International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 3 Issue 12, December – 2019, Pages: 44-50

Anthelmintics Efficacy of Albendazole, Levamisole and Ivermectin Against Gastrointestinal Nematodes (GINs) Infection in Goats in Nyala Area, South Darfur State, Sudan

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Abstracts*:The lack or reduced efficacy of some anthelmintics to control the gastrointestinal nematodes of goats was recognized as one of the greatest threats to grazing livestock production. The objective of this study was to investigate whether the perceived change of anthelmintics efficacy in goats in South Darfur State is due to treatment failure because of under-dosing or the actual development of anthelmintics resistance. Experimental treatment trials were conducted on naturally infected goats in three randomly selected goats' farms to evaluate the efficacy of three types of commonly used anthelmintic drugs; Albendazole (ABZ), Levamisole (LVE) and Ivermectin (IVM) using faecal egg count reduction test (FECRT). The efficacy of ABZ was (89%) and (97.4%), while it was (85%) and (95.7%) for LVE, in the first and second farms respectively. IVM showed high efficacy (98%) in the third farm. Mean faecal egg counts were calculated on days (0), (7), (14) and (21). ABZ and LVE showed lowest egg count (30±21.34) and (50±30.73) on day (7) respectively, while IVM showed the lowest count (15.38±10.42) on day (14). Species composition of nematodes was determined by identification of larvae recovered from faecal cultures. The study concluded that Haemonchus contortus was observed to be resistant to all three types of anthelmintic drugs. Further studies using molecular or other robust techniques are recommended to evaluate the efficacy of these drugs in the area.*

Keywords: anthelmintic, resistance, nematode, goats, Nyala, Sudan.

Introduction

Goats are considered important resources for poor communities, since they are able to survive in hardy conditions [17] Gastrointestinal Nematodes (GINs) of goats remain one of the main constraints to goats production; they cause reduction of animal productivity by reduction of body weight and milk yield [26], Parasitic worms of livestock cause diseases of major socioeconomic impact worldwide [23]. (GINs) have a worldwide distribution and more commonly affect goats in the tropical and sub- tropical regions of the world [26]. Anthelmintics resistance is the ability of worms to survive treatments that is generally effective at recommended dose rate. Anthelmintics resistance in small ruminants is probably due to the intensive and indiscriminate use of both a broad and narrow spectrum drugs for controlling nematodes [6]. Anthelmintics resistance of (GINs) of goats has become a global problem in small ruminants industry during the last three decades [28] and was considered a major threat to the future control of worm parasites of small ruminants [4]. The most commonly classes of anthelmintics used in the Sudan to control helminthes infections of ruminants including goats for more than two decades are benzimidazoles (e.g. albendazole) , imidazothiazole (e.g. levamisole) and macrocyclic lactones(e.g. Ivermectin).They have been distributed under various trade names by different companies without strategic plans for their use [1]. Recently, the only published study on anthelmintics resistance in South Darfur State was carried out by [19] who evaluated the efficacy of albendazole and reported that faecal egg count reduction (FECR) was only 77 -82%. The objective of this study was to investigate whether the perceived change of anthelmintics efficacy in goats in South Darfur State is due to treatment failure because of under-dosing or the actual development of anthelmintics resistance.

Materials and Methods

Study Area

South Darfur State is located in southwestern part of the Sudan between latitudes 8^0 30" and 13^0 30" N and longitudes 22^0 and 28^0 E, covering an area of 137800 km2. It shares international borders with Central African Republic and South Sudan from the south-west and south respectively. The climate is savannah type with sandy soil in its northern parts and clay in the southern parts. It is characterized by a very long draught season (November to June). According to the meteorological data obtained from Nyala Airport meteorological station(Meteorological Authority Weather annual report,2017),the mean rainfall throughout the rainy season was 459mm and the mean minimum and maximum temperatures were 17.30 and 41°C while the mean relative humidity ranged from 20.5% in summer to 54.8% in autumn. Two types of animal husbandry systems are practiced, the nomadic (80%) and the sedentary type of animal husbandry (20%). The goat population was estimated to be about 3,500,000 goats, [18]

Samples:

Three randomly selected goats' farms were screened for gastrointestinal nematodes (GINs) by parasitological survey. Faecal samples were collected directly from the rectum of goats in these farms to estimate and evaluate the situation of (GINs) infestation. Faecal samples were immediately transported to the laboratory in sterile labeled plastic bags for parasitological examination. Nematodes egg counts were determined by the modified McMaster Technique with saturated solution of sodium chloride as described by [5] [29].

Experiment design

The experiments were conducted on naturally infected goats in the selected goats' farms to evaluate the efficacy of anthelmintics (Albendazole, Levamisole and Ivermectin). The inclusion criterion for animal selection was the absence of anthelmintic treatment for at least 30 days. In the first farm, 30 animals were divided into three groups (each of 10 animals), where the first group was treated with Albendazole (ABZ) 2.5% oral suspension at the recommended dose of 5mg/kg body weight, the second group was treated with Levamisole (LVE) 3% at the recommended dose of 22.5mg/kg body weight, while the third group as untreated control group.

In the second farm, 36 animals were divided into three groups (each of 12 animals), where the three groups were treated respectively similar to animals in the first farm. In the third farm, 26 animals were divided into two groups, where one groups was treated with Ivermectin (IVM) injection at the recommended dose of 0.225mg/kg body weight and the other as untreated control group. Faecal samples were collected directly from the rectum of each animal pre-treatment(day o) and on days (7), (14) and (21) post treatment and deposited in clean specimen bottles in cool box then transported to the laboratory on the same day of collection to be examined. Nematode egg counts were determined using the McMaster method. Animals that did not have at least 150 nematode eggs in the pre-treatment samples were excluded from the analysis. To identify the nematode species and determine the drug resistant larvae, faecal samples were cultured in pre-treatment and post-treatment by placing them in honey jars left in dark place for 7 days at room temperature, and then the larvae were harvested using Baerman's techniques as described by Hansen and Perry [14]. The anthelmintics resistance was assessed by the faecal egg count reduction test (FECRT) guidelines available by the World Association for the Advancement of Veterinary Parasitology (WAAVP) [8]. FECRT was calculated by the following formula:- FECRT=100 × (1-[T2/C2] where T2 and C2 designate the counts after treatment, using the arithmetic means where T and C are the means for the treated and control groups [8].

Statistical analysis

Data was statistically analyzed by using SPSS, Version.20. The data obtained was organized into tables. Data obtained for egg counts were expressed as mean ± SE.

Results

In this study, the experimental treatment trial showed that the efficacy of (ABZ) was 89% and (97.4%), while the efficacy of (LVE) was (85%) and (95.7%) in the first and second farms respectively. (IVM) showed (98%) efficacy in the third farm. (GINs) were suspected resistant to those compounds. The mean faecal egg counts (EPG) of control and treated animals with ABZ, LVA& IVM were shown in Table (1) and Figure (1).

Table (1). Mean Faecal egg counts (EPG) of control and treated animals with ABZ, LVA& IVM in Nyala Area, South Darfur State

day post-treatment	Farm1	Farm2	Farm3

	Control (n = 10)	ABZ treated (n = 10)	LVE treated (n = 10)	Control (n = 12)	ABZ treated (n = 12)	LVE treated (n = 12)	Control (n = 13)	IVM treated (n = 13)
	Mean±SE							
(0)	740±130.98	710±129.49	760±96.84	491.67±202.06	541.67±85.69	725±159.13	607.69±114.61	676.92±111.03
(7)	1150±322.92	30±21.34	50±30.73	766.67±118.28	83.33±36.58	133.33±46.60	830.77±225.99	146.15±52.64
(14)	920±271.54	180±90.43	150±34.16	483.33±112.03	183.33±62.56	166.67±54.12	646.15±134.74	15.38±10.42
(21)	650±85.96	210±80.89	310±84.92	550±142.75	233.33±87.33	258.33±104.05	684.62±130.50	76.92±42.59

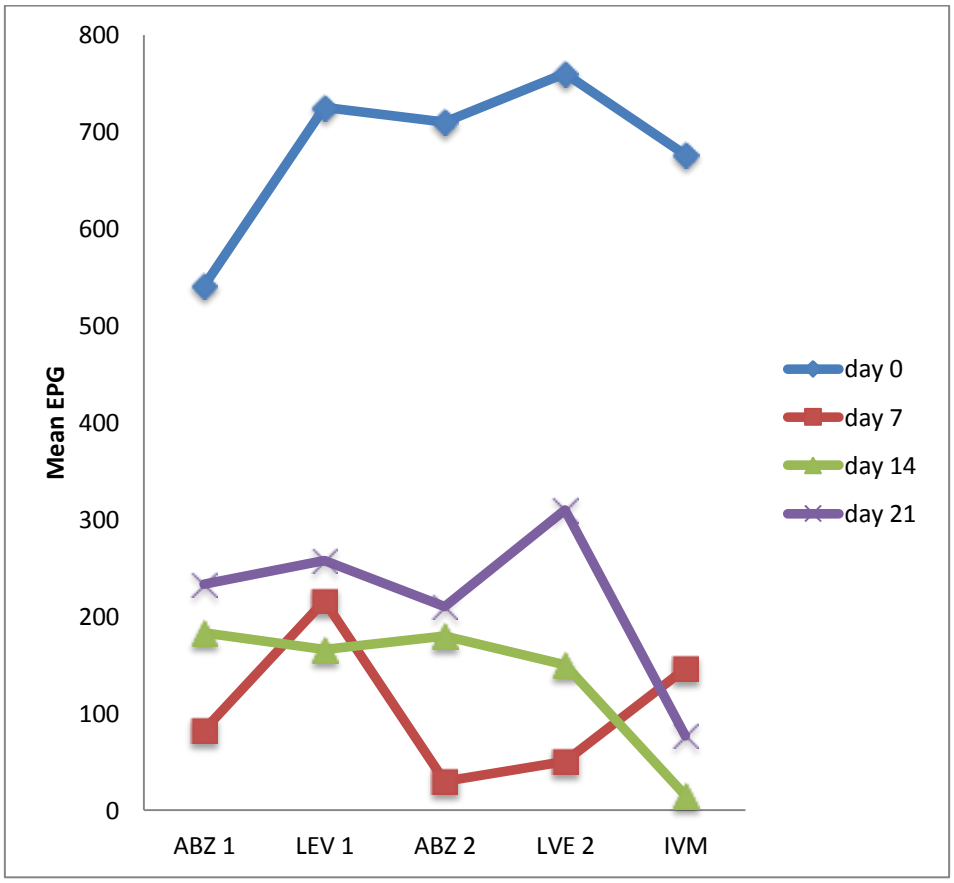

Figure (1). Mean faecal egg count(EPG) from day (0) to day (21st) post-treatment with LVA, ABZ and IVM anthelmintic drugs in goats' farm in Nyala area.

The species composition (%) of nematodes infecting dairy goats was determined before and after treatment of goats with anthelmintics. *Haemonchus contortus* was the dominant species, recorded in the three farms. The results were shown in Table (2).

Table (2). Species composition (%) of nematodes larvae recovered from faecal cultures of goats treated with anthelmintics, in three farms in Nyala Area, S.D.S.

species	Farm1(n = 30)			Farm2 (n =36)			Farm3 (n =26)	
	Pre-treatment	Post-treatment		Pre-treatment	Post-treatment		Pre-treatment	Post-treatment
		ABZ	LVA		ABZ	LVA		IVM
Haemonchus. contortus	40%	83%	80%	63%	87%	80%	73%	95%
Trichostrongylus.sp	10%	6%	9%	21%	10%	9%	14%	0%
Strongyloides papillosus	23%	11%	11%	5%	1%	3%	5%	5%
Bunostomum trigonocephalum	17%	0%	0%	0%	0%	0%	2%	0%
Oesphagostomum colmbianum	10%	0%	0%	11%	2%	8%	6%	0%

Discussion

The present study was focused on investigation of the occurrence of anthelmintic resistance in gastrointestinal helminth of goats. In this study the Broad spectrum anthelmintics ABZ and LVE revealed 89% and 85% efficacy respectively. These results were in agreement with those reported by [3], [21] and [10] who reported resistance to ABZ at different doses. In farm two, anthelmintics resistance was suspected to develop against ABZ and LVE with efficacy of 97.4% and 95.7% respectively. This result was in line with [11] in Sudanese desert sheep and was also in agreement with [24]. [23] reported similar result to ABZ and also [13] to LVE. However, [27] reported low efficacy of LVE (75%). This study showed that IVM had high efficacy (98%) which was similar to that observed by [7] and [13]. Furthermore [11], [2], [16] and [9] reported (100%) efficacy to IVM. This result was in contrary with that reported by [20], [21]. and [12], who reported low efficacy of IVM.

The differences of efficacy of the tested drugs may be attributed to the difference in treatment frequency, dosages, misuse of drugs and ways of utilization of drugs. Furthermore IVM generally is known to be more persistent in mammalian tissues than LVE and ABZ, hence more long acting [21]. Many parasitic nematodes of veterinary importance have genetic feature of resistance [15]. This study revealed variation in mean faecal egg counts (epg) between groups treated with different drugs from day (0) to day (21), ABZ, LVE and IVM revealed declined mean (epg) in day (7) and (14) and raising in day (21). This finding is similar to that observed by [1] and [21]. *Haemonchus contortus* was found resistant to all types of drugs tested in this study. This finding is similar to that reported by [19] who reported benzimidazole resistant *H. contortus* in South Darfur State. The result is also in line with [7] and [25]. The anthelmintics resistance by *H. contortus* may possibly attributed to the frequent under-dosing. [19] claimed that strongyle larvae are unlikely to survive on the ground during dry months, so treating animals during the dry season

will further decrease the refugium with the effect that the next generation of worms is only the progeny of worms surviving treatment. Another factor potentially contributing to the selection of resistant worm populations is that not all anthelmintics used in Sudan may be genuine. This may mean that they actually contain considerably less drug than they claim to contain, and this will further worsen under-dosing. [22] explained that the practice of anthelmintic treatments without proper prior estimation of animal body weight has also resulted in under-dosing, which accelerates the frequency of resistance development. The study provided evidence for the occurrence of Albendazole, Levamisole and Ivermectin resistance in goats naturally infected with GINs, especially *H. contortus* in the study area. Further studies using molecular or other robust techniques are recommended to evaluate the efficacy of these drugs in the area and adjust the effective dose to overcome the development of anthelmintic resistance.

Acknowledgements

The authors thank the goat producers for permission to collect faecal samples and conduct experimental treatment trials on their farms with their animals. The laboratory facilitation by Faculty of Veterinary Science, University of Nyala is certainly acknowledged. The funding of the research by University of Nyala is highly appreciated.

Conflict of interest

Authors declare that there is conflict of interest.

Authors contribution

All authors contributed equally

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