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Original Article

# The Effectiveness of Various Brands of the Drugs Fenbendazole and Ivermectin in Treating Horses with *Strongyle* Nematodes in Holeta, Oromia, Central Ethiopia

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**Abstract**

**Introduction:** Gastrointestinal parasites have always been a problem, and they are likely to continue to be a long-term issue that threatens the livestock industry.

**Methods:** The purpose of this study was to assess the efficacy of various fenbendazole and ivermectin brands against *Strongyle* nematodes in naturally infected horses in Holeta, central Ethiopia. A total of 120 horses were divided into three groups at random. Group 1 horses were left untreated (n=12), while group 2 horses were given five different brands of ivermectin (SG-Ivermectin 1%, Tecmectin, Ivertong, ivermectin 1%, and Ivervik 1%), and group 3 horses were given four different brands of fenbendazole (Fenbendazole, Fenacure 750 mg, Hunter 22%, and Fenacure 22%). Fecal samples were collected rectally and parasitologically processed using the modified McMaster method and fecal culture, respectively, to determine egg per gram (EPG) and *Strongyle* species. The efficacy of these anthelmintics was determined by comparing the EPG before (day 0) and after treatment using a fecal egg count reduction test (FECRT) (day 14).

**Results:** The results of this study revealed that the efficacy of ivermectin brands was superior to that of fenbendazole brands. Horses treated with Ivervik 1%, Hunter 22%, SG-Ivermectin 1%, Tecmectin, Ivertong, and Fenacure 22% had the highest reduction in fecal egg counts, followed by horses treated with fenbendazole, ivermectin 1%, and Fenacure 750 mg.

**Conclusion:** Based on the results of this field study, it can be concluded that the various brands of ivermectin and fenbendazole are effective against *Strongyle* spp. and *P. equorum* in horses.

**Keywords:** Anthelmintic efficacy, FECRT, Horse, *Parascaris equorum*, *Strongyle* spp.

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## Introduction

Equines (donkeys, mules, and horses) are used as draft animals in many parts of the world for packing, riding, carts, and agriculture. Both rural and urban transportation systems rely heavily on horses. It is the best and cheapest option in areas with underdeveloped road infrastructure, where the steep hilly terrain and narrow roads make product delivery difficult (1,2). As a result, these animals are frequently overworked and forced to graze and feed on garbage in their spare time. These can hurt their well-being and quality of life (3).

*Strongyle*, *Cyathostomess*, *Triodontophorus* spp., *Strongyloides westeri*, *Parascaris equorum*, and *Dictyocaulus arnfieldi* are the most commonly reported equine gastrointestinal worms in different parts of the country (2,4,5). *Strongyle* infections are common in equines when it comes to GIT helminths. *Strongylus vulgaris* and *Strongylus edentates* are the most common and significant GIT parasites in horses, with *S. vulgaris* infection reaching 100% in foals. *Strongylus equinus*, on the other hand, occurs only infrequently in comparison to other *Strongyle* species. These parasites are significant because they cause multiple organ damage, including circulation damage, which can be fatal in some cases. The primary goal of strongylosis management and control in horses is to reduce the number of eggs and infective L3 in pasture areas, which helps to reduce clinical and subclinical infection. Thus, anthelmintics are the most effective way to treat *Strongyle* infection, particularly virulent *S. vulgaris*. However, the effectiveness of anthelmintics has declined in recent decades due to drug resistance caused by the irrational and widespread use of these drugs (6,7).

Resistance to benzimidazole (BZ), macrocyclic lactones (ML), and tetrahydropyrimidines has resulted from the widespread use of anthelmintics (8,9). The recurrence of alleles coding for resistance when the worms are exposed to the medication determines the rate of resistance

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development. Continuous use of anthelmintics exposed more generations of nematode parasites to the medication, particularly when prepatent periods were shorter than when parasites had longer prepatent periods. This condition is almost certainly related to the advancement of anthelmintic resistance (AR) (10,11).

Anthelmintic drug resistance is defined as parasites' ability to withstand portions of medications that would normally kill parasites of similar species and stages. It is acquired and chosen because overcomers of medicines pass qualities of impediment onto their descendants. These resistance genes are initially uncommon in the population or emerge as uncommon mutations; however, as selection progresses, their prevalence in the population grows, as does the prevalence of resistant parasites (12).

Using various laboratory techniques, the level of GIT parasitic infestation in the horse can be estimated and identified (13). Fecal egg counts (FECs) and fecal egg count reduction tests (FECRTs) are the simplest and cheapest diagnostic options for estimating parasite load. They are also used to assess the efficacy of anthelmintic drugs after administration, i.e., to estimate the level of infection reduction. According to various studies, the FECRT is the gold standard test for estimating AR in vivo screening tests (13-16).

Anthelmintic selection should be more evidence-based, and instruments that illuminate levels of contamination, effective diagnosis, and anthelmintic adequacy should be powerful. As a result, the current study was carried out to evaluate the efficacy of commonly used anthelmintics in naturally infected horses from the Holeta region.

## Materials and Methods

### *Study Area*

The current study was conducted at three different locations in Holeta, Oromia Regional State, central Ethiopia, 29 km from the capital, Addis Abeba. The elevation is 2400 m above sea level at a latitude of 9° 00′ N and a longitude of 38° 30′ E. Furthermore, the area receives 1144 mm of rain per year (17).

### *Study Animals and Experimental Design*

Horses of both sexes and different age groups were used in the study, and they were kept under a strict husbandry system on communal grazing land with similar water access points. During the night, all the selected horses from each farm were kept in pens at their respective owners' homes. The horses' ages were determined based on their dentition and classified as young (between 1 and 4 years) or adults (over 5 years) (18). The horses' body condition was assessed using the guidelines (19).

For screening purposes, 200 horses were chosen from three different sites, and 200 fecal samples were collected from each one, tested for parasite infection, and individually determined for the number of eggs per gram of faces (EPG) of *Strongyle* nematodes using the McMaster technique. The helminth parasite species were identified using the technique described by Hendrix and Robinson (20). Furthermore, experimental horses were chosen based on inclusion criteria such as having not received any anthelmintic in the previous 12 weeks, sharing the same grazing area and watering point, farmers' willingness to participate, and a McMaster FEC of 300 eggs per gram (EPG) of feces (21).

### *Sample Collection, Processing, and McMaster Technique*

Following that, fecal samples were collected from each horse per rectum, and the FEC was determined based on pre- and post-treatment at days 0 and 14, respectively, following the recommendations of (22). The samples were placed in individually sealed containers, labeled with the horse identification number, stored in a cool icebox, and transported to the parasitology laboratory for a fecal examination as soon as possible. The samples were kept in the laboratory refrigerator at 4 °C until processing. The fecal samples were then examined using fecal flotation analysis and McMaster egg counting (23). The helminth species were then identified using the technique described by Hendrix and Robinson (20). The EPG was determined using the modified McMaster technique.

Furthermore, each horse's level of *Strongyle* infection was determined using *Strongyle* egg shedding or EPG of feces following the guidelines of (21) and (24), and if the egg count level was between 0-300 EPG, it was classified as low, 301-500 EPG was moderate, and 500 EPG was severe. Before administering any treatment, the different types of GIT helminth species were identified using McMaster techniques. The FECRT was used to evaluate efficacy (22).

### *Grouping of Treatment Animals*

Based on the above criteria, 120 naturally infected horses were chosen and randomly assigned to three main groups. Furthermore, 12 horses were assigned to each anthelmintic drug brand and control group. The horses in group I were not treated (n = 12). Group II horses were given ivermectin (n = 60), while group III horses were given fenbendazole (n = 48). Each horse was treated with the manufacturer's recommended dose (ivermectin, 200 mcg/kg, and fenbendazole, 7.5 mg/kg).

As a result, horses in the first category (control) were not given any anthelmintic drugs, horses in the second category (SG-Ivermectin 1%, Tecmectin, Ivertong, ivermectin 1%, and Ivervik 1%), and horses in the third category (Fenacure 750 mg, Hunter 22%, Fenacure 22%, and fenbendazole) (Supplementary file) (Figure 1).

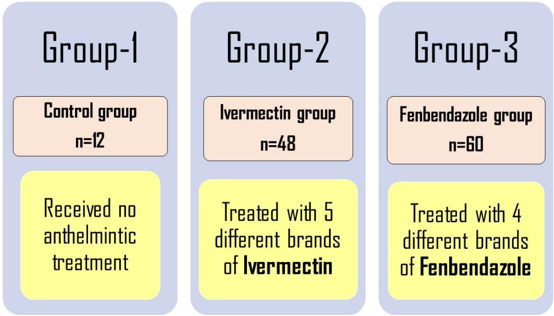


**Figure 1**. Grouping of study horses for anthelminthic efficacy

### *Data Analysis*

The collected data was saved in a Microsoft Excel 2016 spreadsheet and analyzed with STATA (version 13). The chi-square test was used with to compare the prevalence of *Strongyle* infections. The mean percentage reduction of the mean egg excreted on day 14 post-treatment was calculated using the arithmetic mean of the egg count and nematode burden (22). The FECRT was used to determine the effectiveness of deworming. Furthermore, the level of AR in the horses was assessed using the World Association for the Advancement of Veterinary Parasitology (WAAVP) guidelines. As a result, the AR cutoff values for fenbendazole and ivermectin were 90% and 95%, respectively, based on the agreed-upon cutoff value of fecal egg count reduction (FECR).

$$FECR\% = \frac{pretreatmentEPG - posttreatmentEPG}{pretreatmentEPG} * 100$$

## Results

### *Prevalence of Helminth Infections in Horses at Holeta*

The study found that *Strongyle* infections were common in the area's horses, as all 120 horses tested positive for *Strongyle* eggs. Furthermore, the study found more *Parascaris equorum* eggs (17.5%) in the study area (Table 1).

### *Horse Age and Fecal Egg Output*

The current study found that the mean number of EPGs was higher in the younger horses (less than 5 years) than in the adult horses ($\chi^2 = 0.05$, $P = 0.39$); however, there was no significant difference in the mean EPG between the two age groups. Thus, the study found that *Strongyle* nematodes were more common in the young horses than in the adults in the study area. *P. equorum*, on the other hand, had no significant ($P > 0.05$) difference in EPG between the adult and young horses (Table 2).

### *Anthelmintic Efficacy on Strongyle Species*

The current study found that all the brands of fenbendazole and ivermectin were effective against *Strongyle* infection in the horses in the study area. The horses treated with Ivervik 1%, Hunter 22%, SG-Ivermectin 1%, Tecmectin, Ivertong, and Fenacure 22% had the highest reduction in FECs, followed by the horses treated with fenbendazole, Ivermectin 1%, and Fenacure 750 mg. The FECRTs of 90.8%, 92.8%, 98.6%, 99%, 100%, 100%, 100%, 100%, 100%, and 100% were also recorded for fenbendazole, Ivermectin 1%, Fenacure 750 mg, Ivervik 1%, Hunter 22%, SG-Ivermectin 1%, Tecmectin, Ivertong, and Fenacure 22%, as shown in Table 3.

## Discussion

All 120 horses were infected with various types of *Strongyle* infection, with a prevalence of 100%. Strongylus spp. (83%) and *P. equorum* (17%) eggs were the most common nematodes parasites in the study area. A study conducted by (25) in Australia also revealed that 80% of horses were infected with GIT parasites. Similarly, (5) in Hossana and (2) in the Hawassa area reported that *Strongyle* spp. infection was common among working horses, with prevalence rates of 48.2% and 56.1%, respectively.

Additionally, research on the degree of infection that was determined using EPG revealed that 59% of the horses were severely infected by strongyles, while a mild infection of *P. equorum* (13.8%) was reported in a horse from the study sites. In line with this study, Chapman et al (26), Seyoum et al (15) in Gondar, and Fesseha et al (14) in Hossana reported a higher level of *Strongyle* species per gram of feces in infected horses. The differences in the prevalence of helminth infection in horses could be explained by egg presence or absence of intervention. In and around Holeta, there is anthelmintic treatment coverage given to the horses, according to the response we obtained from the owners during the assessment. The presence and distribution of strongylosis in horses were investigated in a field study based on the number of fecal eggs.

Most horses are treated with anthelmintic drugs, so it is believed that strongyloidiasis eggs are mainly produced by adults. Thus, the eggs raised from suppressed larvae are known to be resistant to anthelmintics. A possible justification for the high levels of EPG in young horses could be that young horses, in general, have more mucosal larval stages than older horses, i.e., 61.4% and 38.6%, respectively (27,28).

Age-related immune development showed fewer worms in older individuals than younger individuals in experimental studies using ponies of different ages (29). Lower worm fertility is another sign of immunity that may explain the age difference observed in mean EPG values. For example, the strong immunity of ponies has been shown to reduce the fertility of worms (30,31). An additional reason for the higher EPG values in younger horses ought to be that the anthelmintic remedies carried out previously were less effective in younger horses than in adult animals. This recommendation is based

**Table 1.** Frequency and Degree of Helminth Infection in the Area

| Helminths (EPG) | Total Examined | Positives | | | 95% CI | SD | Overall Prevalence |
|---|---|---|---|---|---|---|---|
| | | Degree of Infection (%) | | | | | |
| | | Mild | Moderate | Severe | | | |
| *Strongyle* egg | 108 | 0 (0) | 44 (40.7) | 64 (59.3) | 2.49-2.68 | 0.047 | 100% |
| *P. equorum* egg | | 15 (13.8) | 3 (2.8) | 1 (0.9) | 0.12- 0.32 | 0.05 | 17.5% |

**Table 2**. Age-Specific Egg Counts of *Strongyles* and *Parascaris*

| Age | No. of Examined | Prevalence (%) | | Mean (SE) EPG | |
|---|---|---|---|---|---|
| | | *Strongyle* spp. | *P. equorum* | *Strongyle* spp. | *P. equorum* |
| Young | 58 | 100 | 17.5 | 98.4(0.5) | 25(32) |
| Adult | 50 | 93 | 10.00 | 93.3(0.33) | 41.1(20) |

**Table 3.** Efficacy of Different Anthelmintic Drugs on Fecal Egg Count Reduction

| Chemical Group | Treatment Group | Examined Animals | Mean EPG | | FECR (%) | Status of Resistance |
|---|---|---|---|---|---|---|
| | | | Pre-treatment | Post-treatment | | |
| Fenbendazole | Fenbendazole | 12 | 1007 | 92 | 90.8 | Susceptible |
| | Fenacure® 750 mg | 12 | 1040 | 15 | 98.6 | Susceptible |
| | Fenacure® 22% | 12 | 8700 | 0 | 100 | Susceptible |
| | Hunter® 22% | 12 | 1400 | 0 | 100 | Susceptible |
| Ivermectins | Ivermectin® 1% | 12 | 1192 | 92 | 92.3 | Susceptible |
| | Ivervik® 1% | 12 | 1329 | 7 | 99 | Susceptible |
| | Sg-ivermectin® 1% | 12 | 1308 | 0 | 100 | Susceptible |
| | Tecmectin® | 12 | 1173 | 0 | 100 | Susceptible |
| | Ivertong® | 12 | 1600 | 0 | 100 | Susceptible |

totally on the interactions that have been found between anthelmintic drugs and horse age (27,28).

The present study aimed to evaluate the efficacy of the different brands of ivermectin and fenbendazole. The results confirmed that all the anthelmintic drugs were effective in treating *Strongyle* species. In line with the results of (29-31) and in Ethiopia and (32-35) in France, the efficacy of all the brands of ivermectin was effective against strongyle. However, some brands of Fenbendazole groups were not effective against *Strongyle* infection, as described by (36-38) in the Hossana area, Ethiopia, and other European countries (39-42), which disagrees with the current findings.

In contrast, the results of other studies have indicated the inefficacy of fenbendazole treatment, which might be due to resistance development to fenbendazole (43-46). Moreover, this might be ascribed to factors such as the quality of generic repacked or reformulated products and management and the quality of drugs (7,14), which might be responsible for these varied reports. Resistance to a benzimidazole group of anthelmintics has now been widely reported (7,34,35). The observed differences between the studies may be related to production systems and environments. In a wide range of production systems, the selectivity for the worm population is much lower because most parasites are in shelters and treatment is infrequent (35,36).

The FECRT, however, is known to be a less sensitive method for the early detection of AR, and owners and veterinarians need to consider individual cases related to effective anthelmintics for horses. Evaluation of the efficacy of the FECRT treatment should be integrated into the routine administration of anthelmintics in these areas. If AR is suspected based on a stool test or herd history, more sensitive tools and approaches should be used to investigate true herd resistance (47,48).

All brands of ivermectin and fenbendazole in horses except *P. equorum* are considered dose-limiting species and hence have a lower threshold for the development of AR (37). Resistance to anthelmintics found in any brand of fenbendazole may be related to the infrequent use of low-quality anthelmintic therapy compared with other anthelmintics and the development of drug-resistance genes.

Conversely, the lack of resistance can also be explained by the fact that the FECRT is not sensitive to the detection of resistance levels below 99% (38). Also, it detects clinical treatment levels rather than the complete elimination of parasites (22,41,42). In this regard, the recovery of *Strongyles* after anthelmintic treatment means that a small number of these parasites have escaped or are resistant to treatment, and that the animal can continue to shed eggs on these parasites. This result is in agreement with the reports of previous studies (14,39,40). This has the potential to lead to the selective existence of resistant isolates of the parasite; therefore, resistance to anthelmintics is largely genetic, which in turn poses a risk of future resistance (49,50).

## Conclusion

The results of the field test study revealed that, although the efficacy of the two chemical groups and the various brands of the two chemical groups varies, all the brands of fenbendazole and ivermectin were effective against *Strongyle* species and *P. equirum* nematode parasites. This is good for preventing the worry of AR. To assess the efficacy of anthelmintics frequently used in agroecology, management systems, and a large number of animals, national studies utilizing standardized protocols are required.

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### Authors' Contribution

**Conceptualization:** Haben Fesseha Gebremeskel, Isayas Asefa Kebede.
**Data curation:** Haben Fesseha Gebremeskel, Isayas Asefa Kebede.
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**Funding acquisition:** Haben Fesseha Gebremeskel.
**Investigation:** Haben Fesseha Gebremeskel.
**Methodology:** Haben Fesseha Gebremeskel.
**Project administration:** Haben Fesseha Gebremeskel.
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**Writing–original draft:** Haben Fesseha Gebremeskel.
**Writing–review & editing:** Haben Fesseha Gebremeskel, Isayas Asefa Kebede.

### Competing Interests

All the authors declare no competing conflict of interest.

### Consent for Publication

Not applicable.

### Data Availability Statement

The data will be provided upon request by the corresponding author.

### Ethical Approval

The best practice guidelines for veterinary care were followed during sample collection, and ethical clearance was obtained from the Institutional Review Board (IRB) of Wolaita Sodo University. The purpose of the study was well explained to the study participants, and informed consent was obtained through a verbal consent form approved by the institutional ethical board (Ref No: WSU41/22/2242).

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### Supplementary Files

Supplementary file 1 contians different brands of fenbendazole and ivermectin anthelminthic groups.

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