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Anthelmintic Efficiency of Synthetic and herbal Compounds Against Gastrointestinal Nematodes in Naturally Infected Goats

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Abstract

The present study was aimed to assess the anthelmintic resistance against gastrointestinal (GI) nematode infections in goats. GI nematode infected goats (n=120) were randomly assigned to six treated groups, and untreated control group. Six treatments were given and faecal egg count reduction (FECR) was performed. Significant differences (P<0.05) were observed between the prevalence rate of different nematodes and their FEC levels. Ten nematodes species, *Haemonchus contortus, Ostertagia, Trichostrongylus, Strongyloides, Oesophagostomum, Nematodirus, Bunostomum, Chabertia ovina, Marshallagia* and *Cooperia* were identified. The FECR for the six anthelmintics showed significant (P<0.05) reduction in eggs per gram of feces of treated groups compared to control group on 3rd, 6th, 12th and 30th days post treatment. The highest efficacy was recorded of Oxyclozanide + Oxfendazole + Cobalt + Selenium treated group at 12th and 6th days of post treatment (99.3% and 98.6% respectively); whereas Levamisole + Oxyclozanide + Selenium + Cobalt treated group showed highest efficiency (97.7%) at 30th day. In herbal anthelmintics, lowest efficacy (87.4%) was with Deedani treated group and Atreefal Deedan treated group showed high efficacy of 91.2%. The most efficacious time in all groups treated with anthelmintics was 12th and 30th day of post treatment against GI nematodes in goats. In conclusion, imported anthelmintics need efficacy testing before use and novel combination of anthelmintics holds potential to reduce the burden and resistance in nematodes for control purposes in small ruminants.

Keywords: *Anthelmintics, Gastrointestinal nematod, Goats, Herbal medicines*

Doğal Olarak Enfekte Keçilerde Gastrointestinal Nematodlara Karşı Sentetik ve Bitkisel Bileşiklerin Anthelmintik Etkinliği

Öz

Bu çalışmanın amacı keçilerde gastrointestinal (GI) nematod enfeksiyonlarına karşı antelmintik direnci değerlendirmektir. GI nematodla enfekte keçiler (n = 120) rastgele olarak altı tedavi grubuna ve tedavi edilmemiş kontrol grubuna ayrıldı. Altı tedavi grubunda verilen ve dışkıda yumurta sayısının azalması (FECR) değerlendirildi. Farklı nematodların yaygınlık oranları ile FEC seviyeleri arasında önemli farklılıklar (P<0.05) gözlendi. On nematod türü, *Haemonchus contortus, Ostertagia, Trichostrongylus, Strongyloides, Oesophagostomum, Nematodirus, Bunostomum, Chabertia ovina, Marshallagia* ve *Cooperia* identifiye edildi. Altı antelmintik için FECR, kontrol grubuna oranla tedavi edilen grupların gram dışkı başına yumurtalarında tedavi sonrası 3., 6., 12. ve 30. günlerde önemli (P<0.05) azalma gösterdi. En yüksek etkinlik Oksiklozanid + Oksfendazol + Kobalt + Selenyum ile tedavi edilen grupta tedavi sonrası sırasıyla 12. ve 6. günlerde kaydedilmiştir (%99.3 ve %98.6); Levamisol + Oksiklozanid + Selenyum + Kobalt ile tedavi edilen grup ise 30. günde en yüksek etkinliği (%97.7) göstermiştir. Bitkisel antelmintiklerde en düşük etkinlik (%87.4) Deedani ile tedavi edilen grupta olmuştur ve Atreefal Deedan ile tedavi edilen grup %91.2 ile yüksek etkinlik saptanmıştır. Keçilerde antelmintiklerle tedavi edilen tüm gruplarda en etkili zaman, GI nematodlara karşı tedavinin 12. ve 30. günleri olduğu belirlenmiştir. Sonuç olarak, ithal edilen antelmintiklerin kullanımdan önce etkinlik testine ihtiyacı vardır ve antelmintiklerin yeni kombinasyonu, küçük ruminantlarda kontrol amaçlı nematodlardaki sayı ve direnci azaltma potansiyeline sahiptir.

Anahtar sözcükler: *Anthelmintik, Gastrointestinal nematod, Keçi, Bitkisel ilaç*

INTRODUCTION

Gastrointestinal (GI) nematode infections are one of the major problems to small ruminant industry and its sustainability worldwide. It causes immense monetary losses in livestock industry including reduction in weight, poor growth, infertility, poor wool quality, reduction in meat and milk yield [1]. The animal clinical symptoms

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associated with diarrhea, anorexia, anaemia and oedema [2] Around 90% of small ruminant population in Pakistan is at risk of parasitic infections [3]. Previous studies conducted on prevalence of GI nematodes in small ruminants have been reported from 26.5% to 91.7% in different areas of Pakistan [4]. The anthelmintics are used against GI nematode infections as prophylactic measures. The efficacy of anthelmintics has greatly reduced due to emergence of resistant in nematodes and extensive usage of anthelmintics for treatment and control purpose [5]. Resistivity of internal parasites to the commonly used anthelmintics has been a challenge for goat industry [6]. Current situation needs substitutes rather than relying on conventionally used compounds, alternative strategies for control of GI nematode infections to circumvent these resistance problems [7].

For helminth control many bioactive compounds extracted from medicinal plants are of growing interest in veterinary parasitology [8]. Moreover, most of the commercially available anthelmintic compounds are imported without proper test and registration, which may have effect on their efficacy [9]. Other than this increasing resistivity in nematodes have been contributed by different factors which includes low dose, use of drug with poor efficacy, prolong exposure to same drug, low protein diet and not isolating diseased animals [10]. Keeping in view the importance of these GI nematodes, current study was conducted to evaluate the anthelmintic efficacy of synthetic and herbal medicines against GI nematodes in flocks of dairy goats in Pakistan, in which data is lacking. Therefore, present study was designed to investigate these parameters for the wider benefits of livestock farming community.

MATERIAL and METHODS

The study was carried out between May 2018 to January 2019 at three livestock experimental stations, Islamabad i.e. National Agriculture Research Centre (NARC), Said-pur and Tramari. The study was approved by ethical committee of Quaid-i-Azam University, Islamabad Pakistan. The naturally infected goats (n=120) were selected which were not subjected to any anthelmintic drugs since last 3-4 months. The goats were reared on grazing and grazing pasture was shared by the multiple goats from farmer flocks. The fecal samples were collected in polythene bags from the rectum of each animals and examined with standard parasitological procedures i.e. flotation method and McMaster technique for counting of nematodes eggs [11]. The faecal samples were cultured to cultivate the L3 larvae for gastrointestinal nematodes identification according to the criteria of Coles [12]. The selected goats were equally divided into six treatment groups (n=20 each) and one control (untreated) group.

In certain time intervals (on day 3rd, 6th, 12th and day 30th), fecal samples of each group individuals were collected and the number of eggs per gram (EPG) of feces of each goat was evaluated. All goats were weighed, and randomly assigned to 6 treatments. Following treatments were given to each group orally:

Control: Untreated (no medication given)

Group A: Albendazole (Albasym; SYMANS Pharmaceuticals (PVT) Ltd.) at 1 mL/5 kg b.w.

Group B: Oxyclozanide + Oxfendazole + Cobalt + Selenium (Punch; Selmore Pharmaceuticals) at 1 mL/5 kg body weight (b.w.)

Group C: Oxfendazole (Systamex; ICI Pakistan Ltd.) at 1 mL/5 kg b.w.

Group D: Levamisole + Oxyclozanide + Selenium + Cobalt (Nilzan Plus; ICI Pakistan Ltd.) at 1 mL/5 kg b.w.

Group E: Deedani *(Mallolus philppinensis, Embelia ribes, Piper longum)* at 5 g/head/day for 3 days

Group F: Atreefal deedan *(Emblica officianalis, Terminalia bellerica, Terminalia chebula, Embelia robusta, Ipomoea turpethum, Saussurea lappa, Mallotus philippinensis, Lupinus albus, Artemisia absinthium, Darmina turki, Cascuta reflexa, Black salt, Brassica cernua, Citrullus colocynthis, Cyprus scariosus, Zingiber officinale,* liquid glucose and sugar*)* at 10 g/5 kg b.w. once

The Fecal eggs count percent reduction (FECR) was calculated by using the following formula and interpret according to efficiency assessment by WAAVP [12].

FECR (%) = EPG pre-treatment - EPG post-treatment/EGP pre-treatment x 100

The data was log transformed to confirm the normality and analysis of variance (ANOVA) was applied using Statistics 8.1 statistical package for Windows. The level of significance was set at P value <0.05. All values are expressed as mean EPG ± SD.

RESULTS

Significant differences (P<0.05) were observed between the prevalence rate of different nematodes and their FEC levels. Among these, *Haemonchus contortus* showed higher prevalence (54%) followed by O*stertagia* (15%), *Trichostrongylus* (9%) and *Strongyloides* (9%) during the study period *(Fig. 1)*.

All the treated groups of goats (A, B, C, D, E and F) showed statistically significant (P<0.05) difference of FEC reduction in post-treatment 3rd to 30th days *(Table 1)*. The goats treated with syntactic drugs i.e. Levamisole + Oxyclozanide + Selenium + Cobalt, showed higher reduction (97.6%) in nematode egg counts followed by Oxyclozanide + Oxfendazole + Cobalt + Selenium (95.5%), Oxfendazole (94.6%) and Albendazole (93.4%). These synthetic drugs were found effective against goat nematodes. Maximum

Table 1. *Mean EPG±SD of six treated groups and untreated control of experimental goats at livestock research stations, ICT, Islamabad*

Groups	Anthelmintics	Pre-Treatment	Post Treatments			
			3rd	6th	12th	30th
Control	Untreated	4134±426.5	4178±365.2	4029±419.7	3997±497.2	4012±456.8
A	Albendazole	4225±345.1^{bc}	1062.5±107.8^{c}	362.5±83.4^{b}	272.5±72.0^{b}	265±73.0^{a}
B	Oxyclozanide + Oxfendazole + Cobalt + Selenium	3977.5±432.3^{bc}	370±50.2^{d}	67.5±18.2^{b}	37.5±16.2^{b}	170±94.3^{a}
C	Oxfendazole	4895±464.2^{ab}	702.5±113.4^{cd}	200±36.4^{b}	277.5±46.5^{b}	220±36^{a}
D	Levamisole + Oxyclozanide + Selenium + Cobalt	5660±630.7^{a}	695±131.9^{cd}	385±84.4^{b}	327.5±93.0^{b}	197.5±136^{a}
E	Deedani	2955±355.9^{c}	2025±305^{b}	1685±309^{a}	1185±289^{a}	410±174^{a}
F	Atreefal Deedan	4205±558.6^{bc}	2966.5±456.7^{a}	1976.5±365.4^{a}	1246±234.5^{a}	355±124.9^{a}
P Value		0.004*	0.000*	0.000*	0.000*	0.6464^{NS}

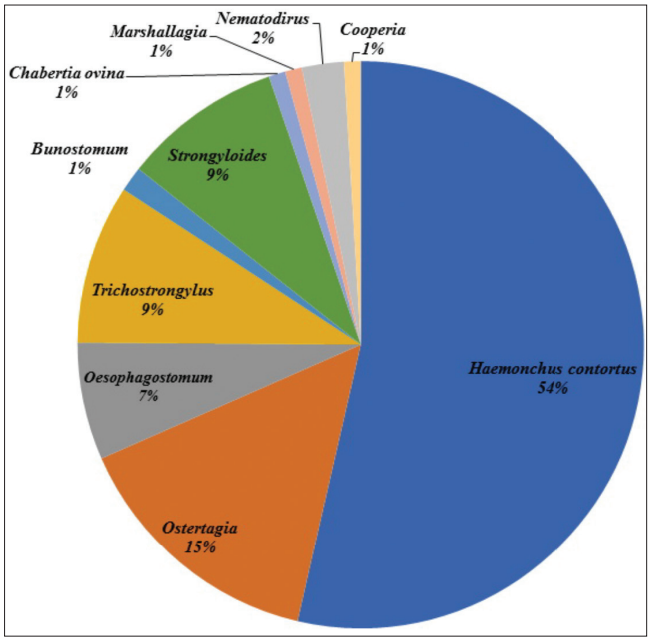

Fig 1. Prevalence (%) of gastrointestinal nematodes identified in six treated groups of goats

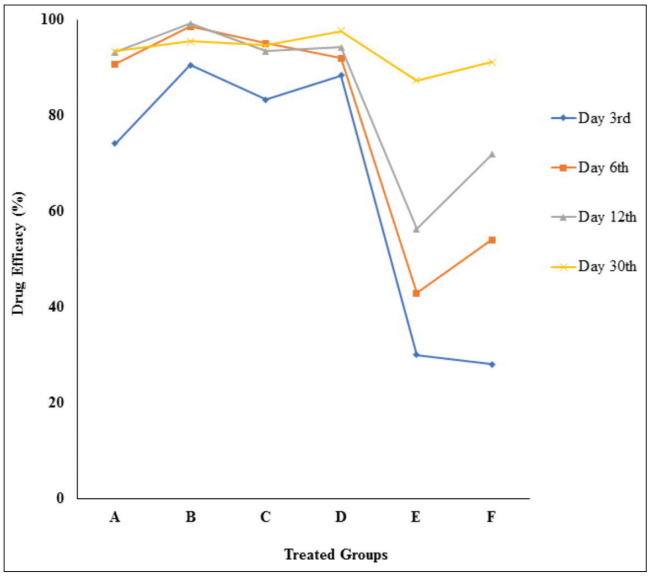

Fig 2. Anthelmintic efficacy (%) of six treated groups of goats

FECR percentage (99.27%) was recorded for group B in goats at 12th day and 6th (98.6%) after treatment. Two herbal products i.e., Atreefal deedan and Deedani also showed high percentage of egg counts reduction (91.2% and 87.4% respectively) and found effective against goat GI nematdes *(Fig. 2)*. The results indicate that all the medicines are effective and recommended as alternative to avoid problem of anthelmintics resistance in goats. However, in untreated control group regular increase in FEC % was observed during experiment.

DISCUSSION

To confirm synthetic and herbal medicines effects against GI nematodes in goats, a fully controlled experiment was performed. We used faecal egg output of goats as indicator of effect of medicines. Maximum value for FECR percentage remained 99.3% and 98.6% for Oxyclozanide + Oxfendazole + Cobalt + Selenium at day 12th and 6th respectively, which is similarly higher percentage recorded by Khan et al.[13]. Similarly, reduction in group of goats treated with Levamisole + Oxyclozanide + Selenium + Cobalt showed 97.7% reduction due to use of levamisole with combinations. Previous study recorded lower efficacy with levamisole up to 63.7% on day 14th of post-treatment [14] and up to 74.3% by Khan et al.[13]. The lower efficacy is thought due to development of resistance in parasites against levamisole [15].

The FEC reduction with albendazole observed in current study was 93.4%, which was lower percentage than 100% against GI helminthes of goats recorded in study by Bersissa et al.[16]. The lower efficay of albandaozle in current study may explained with development of resistance to this drug in goats reported in world (reference needed). The present result showed FECR with Oxfendazole was 94.7%, which is higher than 54-66% reported by Saddiqi et

al.[17]. This drug belongs to benzimidazoles group and is a broad spectrum anthelmintic, which shows higher efficacy against the nematode infection [13].

The treatment with two herbal medicines in current study showed high fecal egg count reduction in GI nematodes of goats. The efficacy of Atreefal Deedan treated group was recorded 91.2% against nematode infections in this study. Comparable results were recorded by Razzaq et al.[18] in sheep against GI helminths, which showed similarly high efficacy. The combinations of herbal products are commonly used to control parasitic infection and have significant contribution to reduce the development of resistance. In Deedani treated group, 87.4% efficacy was recorded at 30th day post treatment which is not compatible with the result of Razzaq et al.[18], who reported lower efficacy in sheep.

The combination therapy of the Oxyclozanide + Oxfendazole + Cobalt + Selenium and Levamisole + Oxyclozanide + Selenium + Cobalt and Atreefal Deedan resulted with lower resistance and effective control of nematode infections in the goats. The imported anthelmintics need efficacy testing before use to avoid resistance and overdosing of drugs to animals. Further studies on chemotherapeutic trials should be replicated for alternative drugs to avoid problem of anthelmintic resistance.

Declaration of Competing Interest

Authors declares that there is no conflict of interests

Author's Contribution

KA and AR designed the study. SR, AR and MH performed the experiment. KA, SF conducted the literature search, data analysis and manuscript preparation, advised on methods and interpretation of findings. KA reviewed the manuscript. All authors participated in the study and concur with the submission and subsequent revisions submitted by the corresponding author.

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