 for windows, the mean values obtained in the different groups were compared by one-way ANOVA, and the least significant difference was used to determine the significant difference between the means of each parameter.

3. Results

3.1. Therapeutic Efficacy of Albendazole

The results of mean faecal egg count per gram (FPG) and reduction (FECR %) after treatment with albendazole are shown in **Table 1**. The results revealed that, the group received albendazole at dosage 5 mg/kg BW as a single dose revealed 81.3, 100, 97.4, 85.2, 72.7, - 24.7 and - 19.4 %, the group received 10 mg/kg BW as a single dose revealed 70, 95.7, 73.7, 68.2, 80.9, 14.6 and 11.3%, the group received 2.5 mg/kg BW repeated for four days revealed 73.8, 100, 100, 97.4, 87.7, 55.3 and 55.2%, the group received 1.25 mg/kg BW repeated for eight days revealed 28.8, 97.9, 100, 97.7, 95.4, 67.3 and 61.1% on day 1, 3, 7, 15, 30, 45 and 60 respectively of FECR %.

3.2. Effect on the Hematological Parameters

Studying erythrogram in different groups **(Table 2)**, the group received albendazole at dosage 5 mg/kg BW as a single dose revealed a significant ($P < 0.05$) decrease in haemoglobin and MCH on day 15, PCV % on day 30 and MCHC on day three and 15. Furthermore, the group received 10 mg/kg BW as a single dose showed a significant ($P < 0.05$) decrease on RBC and MCHC on day 15 and PCV % on day 30. On the other hand, the group received 1.25 mg/kg BW repeated for eight days revealed a significant ($P < 0.05$) increase on PCV % at day 30 and 45. The results of MCV revealed a non significant ($P < 0.05$) difference between treated groups and control.

Studying leukogram in different groups **(Table 3)**, the results revealed a significant ($P < 0.05$) decrease in total leukocyte count in treated groups when compared to control on day seven, 15 and 30, the decrease refers to a significant ($P < 0.05$) decrease in neutrophils count on day 15 and lymphocytes and monocytes count on day 15 and 30. Furthermore, the result revealed a significant ($P < 0.05$) decrease in neutrophils count in the groups received albendazole at dosage 5 mg/kg BW as a single dose and 2.5 mg/kg BW repeated for four days on day 45. The results of eosinophils count revealed a significant ($P < 0.05$) increase in groups received albendazole at a single dose of 5 and 10 mg/kg BW on day 3. On the other hand, a significant ($P <$

0.05) decrease in eosinophils and monocytes count revealed on day 60 among treated groups and control.

3.3. Effect on the Biochemical Parameters

As summarized in **Table 4**, the results revealed non significant ($P < 0.05$) effects on the level of serum total proteins, globulins, AST, urea and creatinine within and among treated groups and control. The group received albendazole at dosage 1.25 mg/kg BW repeated for eight days revealed a significant ($P < 0.05$) increase in the level of serum albumin at day 45. On the other hand, a significant ($P < 0.05$) decrease in the level of albumin revealed in the group received albendazole at dosage 10 mg/kg BW as a single dose on day 45.

4. Discussion

Before starting the study, *H. contortus* eggs identified in the faecal samples of experimental animals **(Figure 1)** and confirmed by recognizing *H. contortus* larvae (L_3) after faecal samples cultured **(Figure 2)**. At the end of the experiment and according to the confidence of Coles et al.[15], the faecal egg count reduction demonstrated that; albendazole at a single dose of 5 mg/kg BW had ≥ 95 % on day three and seven. These observations were supported by Waruiru[16]. Furthermore, albendazole at a single dose of 10 mg/kg BW had ≥ 95 % on day three. These results in agreement with Mohamed and Al-Farwachi[12] who reported low effectiveness of albendazole at a single dose of 10 mg/kg BW against gastrointestinal nematode infestation in sheep. On the other hand, the results revealed that, albendazole at dosage 2.5 mg/kg BW repeated for four days had ≥ 95 % on day three, seven and 15. Furthermore, albendazole at dosage 1.25 mg/kg BW repeated for eight days had ≥ 95 % on day three, seven, 15 and 30. These results in agreement with Helle[17] who reported that, repeated administration of albendazole at small doses more effective against lung nematode infestation in goats.

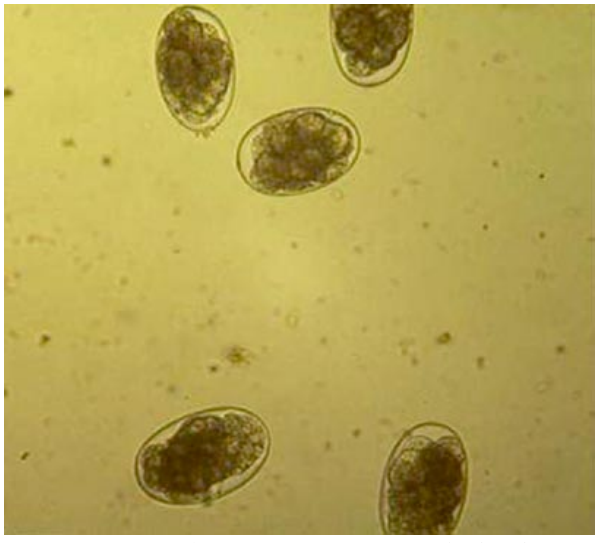

Figure 1. *Haemonchus contortus* eggs were examined on day zero

Figure 2. *Haemonchus contortus* larvae (L3) after faecal samples cultured before starting the study

The results revealed a significant increase in PCV % in the group received albendazole at dosage 1.25 mg/kg BW repeated for eight days on day 30 and 45. This finding in agreement to other researchers Theera et al.[7] and Githigia et al.[18]. Albendazole at a single dose of 5 and 10 mg/kg BW failed to enhance the effect of *H. contortus* infestation on erythrogram at day 15 and 30. These results disagree with Islam et al.[19] who reported a significant increase in erythrocyte values after treatment with albendazole at dosage 7.5 mg/kg BW as a single dose in goats naturally infected with gastrointestinal nematodes. The differences might be due to different parasitic infestation levels and environmental condition.

The mean values of total leukocyte count in the treated groups revealed a significant decrease on day seven, 15, and 30 when compared to control. These results might be due to decrease in secondary bacterial infection after treatment of *H. contortus* with albendazole. These results supported by Koko et al.[20] who reported a significant decrease in leukocyte values in goats infected with gastrointestinal nematodes after treatment with albendazole.

The amount of total serum protein and globulin show non significant difference between groups. The results in agreement with Githigia et al.[18] and Theodorides[21]. Albendazole at dosage 1.25 mg/kg BW repeated for eight days revealed a significant increase in the level of serum albumin at day 45. On the other hand, albendazole at a single dose of 10 mg/kg BW failed to enhance the level of serum albumin on day 45. These results disagree with Francis et al.[22] who reported a non significant effect on the level of albumin in goats naturally infected with gastrointestinal nematodes after treated with albendazole at dose 7.5 mg/kg BW as a single dose orally. The differences might be due to different breeds, environmental condition and level of parasitic infestation.

The mean values of serum AST in the treated groups and control revealed a non significant difference. These results supported by Ernest et al.[23]. Analysis of the biochemical results indicated that, no significant effects occurred in the level of serum urea and creatinine within and among the

treated groups and control. These results supported by Ernest et al.[23] who reported a non significant effect on renal function in goats treated with albendazole at dosage 30 mg/kg BW twice a week for four weeks when compared to control.

Table 1. The Effect of Oral Administration of Albendazole at Dosage 5 mg/Kg BW as A Single Dose, 10 mg/Kg BW as A Single Dose, 2.5 mg/Kg BW Repeated for Four Days and 1.25 mg/Kg BW Repeated for Eight Days on Faecal Egg Count per Gram and Reduction %

Faecal egg count per gram (FPG) and Reduction (FECR %)									
Treatment	Control	ABZ 5mg s.		ABZ 10mg s.		ABZ 2.5mg r.4		ABZ 1.25mg r.8	
Day 0	600±404	675±214	-	525±160	-	525±193	-	275±85	-
Day 1	667±384	125±48	81.3 %	200±71	70 %	175±85	73.8 %	475±225	28.8 %
Day 3	1167^{a} ±449	0^{b} ±0	100 %	50^{b} ±29	95.7 %	0^{b} ±0	100 %	25^{b} ±25	97.9 %
Day 7	1900^{a} ±851	50^{b} ±29	97.4 %	500^{b} ±332	73.7 %	0^{b} ±0	100 %	0^{b} ±0	100 %
Day 15	6600^{a} ±2413	975^{b} ±390	85.2 %	2100^{b} ±725	68.2 %	175^{b} ±144	97.4 %	150^{b} ±150	97.7 %
Day 30	9237^{a} ±929	2525^{b} ±699	72.7 %	1763^{bc} ±428	80.9 %	1225^{bc} ±442	87.7 %	425^{c} ±229	95.4 %
Day 45	9567±4504	11925±715	-24.7 %	8175±4269	14.6 %	4275±1289	55.3 %	3125±1185	67.3 %
Day 60	5467±2118	6525±307	-19.4 %	4850±2168	11.3 %	2450±681	55.2 %	2125±829	61.1 %

*(Mean ± S.E). *(N= 4, Control N=3). *Means Within the Same Row Having Different Letters (a, b, c, …) are Significantly Different at $P < 0.05$

Table 2. The Effect of Albendazole at Different Doses and Durations Used in the Present Study on Erythrogram

Day	Treatment	RBCs×10^{6}/µL	Hb (g/dL)	PCV %	MCV (fL)	MCH (Pg)	MCHC %
Day 0	Control	12.0±0.5	10.2±0.9	28.3±1.9	23.7±2.1	8.5±1.0	35.9±0.9
	5mg/kg	9.8±0.4	8.7±0.4	27.0±1.4	27.9±2.2	9.2±0.5	32.4±1.8
	10mg/kg	10.7±0.5	10.7±0.5	27.5±0.9	25.9±1.6	10.1±0.9	38.9±1.4
	2.5mg/kg	11.3±0.4	10.8±0.0	29.5±1.0	26.1±0.8	9.6±0.4	34.7±1.7
	1.25mg/kg	11.0±0.6	11.0±0.8	30.8±1.7	28.2±1.8	10.0±0.6	38.4±3.0
Day 1	Control	9.6±0.7	11.1±1.7	28.3±1.9	30.2±4.3	12.0±2.6	39.0±4.4
	5mg/kg	10.6±0.6	11.2±0.8	26.3±1.3	24.9±1.2	10.8±1.3	43.1±4.0
	10mg/kg	9.3±0.2	11.5±1.6	27.5±0.9	29.5±1.2	12.3±1.8	41.3±4.8
	2.5mg/kg	11.2±0.5	11.6±1.7	30.0±2.2	26.8±1.5	10.2±1.2	38.2±4.4
	1.25mg/kg	9.7±0.5	9.4±1.1	30.8±1.7	31.7±1.2	9.7±1.0	30.4±2.1
Day 3	Control	9.7±0.7	9.2±0.6	25.8±3.5	26.2±1.6	9.5±0.2	36.5^{ab} ±2.7
	5mg/kg	9.7±0.4	8.8±0.8	27.5±3.1	27.7±2.6	9.0±0.8	32.2^{b} ±1.9
	10mg/kg	8.9±0.4	10.2±1.2	24.3±2.2	27.1±1.4	11.4±0.9	41.7^{a} ±2.6
	2.5mg/kg	10.4±0.4	11.4±0.5	30.0±0.8	29.1±1.6	11.1±0.8	38.0^{ab} ±1.0
	1.25mg/kg	9.8±0.1	11.6±0.9	30.5±1.3	31.1±1.4	11.8±0.9	37.9^{ab} ±1.7
Day 7	Control	10.1±0.7	9.6±1.3	25.7±4.8	25.1±3.2	9.5±0.7	38.2±2.0
	5mg/kg	9.3±0.4	8.9±1.1	26.3±1.2	28.2±0.8	9.5±0.8	33.8±3.1
	10mg/kg	9.1±0.5	9.2±0.5	26.8±0.9	29.7±1.5	10.6±0.9	34.6±2.1
	2.5mg/kg	10.0±0.7	10.6±0.9	28.5±1.9	28.5±1.1	10.6±0.5	37.5±3.1
	1.25mg/kg	10.4±0.4	9.3±0.5	27.0±1.9	25.9±0.9	9.0±0.2	35.0±1.7
Day 15	Control	14.9^{a} ±0.2	9.5^{a} ±1.0	27.0±1.0	18.2±0.5	6.4^{a} ±0.6	35.1^{a} ±2.2
	5mg/kg	14.7^{a} ±0.4	5.9^{b} ±0.6	26.0±1.4	17.7±0.8	4.0^{b} ±0.3	22.6^{c} ±1.7
	10mg/kg	12.9^{b} ±0.5	7.7^{a} ±0.5	28.3±2.0	15.9±0.8	6.0^{a} ±0.4	27.2^{bc} ±0.8
	2.5mg/kg	14.0^{ab} ±0.6	10.2^{a} ±1.3	27.3±1.4	19.5±0.6	7.2^{a} ±0.7	37.0^{a} ±3.0
	1.25mg/kg	15.1^{a} ±0.6	10.1^{a} ±1.1	32.0±2.2	21.3±1.9	6.8^{a} ±0.9	31.9^{ab} ±2.9
Day 30	Control	13.3±1.2	8.0±0.2	24.7^{bc} ±0.3	18.9±1.4	6.2±0.7	32.5±1.3
	5mg/kg	13.1±0.6	7.7±0.4	21.8^{d} ±0.5	16.7±1.0	5.9±0.4	35.2±1.6
	10mg/kg	14.3±0.4	8.1±0.6	22.8^{cd} ±1.1	22.0±1.4	5.7±0.5	35.7±2.0
	2.5mg/kg	14.2±0.7	8.8±0.7	26.3^{ab} ±1.0	18.7±1.3	6.3±0.6	33.4±1.4
	1.25mg/kg	13.9±0.1	9.0±0.6	27.8^{a} ±0.6	20.0±0.5	7.3±1.2	32.4±1.7
Day 45	Control	12.9±0.3	6.9±0.4	18.7^{b} ±1.3	14.5±0.8	5.4±0.2	37.1±1.4
	5mg/kg	13.3±0.7	7.4±0.2	19.0^{b} ±0.4	14.5±0.9	5.6±0.3	38.4±0.4
	10mg/kg	14.6±1.1	7.5±0.5	21.0^{b} ±1.2	14.7±1.7	5.3±0.6	35.9±1.1
	2.5mg/kg	14.2±0.4	8.0±0.7	21.3^{b} ±1.4	15.1±1.3	5.7±0.6	38.4±5.2
	1.25mg/kg	14.9±0.8	8.0±0.3	26.0^{a} ±0.9	17.7±1.4	5.4±0.5	30.8±1.2
Day 60	Control	14.2±1.0	9.1±0.1	17.3±0.9	12.3±0.5	7.0±0.4	56.5±2.0
	5mg/kg	13.4±0.2	6.6±0.3	19.0±1.8	14.3±1.5	4.7±0.3	34.6±1.8
	10mg/kg	12.8±0.8	8.6±1.8	18.3±2.5	14.1±1.4	6.7±1.2	46.5±5.7
	2.5mg/kg	13.7±0.4	8.9±1.6	20.3±1.1	14.8±0.8	6.6±1.2	43.6±6.1
	1.25mg/kg	14.4±0.4	8.8±0.6	20.8±2.8	14.2±1.7	6.1±0.4	44.1±4.5

*(Mean ± S.E), *(N= 4, Control N=3), *Means Within the Same Column Among the Day Having Different Letters (a, b, c, …) are Significantly Different at $P < 0.05$

Table 3. The Effect of Albendazole at Different Doses and Durations Used in the Present Study on Leukogram

Day	Treatment	T.L.C $\times10^3/\mu L$	Neutrophils $\times10^3/\mu L$	Eosinophils $\times10^3/\mu L$	Basophils $\times10^3/\mu L$	Lymphocytes $\times10^3/\mu L$	Monocytes $\times10^3/\mu L$
Day 0	Control	9.5±1.2	4.2±0.5	0.3±0.2	0.37±0.32	4.3±0.8	0.6±0.4
	5mg/kg	10.9±1.7	4.0±1.2	0.2±0.1	0.30±0.23	6.4±0.8	0.4±0.2
	10mg/kg	13.1±1.4	5.8±1.2	0.3±0.2	0.55±0.49	7.0±1.0	0.4±0.3
	2.5mg/kg	10.6±1.2	3.7±1.5	0.4±0.1	0.30±0.24	6.2±1.4	0.4±0.2
	1.25mg/kg	13.9±1.7	3.4±1.3	0.1±0.0	0.33±0.23	9.2±1.2	0.2±0.0
Day 1	Control	13.7±1.2	4.8±1.0	0.5±0.2	0.74±0.63	7.0±0.5	0.3±0.0
	5mg/kg	10.8±1.4	3.8±0.7	0.2±0.0	0.83±0.44	5.5±1.4	0.4±0.1
	10mg/kg	10.6±0.8	4.5±0.4	0.2±0.1	0.35±0.22	5.8±0.6	0.2±0.1
	2.5mg/kg	10.7±0.4	3.8±0.6	0.3±0.1	1.00±0.41	5.4±0.5	0.2±0.1
	1.25mg/kg	13.3±0.7	4.1±0.6	0.3±0.0	0.76±0.48	7.7±0.4	1.6±1.3
Day 3	Control	13.5±0.3	5.1±0.4	0.4^{c}±0.0	0.67±0.67	7.2±0.5	0.8±0.2
	5mg/kg	14.9±2.1	2.9±0.9	0.8^{ab}±0.1	0.75±0.48	7.6±1.4	1.2±0.2
	10mg/kg	12.5±2.0	3.3±0.1	1.1^{a}±0.2	0.28±0.24	6.9±1.5	1.5±0.6
	2.5mg/kg	12.3±0.9	3.1±0.4	0.5^{bc}±0.1	0.75±0.48	7.4±0.8	1.4±0.4
	1.25mg/kg	12.2±0.5	3.3±0.4	0.7^{bc}±0.1	0.50±0.29	7.3±0.9	1.0±0.3
Day 7	Control	21.6^{a}±1.3	3.7±1.4	1.4±0.8	1.00±0.48	13.6±1.2	2.9±1.7
	5mg/kg	15.0^{b}±1.0	4.1±0.8	1.8±1.3	0.75±0.48	9.4±0.5	1.0±0.3
	10mg/kg	11.4^{b}±1.5	3.0±0.4	0.4±0.2	0.50±0.29	7.4±1.1	1.9±0.3
	2.5mg/kg	12.6^{b}±0.8	4.3±0.2	0.2±0.1	1.25±0.48	7.7±1.1	0.5±0.1
	1.25mg/kg	15.1^{b}±2.0	3.2±0.8	0.6±0.2	0.75±0.48	9.8±2.3	0.7±0.3
Day 15	Control	22.8^{a}±4.0	6.2^{a}±1.1	0.8±0.1	0.67±0.33	14.3^{a}±2.8	1.5^{a}±0.4
	5mg/kg	9.8^{b}±0.7	3.6^{b}±0.3	0.3±0.1	0.75±0.48	5.5^{b}±0.3	0.4^{b}±0.2
	10mg/kg	10.2^{b}±0.8	3.8^{b}±0.5	0.4±0.1	1.00±0.41	5.8^{b}±0.4	0.3^{b}±0.1
	2.5mg/kg	8.5^{b}±1.7	3.3^{b}±0.3	0.3±0.1	0.75±0.48	4.7^{b}±1.3	0.2^{b}±0.1
	1.25mg/kg	9.6^{b}±1.5	3.4^{b}±0.4	0.8±0.4	0.75±0.48	5.4^{b}±1.3	0.5^{b}±0.2
Day 30	Control	17.1^{a}±1.5	5.6±1.0	0.9±0.3	1.00±0.58	9.6^{a}±0.6	1.0^{a}±0.3
	5mg/kg	12.6^{b}±0.9	3.9±0.5	0.7±0.2	0.75±0.48	7.2^{b}±1.2	0.9^{ab}±0.1
	10mg/kg	8.6^{c} ±0.9	3.2±0.6	0.4±0.1	0.50±0.29	4.7^{c}±0.3	0.4^{c}±0.1
	2.5mg/kg	11.3^{bc}±1.0	3.7±0.4	0.7±0.2	1.00±0.41	6.6^{bc}±0.8	0.5^{bc}±0.1
	1.25mg/kg	10.7^{bc}±0.7	3.1±0.5	0.5±0.2	0.75±0.25	6.7^{bc}±0.1	0.5^{bc}±0.2
Day 45	Control	17.4±0.9	6.8^{a}±0.6	0.9±0.1	0.67±0.33	8.7±0.5	1.0±0.5
	5mg/kg	12.0±1.5	3.6^{b}±0.3	0.5±0.1	1.25±0.48	6.7±0.9	1.3±0.3
	10mg/kg	15.9±1.4	6.8^{a}±1.2	0.4±0.0	0.75±0.48	7.5±0.7	1.2±0.3
	2.5mg/kg	14.1±2.0	4.5^{b}±0.3	0.5±0.3	0.50±0.29	8.3±1.6	0.8±0.3
	1.25mg/kg	14.3±1.9	5.7^{ab}±0.8	0.3±0.1	1.25±0.49	7.4±1.7	0.7±0.2
Day 60	Control	18.6±1.1	5.5±1.3	1.4^{a}±0.5	1.00±0.55	10.1±0.6	1.6^{a}±0.3
	5mg/kg	13.7±1.6	6.4±0.7	0.4^{b}±0.1	0.75±0.48	6.3±1.0	0.5^{b}±0.1
	10mg/kg	17.2±2.5	7.6±2.6	1.2^{a}±0.2	1.00±0.41	7.1±1.3	1.2^{a}±0.2
	2.5mg/kg	12.3±2.0	5.8±0.8	0.2^{b}±0.1	1.25±0.48	5.9±1.2	0.3^{b}±0.1
	1.25mg/kg	11.3±0.2	4.9±0.3	0.1^{b}±0.0	0.75±0.48	5.8±0.5	0.2^{b}±0.1

*(Mean ± S.E). *(N= 4, Control N=3). *Means Within the Same Column Among the Day Having Different Letters (a, b, c, …) are Significantly Different at $P < 0.05$

Table 4. The Effect of Albendazole at Different Doses and Durations Used in the Present Study on Some Serum Biochemical Parameters

Day	Treatment	Total protein (g/L)	Albumin (g/L)	Globulin (g/L)	AST (U/L)	Urea (mg/dl)	Creatinine (mg/dl)
Day 0	Control	75.1±2.6	33.0±2.1	42.3±4.8	30.8±7.6	67.3±7.6	1.0±0.2
	5mg/kg	76.1±1.4	42.2±0.9	34.0±1.8	36.2±6.0	75.4±5.8	1.3±0.7
	10mg/kg	74.1±6.1	42.5±6.8	31.5±7.9	48.3±7.6	78.5±10.7	2.4±1.2
	2.5mg/kg	66.2±5.3	32.9±1.4	33.3±3.9	34.8±1.6	64.9±6.3	1.0±0.4
	1.25mg/kg	70.6±1.4	34.5±2.0	36.0±2.9	52.5±10.0	79.1±5.5	0.8±0.2
Day 1	Control	75.1±5.1	43.1±2.8	31.7±7.2	38.2±13.1	56.6±8.8	1.4±0.4
	5mg/kg	73.3±3.3	38.1±2.5	35.5±0.9	35.4±2.2	56.0±5.6	1.4±0.6
	10mg/kg	71.3±6.4	41.7±7.3	29.8±4.1	40.9±6.7	60.3±6.3	0.7±0.2
	2.5mg/kg	66.7±1.9	32.8±1.1	34.0±2.4	29.4±3.8	62.2±4.3	0.9±0.3
	1.25mg/kg	74.4±3.0	38.9±3.6	35.8±5.3	49.7±10.4	74.4±6.7	1.2±0.3
Day 3	Control	68.6±5.2	32.2±5.6	36.3±7.3	70.7±31.2	73.0±9.2	2.9±2.0
	5mg/kg	65.7±8.9	35.0±2.1	30.5±9.1	34.8±6.0	62.5±7.9	0.5±0.1
	10mg/kg	79.3±5.0	33.1±1.9	46.3±4.7	37.0±4.2	62.8±9.6	2.9±1.1
	2.5mg/kg	73.3±1.9	35.7±4.3	37.8±5.9	31.4±6.9	64.7±4.8	1.1±0.5
	1.25mg/kg	77.6±10.0	36.6±2.7	40.8±9.7	56.1±6.5	74.4±7.2	1.3±0.3
Day 7	Control	64.2±1.9	44.7±7.0	19.3±5.2	69.6±28.1	62.0±2.5	2.2±1.0
	5mg/kg	67.8±4.7	35.6±3.7	32.0±5.4	33.2±4.0	57.9±2.5	1.2±0.3
	10mg/kg	70.6±6.1	43.2±2.8	27.5±5.2	29.4±2.5	58.2±5.7	0.9±0.2
	2.5mg/kg	72.2±3.0	30.4±4.7	41.5±6.1	32.4±3.5	57.2±3.9	1.7±0.7
	1.25mg/kg	77.1±4.2	36.8±3.7	40.3±2.8	54.0±9.2	69.9±4.5	3.8±1.5
Day 15	Control	62.7±5.3	30.4±7.4	32.7±9.3	56.4±30.5	58.7±5.4	1.3±0.4
	5mg/kg	76.6±4.5	35.3±3.8	41.3±4.3	48.2±8.4	56.6±6.2	1.2±0.2
	10mg/kg	67.3±3.6	37.6±5.6	29.0±5.7	39.8±3.4	60.6±2.6	1.0±0.3
	2.5mg/kg	72.8±1.1	39.3±2.2	33.0±1.9	23.7±4.9	54.8±6.0	3.4±1.8
	1.25mg/kg	72.2±3.5	39.8±7.4	32.3±9.7	29.6±2.1	63.4±5.1	1.1±0.5
Day 30	Control	63.3±4.1	35.5±2.8	28.0±5.5	39.2±2.6	72.2±11.4	1.1±0.6
	5mg/kg	68.9±1.4	33.5±2.9	35.5±3.9	33.5±3.8	77.3±8.8	1.3±0.6
	10mg/kg	65.1±5.6	29.1±3.4	36.0±4.3	38.7±2.4	68.9±9.8	2.0±0.8
	2.5mg/kg	59.6±1.6	34.3±2.8	25.3±3.1	39.6±2.3	72.0±4.3	1.9±1.1
	1.25mg/kg	69.5±2.1	33.0±2.9	36.3±3.8	34.8±4.0	79.1±2.3	0.5±0.1
Day 45	Control	56.9±1.3	28.7^{bc} ±3.0	28.0±3.6	45.2±10.0	69.8±8.3	0.3±0.0
	5mg/kg	74.3±5.9	34.8^{ab} ±3.2	39.5±4.6	34.2±6.9	70.3±5.5	1.8±0.6
	10mg/kg	81.6±6.7	25.7^{c} ±3.5	56.0±4.1	37.3±2.0	75.4±9.1	1.8±0.3
	2.5mg/kg	89.6±14.5	38.1^{ab} ±1.3	47.0±13.2	39.6±2.3	76.6±6.4	0.8±0.2
	1.25mg/kg	84.8±7.7	39.5^{a}±3.3	45.0±7.6	38.4±6.7	66.8±6.0	3.1±2.6
Day 60	Control	66.3±0.7	27.6±2.5	38.3±2.7	35.8±2.2	48.9±10.7	1.2±0.8
	5mg/kg	69.0±3.6	33.0±0.6	35.8±3.4	48.7±18.6	51.3±3.6	0.8±0.2
	10mg/kg	73.9±5.4	30.3±3.6	40.8±3.7	37.2±9.0	51.1±4.2	0.8±0.2
	2.5mg/kg	68.4±7.3	27.7±0.7	40.5±7.4	22.3±3.7	47.4±5.5	1.2±0.1
	1.25mg/kg	61.8±6.5	30.2±2.0	31.8±7.1	26.2±3.6	45.9±2.1	1.4±0.5

*(Mean ± S.E). *(N= 4, Control N=3). *Means Within the Same Column Among the Day Having Different Letters (a, b, c, …) are Significantly Different at $P < 0.05$

5. Conclusions

This study revealed that, the administration of albendazole at small repeated doses was proved to have a satisfactory efficacy and safety for the treatment and control of *H. contortus* infestation in goats.

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