Prevalence and Control of Gastrointestinal and Pulmonary Helminths of Donkeys in Chipinge District, Zimbabwe

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Abstract: During the period between October 2012 and January 2013 (rainy season) individual faecal samples were collected from 105 donkeys of both sexes, aged from two months to >10 years, in Chipinge district, Zimbabwe. The samples were examined by flotation, sedimentation, and Baermann method, and nematode larvae differentiated. Thirty four donkeys were drenched with ivermectin (0.2 mg/kg body weight) and a faecal egg count reduction test performed. This study showed that 100 % of examined donkeys were infected with helminth parasites. The overall prevalence of infection was: family *Strongylidae* (strongyles) - subfamily *Strongylinae* (large strongyles) 74.3 % and subfamily *Cyathostominae* (small strongyles) 68.6 %, *Dictyocaulus arnfieldi* 67.5 %, *Gastrodiscus aegyptiacus* 51.4 %, *Parascaris equorum* 10.5 %, *Oxyuris equi* 8.6 % and *Strongyloides westeri* 1.9 %. The prevalence of helminth infection was highest in youngest animals (<2 years) and *the* most prevalent helminths were strongyles. Ivermectin *was* 100 % effective against all nematodes, except for cyathostomins, *Triodontophorus spp.* and *Parascaris equorum* in young donkeys. The present study revealed that donkeys in Chipinge district are infected with middle range of mixed helminth parasites, which are not duly considered. Therefore, regular deworming (when worm egg counts reach 200-500 per gram faeces) and management actions were recommended.

Keywords: Donkeys, *Equus asinus,* helminth parasites, ivermectin, Zimbabwe.

1. INTRODUCTION

Donkeys (*Equus asinus* Linnaeus, 1758) play an important role in farming (tillage) and in transportation (riding, pick transport or pulling cart) in rural areas [1]. They have prominent position in the agriculture system of many developing countries. Their most readily recognizable function against traction and draught in agriculture is that they have made the greatest contribution to human welfare and advancement [2, 3]. In areas where draft power is a constraint for crop cultivation, a pair of well-conditioned donkeys could be used as an alternative draught power source for secondary and primary land preparation [4, 5]. A notable increase in the use of donkeys for tillage is evident in Africa as the number of draught cattle on small farms has declined [6]. This has resulted in changing perceptions of the value of the donkeys in many rural communities that relay on animal power for crop production. Donkeys are the only alternative to oxen on many smallholder farms in Africa [6]. Despite increase in mechanization throughout the world donkeys still deserve the title of beast of burden in many developing countries, and are a source of cheap readily available transport [7]. The low level of development of road transport network and rough terrains make donkeys the most valuable, appropriate and affordable pack animals, especially under the smallholder farming system. Millions of people in the world depend on donkeys daily for transport and agriculture [3]. Also, they are available to women in cultures where men usually manage the draught animals and are therefore able to alleviate the drudgery of women's household activities, such as water and firewood carrying [2].

Donkeys have a prominent position in the agriculture system of Zimbabwe. They play a great role in the frame works of food security and social equity of high food insecure areas. This is shown by the wide spread use of donkeys in rural areas.

Although donkeys are often described as hardy and resistant animals, they do suffer a number of health problems. Some of the most important are parasitic diseases [8]. Studies have showed that donkeys are host to a wide diversity and high prevalence of helminth parasites, which can lead to disease when the animals are underfed, badly managed or overworked [2].

Nematodes (roundworms) are one of the most important and predominant parasites of equines; they represent five taxonomic families and more than 40 different species [9, 10]. Gastrointestinal parasites are the most serious health problem of donkeys in Africa, contributing to poor body condition, reduced power output, poor reproductive performance and short lifespan [11].

Donkeys, infected with gastrointestinal parasites show a rough dull-coat, weight loss, stunted-growth,

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colic, weakness, diarrhea and tail-rubbing. They die from heavy infections and even healthy looking animals die from internal damages due to gastrointestinal helminth parasites [12]. The damage to organs is caused by migration of the parasite through the various tissues. Damage to tissues requires energy and protein to repair them, which diverts energy from production. Scarring from damage reduces organ function as well [8]. Parasites cause irritation of the gastrointestinal tract. This brings mucus discharge and gut becomes more motile initiating the sore symptoms, which translates into reduced nutrient absorption and reduced production in infected animals [13]. Nematodes seek out blood supply, usually vessels in the lining of the intestine. They access protein and nutrients for their own metabolic process. Strongylid nematodes cause anemia due to their ability to remove red blood cells as well as proteins, which can lead to ill thrift in animals. However, donkeys with significant small strongyle burdens may appear healthy and it is rare to observe the type of clinical signs (diarrhea, weight loss, colic or poor condition) that are more common in horses [14]. Large numbers of internal parasites and their prevalence have been reported in different studies of donkeys in Africa including Ethiopia [11, 15-18], South Africa [2], Nigeria [19], Botswana [7], Sudan [20], Kenya, Zimbabwe, Burkina Faso, Chad and Morocco [21-23], Lesotho [24], and elsewhere [25-27]. Most of donkeys harbored a mixed parasitic infection. The most prevalent nematode species of donkeys in Africa were those of subfamily *Cyathostominae* and of *Strongylinae* [2, 15, 16] followed by a range of helminths, which are representatives of the important pathogenic parasites found in equines worldwide [16, 21].

Documentation of helminth infections of donkeys in Zimbabwe is lacking since few studies have been conducted to determine the potential losses in donkey population in the country many years ago [9, 10]. Since then, noting much has been documented concerning the welfare of donkeys. Despite the huge numbers and the increasing importance of donkeys in the economy, knowledge about the health problems affecting their welfare are limited for most parts of the country. The attention given by the development agencies and organizations to donkey has been far below to what it deserves. This might be due to the wrong perception that the donkey does not require a lot of care, that when donkey get sick, it is quick to die and the donkey's low traditional status [28]. Some anthelmintic treatments of donkeys are made bluntly before species involved in infection are identified hence are usually ineffective. A few products have specific label indications for donkeys and medicines are often administered based on dose rates optimized for use in horses. However, donkeys differ from horses in how they distribute, metabolize and excrete xenobiotics [29]. Thus, a need is felt to conduct a study regarding helminth prevalence and control to give suggestive guideline for donkey owners and veterinarians that might help to limit parasite burden of donkeys as cost effectively as possible. The specific objectives of the present study were to identify the spectrum of species and prevalence of major helminth parasites of donkeys in Chipinge district, Zimbabwe, to correlate the level of infection with the age and sex and to address anthelmintic efficacy of ivermectin (1 %, oral preparation).

2. MATERIALS AND METHODS

2.1. Study Area

This study was conducted in three areas within Chipinge district, Manicaland province, south-eastern Zimbabwe, namely, Chinyamukwakwa, Mabhiza and Checheche, during the period from October 2012 to January 2013 (rainy season).

The climate of this region is hot and the average annual rainfall is approximately 1 000 millimeters. The monthly mean maximum temperature varies between 22.3 and 30.4^0 C and the mean minimum temperature is between 4.7 and 16.8^0 C. There is a warm rainy season from November to March – April, a cool dry season from May to August and a hot, dry period from September to October. The climatic conditions are well suited to agriculture hence the use of donkeys as draught animals is widespread in this district.

2.2. Study Animals and Design

2.2.1. General Management

More than 90 % of the donkeys in the study area are owned by farmers and no special attention in terms of management is provided. They graze along the other domestic animals during the day and at night they are kraaled. Supplementary feeding is rarely given unless in years of severe drought when the farmers can provide maize stalks. Drinking water is obtained from the nearby Save river which flows throughout the year, therefore no major water shortages are experienced. Generally, no health attention is given to most of the animals. However, some donkeys had once been dewormed, and deworming history of such animals was noted.

2.2.2. Data Collected for each Animal by Observation, Examination and Owner Interaction

Ages of the donkeys were determined using an age determination chart developed based on dentition [30]. Body condition score was assessed on a scale of 1 - 5 including half scores with 1 being emaciated and 5 being obese. Body weight was weighed using a weight band for horses. A total of 105 donkeys of both sexes (59 males and 46 females), ranging in age from 2 weeks to over 10 years were included in the study. Animals were stratified according age into three groups: group A: 26 donkeys to two years of age; group B: 40 donkeys between two and six years old, and group C: 39 donkeys over six years of age. Within each age group, further divisions were made according to the sex.

2.3. Collection of Faecal Samples

A total of 105 Individual faecal samples were collected directly from the rectum of the donkeys, or sometimes fresh deposits from temperamental animals were picked up off the ground when they were seen to pass faeces. At the field, samples were stored in well labeled plastic bags and containers and kept in a portable refrigerator at 4^0 C for a day. Then they were transferred into a cooler box with ice packs and transported to the Veterinary Parasitology laboratory, University of Zimbabwe, Harare and stored at 4^0C until examination.

2.4. Examination of Faeces for Faecal Worm Egg Count

Faecal worm egg counts were performed and eggs per gram of faeces (epg) were determined using the modified McMaster method, improved [31] with a sensitivity of 50 EpG of faeces. Samples were also examined for trematode eggs using a quantitative sedimentation technique [32]. Further, a total of 83 faecal samples from donkeys of each age group were examined for lungworm larvae using the Baermann technique [31].

2.5. Culturing Nematode Larvae from Faeces and Larval Identification

For culturing infective nematode larvae, faecal samples from donkeys of each age group were pooled and cultured in an incubator at 27^0 C for seven days [31]. The larvae were recovered by the Baermann method and identified to their specific genera according to the key description of infective strongylid larvae of horses [33].

2.6. Assessing Anthelmintic Efficacy of Ivermectin Drench

On the same particular day when faecal samples were collected (day 0), a total of 34 donkeys from all age group were treated with ivermectin drench, 1 % (10 mg/ml) administered at a dose rate of 0.2 mg/kg body weight. Twenty donkeys were left untreated (control). Second faecal samples were taken 14 days post treatment and anthelmintic efficacy of ivermectin was estimated using a faecal egg count reduction test (FECRT) for helminth burden [34]. The arithmetic mean of the pre- and post-treatment egg counts and helminth burdens were calculated to determine the mean percentage reduction within each age group.

2.7. Analysis of Results

Faecal egg counts were recorded per sample in Microsoft excel and the data was analyzed for prevalence of gastrointestinal helminths (age- and sex-wise prevalence) using the Statistical Package for Social Sciences (SPSS) version 16.0. For FECRT, the mean epg were analyzed using Minitab version 16.0 to check for any significant differences between egg counts before and after treatment with ivermectin.

3. RESULTS

3.1. Coprological Examination

3.1.2. Prevalence of Helminths in Sampled Donkeys

Coprological examination of 105 sampled donkeys revealed 100 % infection with mixed helminth species parasites. The prevalence of infection was: strongyles (family *Strongylidae)* - subfamily *Strongylinae* (large strongyles) 74.3 %, and subfamily *Cyathostominae* (small strongyles) 68.6 %, *Dictyocaulus arnfieldi* 67.5 %, *Gastrodiscus aegyptiacus* 51.4 %, *Parascaris equorum* 10.5 %*, Oxyuris equi* 8.6 %*,* and *Strongyloides westeri* 1.9 %. Strongyle faecal worm egg counts ranged from 0 to 1600 eggs per gram of faeces. Majority of donkeys (55 %) were in low level of infection (mean EpG = 227 ± 49) which suggest mild strongyle infection [35]. A relatively high epg was recorded in some emaciated donkeys. The highest mean strongyle worm egg count (337 ± 101) was recorded in the less than two years old animals.

3.1.3. Age- and Sex-Wise Prevalence

The prevalence of strongyle infection was highest in the youngest, less than 2 year old donkeys ($P<0.05$), followed by mature donkeys ($P<0.05$) and lowest in

oldest over 6 year of age animals (P<0.05). The infection with *Dictyocaulus arnfieldi* was the second most prevalent in young donkeys in comparison to older donkeys (P<0.05). The same trend was also noted on prevalence of infection with *Gastrodiscus aegyptiacus* (P<0.05) and *Parascaris equorum. Oxyuris equi* and *Strongyloides westeri* were not as common as the above quoted parasites. There was no statistically significant difference between prevalence of infection with *Oxyuris equi* in youngest and oldest animals. A low prevalence of infection with *Strongyloides westeri* was recorded in this study only in old donkeys (2-6 years of age). Generally, the youngest donkeys (<2 years) were the most commonly infected with helminth parasites (Table **1**).

The results showed different prevalence of helminth infection in donkeys of both sexes (Table **2**). Strongyle infection was more prevalent in females (76.1 %) as compared to males (72.9 %), (P> 0.05). A similar trend was noted with *Parascaris quorum* infection. Conversely, the prevalence of infection with *D. arnfieldi, G. aegyptiacus* (P<0.05), *O. equi* and *S. westeri* (P>0.05) was higher in males than in females.

3.1.4. Identification of Infective Nematode Larvae from Faecal Cultures

Examination of faecal cultures enabled the differentiation of six genera and five species of infective nematode larvae (L_3) as follows: *Strongyloides westeri, Strongylus vulgaris, S. equinus, S. edentatus, Oesophagodontus* spp*., Triodontophorus* spp., Cyathostomins *(Cyathostomum* spp., *Cylicocyclus* spp., *Cylicostephanus* spp., *Cylicodontophorus* spp,) and *Trichostrongylus axei*. The variation of nematode larvae identified in faecal cultures from various age groups of donkeys demonstrated strongylin larvae (68 %), cyathostomin larvae (30 %), *Trichostrongylus axei* larvae (2 %) in youngest donkeys (<2 years).

The infective larvae recovered from ova culture from 2-6 years old donkeys were: strongylin (52 %), cyathostomin (32 %), *Strongyloides westeri* (4 %) and *Trichostrongylus axei* (12 %), whereas only strongylin

Table 1: Age-Wise Prevalence of Different Helminth Parasites in Donkeys

Helminths	Age group	Total number of samples	Positive samples	Negative samples	Prevalence (%)
Strongyles	<2 years	26	24	2	92.3
	2-6 years	40	33	7	82.5
	>6 years	39	21	18	53.8
Dictyocaulus arnfieldi	<2 years	14	12	2	85.7
	2-6 years	38	27	11	71.1
	>6 years	31	17	14	54.8
Gastrodiscus aegyptiacus	<2 years	26	19	7	73.1
	2-6 years	40	23	17	57.5
	>6 years	39	12	27	30.8
Parascaris equorum	<2 years	26	5	21	19.2
	2-6 years	40	5	35	12.5
	>6 years	39	1	38	2.6
Oxyuris equi	<2 years	26	3	23	11.5
	2-6 years	40	1	39	2.5
	>6 years	39	5	34	12.8
Strongyloides westeri	<2 years	26	0	26	0.0
	2-6 years	40	2	38	5.0
	>6 years	39	0	39	0.0

Table 2: Sex-Wise Prevalence of Different Helminth Parasites in Donkeys

Helminths	Sex of donkeys	Total number of samples	Positive	Negative	Prevalence (%)
			samples		
Strongyles	Female	46	35	11	76.1
	Male	59	43	16	72.9
D. arnfieldi	Female	46	23	23	50.0
	Male	37	33	4	89.2
G. aegyptiacus	Female	46	17	29	37.0
	Male	59	37	22	62.7
P. equorum	Female	46	6	40	13.0
	Male	59	5	54	8.5
O. equi	Female	46	3	43	6.5
	Male	59	6	53	10.2
S. westeri	Female	46	0	46	0.0
	Male	59	2	57	3.4

(62 %) and cyathostomin larvae (38 %) were identified from faecal culture from oldest donkeys (> 6 years of age).

3.2. Anthelmintic Efficacy of Ivermectin

The faecal egg count reduction test revealed that ivermectin is effective in different degree against most common gastrointestinal nematode parasites in the studded population of donkeys (Table **3**). Species of genus *Strongylus* were the most susceptible (100 %) to ivermectin in all age groups of animals (P<0.05). Drug resistance to ivermectin was noted in *Triodontophorus* spp (72 %) (P>0.05), *Parascaris equorum* (72 %) (P>0.05) and cyathostomins (39 %) (P>0.05) only in donkeys less than 2 years of age, which were relatively more intensively infected by these parasites in comparison with older animals. *Gastrodiscus aegyptiacus*, a common intestinal fluke of equines in this country, was unaffected by ivermectin (P=1.000). Control donkeys, which were not treated with ivermectin showed negative reduction of faecal egg count, whereas those treated with ivermectin had positive reduction of faecal egg count, as it is indicated on Table **3**.

4. DISCUSSION

In the present study, an overall of 100 % prevalence of mixed gastrointestinal and lung helminth infections in donkeys of Chipinge district was obtained. The higher parasite prevalence observed in donkeys in the current study is in line of agreement with results of other workers [6, 15, 18, 23, 36], who reported 92.8 % to 100 % prevalence. The difference among these findings and those from different areas might be due to variation in climatic conditions, management system, sample size and sampling method differences [6].

The average prevalence of large strongyle infection in donkeys was 74.3 %, which was highest among the gastrointestinal parasites. Similar studies conducted in

Table 3: Reduction of Faecal Egg Count after Treatment of Donkeys with Ivermectin

Helminths	Egg count reduction (%) in different age groups donkeys							
	<2 years	P value	2-6 years	P value	>6 years	P value	Control	P value
	(n=17)		(n=10)		(n=7)		(n=20)	
Strongylus spp.	100	0.009	100	0.009	100	0.003	-14	1.200
Triodontophorus spp.	72	0.200	100	0.003	100	0.004	-50	2.100
Cyathostomins	39	0.600	100	0.004	100	0.034	-106	3.800
P. equorum	72	0.200	100	0.073	-	-	-37	1.600
O. equi	100	0.030	-	-	-	-	-215	6.700
G. aegyptiacus	-10	1.000	-3	0.900	-11	1.100	-210	6.400

different parts of Africa indicated similar or higher prevalence [15, 16, 18, 37, 38]. Strongyles have largest numbers of genera and species so their percentages commonly represented (75 % - 100 %) of whole nematode infections [39].

Donkeys are susceptible to large strongyle species [14, 16]. In this study most of donkeys were infected with *Strongylus vulgaris, S. equinus, S. edentatus, Oesophagodontus* spp. and *Triodontophorus* spp. which were in consistence with other findings [2, 7, 15, 16]. *Strongylus vulgaris* was the most abundant and prevalent large strongyle species. Early reports [9, 10] from Zimbabwe demonstrated that donkeys harbored only *Strongylus vulgaris* and *S. equinus, S. edentatus* and *S. asini* are recorded in South Africa. The exact reason for the presence of these species in donkeys in Chipinge district is not known. It could be suggested that climatic conditions, contact of donkeys with other equine species and lack of host specificity of parasites may account for the presence of some of them [18]. It may also be attributed to lack of anthelmintic medication and/or immune-suppression due to stress and malnutrition.

Adult large strongyles parasitize in the large intestine, but the larval stages are migratory in the different internal organs in the region of 6 – 12 months. The pathogenicity of large strongyles is related to the migratory pattern of the larvae and tissue and blood feeding of the adults. Large strongyle infections remain a real threat to the health of working donkeys in developing regions were administration of anthelmintics is erratic or absent [16].

Cyathostomins are one of the most common parasite nematodes that affect donkeys [2, 14]. Small strongyle infection was also highly prevalent in donkeys in Chipinge district. This infection has previously been recorded from donkeys in Zimbabwe [9, 22] and elsewhere [2, 15, 16, 18, 40, 41]. The infections of small strongyles and *Strongylus vulgaris* are acquired mainly during the rainy season. Heavy populations of parasites may build up by the end of the rainy season. The small strongyles in Zimbabwe survive unfavorable dry winter mainly as adult worms and not as inhibited larvae [9, 10, 22, 23]. They play an important role in the epidemiology and pathogenicity of this infection [22]. Encysted larvae can emerge synchronously and cause sudden onset weight loss, stomach pain and, sometimes diarrhea and anemia. Donkeys do appear to remain “healthy” when high levels of small strongyles are present, as long as they are not nutritionally compromised or overworked [42, 43]. A study [44] showed significant increases in body condition score in donkeys that received anthelmintic treatment. Due to the complex taxonomy and difficulty in the identification of cyathostomins, few workers have identified these parasites to the species level in donkeys [2, 9]. In the present study the cyathostomins were identified up to genus level. However, the finding of 17 cyathostomin species in Ethiopian donkeys accounted for 34 % of the over 50 valid species that are recognized in equines [45].

Prevalence of strongyles between age groups was found to be significantly different. Strongyle infections tended to be higher in younger donkeys (age <2 years), however, mature (age 2-6 years) and old (> 6 years) donkeys can harbor substantial infection and therefore contribute substantially to pasture contamination. These findings are in contrary to the results of studies in Ethiopia [18], but they are in agreement with others [15, 25]. Young donkeys had greater faecal egg counts compared to the older animals. This difference is most likely due to a less developed immunity in youngest as result of limited exposure or immaturity of the immune system itself. Older donkeys are most likely to have been exposed many times to infection and developed immunity to the parasites. There was no statistical significant difference in prevalence of strongyle infections between sexes that is in line with other results [18].

Dictyocaulus arnfieldi (lungworm) infection was very common in donkeys of the area of study (67.5 %) as that recorded in Sudan (70.5 %) [41], and much higher compared with that in Nigeria [19] and Ethiopia [15, 16]. The age-wise prevalence follows that of strongyles. It was highest in youngest animals, and lowest in oldest group. The sex-wise prevalence followed the tendency to that of other helminth parasites except of *Strongylidae* and *Parascaris equorum.* I*t* was significantly higher in females than in males. No obvious clinical signs of respiratory infection (coughing, nasal discharges) were present in spite of the high prevalence that was noted in this study. Donkeys most at risk of developing disease related to high infection intensity are geriatric and/or immunocompromised [14]. *D. arnfieldi* in donkeys, in contrast to mature horses, is permissive of the entire life cycle. Co-grazing horses are more likely to develop clinical signs, so care must be taken to control for lungworm in resided donkeys.

The prevalence of *Gastrodiscus aegyptiacus* (intestinal fluke) in present study was 51.4 % in

donkeys. The finding of current study was much higher than previously reported in Zimbabwe (in 2/14 animals) [22], and Ethiopia [15, 16, 18], but less than that which was reported in donkeys (63.0 %) in South Africa [46]. The higher prevalence in this study may be due to the difference in geographical location and climatic conditions of the area from the other study areas. This study area is comfortable for the snail population, the intermediate host of intestinal fluke as in South Africa [47]. The pathogenicity of *G. aegyptiacus* to its definitive hosts has not yet been satisfactorily established, but it is commonly believed that it is relatively unimportant. However, reports from Ethiopia [48], South Africa [49], and Zimbabwe [50] concluded that it can be pathogenic to horses and may even lead to acute colic and death.

The prevalence of *Parascaris equorum* (horse ascarid) was 10.5 % in donkeys in the present study. It is in agreement with the reports from Sudan (10.7 %) [41], Turkey (9.8 %) [27] and India (14.93 %) [24]. The reported prevalence from Ethiopia [11, 15, 16, 18, 36, 51, 52], Burkina Faso and Zimbabwe [23] is higher and disagrees with this study. The difference in prevalence from different reports in developing countries is somewhat conflicting and this could be due to compromised immune response related to concurrent disease, but it worthy of further investigation [11]. A relatively high prevalence of *Parascaris equorum* in the youngest donkeys was noted in this study which is in agreement with the general opinion that *P. equorum* is a parasite of young horses [53].Horses develop excellent acquired immunity to this infection, resulting in infections being limited to sucklings, weanlings and yearlings and being observed only occasionally in horses older than 2 years [54]. The relative high prevalence of *P. equorum* in mature donkeys of Chipinge district could be attributed to an inability to develop immunity at a young age as a foal or they may have been immunocompromised as adult. This is in agreement with other reports [10, 14, 55] that in donkeys, mature animals harbor patent infection. Hence, it would therefore appear that, it is common to find ascarids in adult donkeys. Otherwise healthy mature donkeys may be important source of pasture contamination and, when compromised through overwork, ill health or poor nutrition may be at risk of disease. Prevalence of ascarids was higher in females than males like infection with strongyles, which could be due to the fact that females might have lower immunity because of gestation, lactation and oestrus.

Oxyuris equi (pinworm) (8.6 %) was one of the least prevalent in donkeys in the current study. Previously this parasite has been found in high numbers in some donkeys in Zimbabwe [22] but now it is not very common as the cyathostomins [24]. Recorded prevalence of *O. equi* in *donkeys* of Chipinge district was higher than in Ethiopia [15, 16, 18], Botswana [7] and Turkey [27]. In this study the highest prevalence was determined in youngest and oldest groups of animals, as well as in males in comparison with females. The highest prevalence might be due to the effect of the climatic conditions in the present study area, the standard of stable hygiene and more likely the method of examination. Eggs are rarely found on routine faecal flotation examinations, but by removing of egg clumps deposited by adult females on the perinea skin [32]. It is worth noting, that this parasite produces anal irritation and intense anal itching by the egg laying activities of the female worms that may result in rubbing and scratching of the rear region, restlessness, improper feeding and loss of condition.

Strongyloides westeri (threadworm) showed the lowest prevalence in this study (1.9 %) and the parasite was found only in mail donkeys aging 2-6 years. This species was not presented in other countries [7, 18], had nearly the same level [19, 25, 41, 46] or reached a high incidence rate in some other areas [10, 15, 16, 20, 38]. It has been reported that infections of *S. westeri* in foals usually disappear completely between 15-25 weeks of age [56]. The prevalence of *Strongyloides westeri* in adult donkeys of the present study corroborates similar findings in adult donkeys [25, 46] in other African countries and Zimbabwe [10].

In this study, donkeys were infected by a range of helminth species with moderate prevalence. The presence of polyparasitism was an indication that favorable environmental conditions for infection, survival and perpetuation of the parasites exist in Chipinge district. However, the information on the different species of donkey helminth parasites is still limited. A detailed study of the epidemiology, pathogenicity, medication and control strategies, and the immune response of donkeys to the infection of each parasite species is highly recommended.

The assessment of anthelmintic efficacy of ivermectin (oral drench) against the internal parasites of donkeys using a faecal egg count reduction test revealed a high susceptibility of large strongyles to it in all age groups of studied animals. The treatment with ivermectin and other macrocyclic lactones led to substantial reduction in the prevalence of large strongyle infection in managed equines as these

anthelmintics are highly effective against the pathogenic larvae [14]. Although these parasites have become rare in horses in most of developing world [57] they remain a threat for donkeys in developing countries where administration of macrocyclic lactones is absent [16]. No information on anthelmintic resistance have been reported in large strongyles. Cyathostomins, *Parascaris equorum* and *Triodontophorus* spp. were resistant (P>0.05) against ivermectin only in young donkeys. In this study the results of cyathostomin resistance are in contrary with other findings [58] in horses treated with ivermectin. However, it was found out that the counts of small strongyle eggs per gram faeces were returning quicker than initially after ivermectin and moxidectin treatment of equines [59] which is the case in this study. It is documented that the efficacy of ivermectin against encysted helminth stages in the intestinal walls of the animals is low. The 4th stage encysted larvae re-emerged and re-infect once the therapeutic levels of the drug in the body have waned. The resistance shown in this study could have occurred as a result of the sharing of communal pastures with other donkeys, sometimes new for the area. However, the efficacy of the ivermectin was shown by the fact that all controls had a negative faecal egg count reduction as compared to the treated which had positive faecal egg count reduction.

5. CONCLUSION AND RECOMMENDATIONS

This study revealed occurrence of mixed gastrointestinal and lung parasite infection in donkeys in Chipinge district. The identified eggs/larvae types indicated strongyles, *Dictyocaulus arnfieldi, Gastrodiscus aegyptiacus, Parascaris equorum, Oxyuris equi* and *Strongyloides westeri.* Strongyles, *Dictyocaulus* and *Gastrodiscus* were most common parasites with high prevalence in the area of study, so that greater importance should be given to this situation. Donkeys of different age groups in the present study had significantly different prevalence of helminth parasites. Youngest donkeys generally had a highest prevalence of strongyles, *Dictyocaulus, Gastrodiscus and Parascaris.* The level of infection with these parasites was also high in older animals, which is a risk factor for occurrence of gastrointestinal and lung parasitism in the working donkeys kept at poor feeding management system. Generally, ivermectin (oral form) was effective against nematode helminths in donkeys, but a resistance was noted in *Triodontophorus* spp. *Parascaris equorum* and cyathostomins in donkeys less than two years old.

In study area very little attention has thus far been paid to the parasites of donkeys. The presence of several species of helminths in the same animal as revealed in this study suggested that it is highly likely that these parasites might exert pathological effects on donkeys. The animals are further subjected to the stress of poor nutrition and hard work which aid in the precipitation of infection. Based on the above conclusion the following recommendations were forwarded:

1. Regular monitoring faecal worm egg counts of donkeys, to control level of helminth infection and to check the efficacy of deworming. Submit fresh dung samples to the vet for worm egg counts to be done, (once or two times per year and 10 – 14 days after deworming), which will give a good indication of worm infection level, need for deworming and drug resistance.

2. Deworming of infected donkeys when worm egg counts reach 200-500 per gram faeces with an effective anthelmintic drug.

3. Donkeys would benefit from anthelmintic treatment during the dry season when they are subjected to poor nutrition.

4. Implementing appropriate housing and feeding management system for donkeys so that the animals are in good body condition in order to keep some level of resistance against helminth infections and donkeys to be utilized more efficiently.

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