BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF ANIMAL SCIENCE

THE PREVALENCE OF GASTROINTESTINAL PARASITES IN GOATS IN MUMHURWI

BY

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A RESEARCH PROJECT SUBMITTED TO DEPARTMENT OF ANIMAL SCIENCE, BINDURA UNIVERSITY OF SCIENCE EDUCATION, IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE HONORS DEGREE IN ANIMAL SCIENCE AND TECHNOLOGY.

DECEMBER 2022

APPROVAL PAGE

The undersigned confirm that, they have read and recommended this research project entitled, The prevalence of gastrointestinal parasites in goats in Mumhurwi, submitted to Bindura University of Science Education by **ESLYNE MUCHENA (B1953849**) in partial fulfillment of the Honours Degree in Animal Science and Technology.

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ABSTRACT

This study was conducted in Mumhurwi, Bindura District, particularly in small-holder farmersto determine the prevalence of gastrointestinal parasites in goats. The study was conducted from three villages in Mumhurwi namely Mapuranga, Nyamadzawo and Ruvanika. The researcher conducted this study because the researcher has come across many cases of goats showing signs of diarrhea, anemia and loss of body weight. The methodology used in this study is explanation research using laboratory techniques to study current prevalence cases of gastro-intestinal parasite of goats in Mumhurwi, Zimbabwe. The research collected fecal samples from 55 Mashona goats and transported the samples to the laboratory for examination. Each sample was labeled for easy identification. Researchers made examination of fecal using Direct Smear Fecal Exam and then used Light microscope for identification of parasite eggs and oocytes, with 10× or 40× objective magnification. The study revealed an overall prevalence of gastrointestinal parasites in Mashona goats to be 72.72%, this implies that 40 samples were positive and 15 samples were negative of gastrointestinal parasites. The most prevalent parasites recorded in all the 40 positive cases were Coccidia and Haemonchus concontus with Coccidia (Eimeria spp) having 25 (45.5%) and Haemonchus 14 (25.45%). Researcher recommends making seasonal deworming to Mashona goats in small holders which will reduce the prevalence and incidence of gastro-intestinal parasites in goats.

Keywords- Mumhurwi, gastrointestinal parasites, goats, prevalence

DEDICATION

This piece of work is dedicated to my family and friends for the support they gave me towards my degree program and for being my source of inspiration at all times. I am forever grateful and I pray that I will retain the favor.

ACKNOWLEDGEMENT

Firstly, I would like to thank God Almighty for the gift of life, divine guidance and the strength to finish my thesis. My sincere appreciation and gratitude also goes to Dr Chatikobo my supervisor for his tremendous support towards this research. Special thanks goes to all my lecturers for the knowledge they impacted on me. Last but not least, my appreciation goes to my family and friends for their moral and financial support throughout my academic journey.

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BUSE Bindura University of Science Education

FAO Food and Agriculture Organization of the United Nations

GIP Gastro-intestinal Parasites

WHO World Health Organization

CHAPTER 1

1. INTRODUCTION

Goats are among the earliest domesticated animals and have been associated to humans for at least 10,000 years (Monteiro et al., 2018). Due to their adaptability to different environmental and climatic conditions, they are dispersed all over the world (Mahmoud, 2010). Goats are the most beneficial animals in the world, providing meat, milk, fiber, fertilizer, and draft power (Sinn and Rudenberg, 2008). Over 1,153 breeds of goats (FAO, 2007) exist on our planet, from humid tropical rain forests to dry hot desert regions and cold, hypoxic high-altitude regions (Hirst, 2017). They are different from one another by their size, shape and production types. Goats survive and reproduce under a variety of extreme conditions, making them an ideal species for resource-poor farmers.

Small livestock, especially goats, is vital for the livelihood of many rural resource-poor smallholder farmers and is often the only asset they possess. Goats significantly contribute to improving nutrition, providing food with high quality nutrients and micronutrients. Goats generate income and savings, especially for women, enhancing their capacity to cope with economic emergencies and reducing debt. During times of crisis, goats play an important role as 'mobile' food assets (International Goat Association, 2014). Goats are often the "sacrificial" animal during religious festivals and social ceremonies. Goat keeping has proved to be instrumental in achieving the Sustainable Development Goals.

The current global goat population according to the Food and Agriculture Organization (FAO) is 1.002 billion (FAOSTAT, 2018), which has doubled in the last thirty years. The goat population, which was below 400 million during the early 1960s when FAO started collecting data, has increased to over 1 billion in 2018. Zimbabwe has around 3,4 million goats, with the most common breeds being the Matebele and Mashona that are reared on a subsistence basis. The goat population has increased with the increase in human population,

probably due to resource poor smallholder farmers finding it suitable for diversifying sources of their income and nutrition.

Gastrointestinal parasitic infections in goats are of much economic importance because small ruminants' rearing has been a major source of income especially to the marginal farmers of the country. Recurring losses in productivity due to widely prevalent parasitic infection is an important and common problem for small ruminant production in most parts of the world. Parasitic diseases are involved among the major constraints of poor goat health and productivity and might result in weight losses of 6–12 kg per animal per year and 40% mortality rates in goat herd (Githigia et al. 2001). Infections of gastrointestinal helminths and enteric protozoan parasites among goats are implicated in serious economic losses including morbidity and mortality, mostly for young animals (Badran et al. 2012).

1.1 PROBLEM STATEMENT

Goats are highly susceptible to gastrointestinal parasites (GIPs) (Mandonnet et al, 2001) due to their lower innate immune response against specific helminths as a result of their evolution and the nomadic nature of goat husbandry. In this regard, among the production constraints of goats that contribute to production losses in rural communities, GIPs constitute a major share. The challenge is, however, much more severe in tropical countries due to favorable environmental conditions for GIP transmission (Zeryen. T, 2012), poor nutrition of the host animals, and poor sanitation in rural areas. This makes controlling GIPs the most important health issue in goats of all ages. The prevalence of GIP infection in livestock varies according to their existing management practices, season of the year, animal age (Zvinorova P.I et al, 2016) and sex.

1.2 JUSTIFICATION

Gastrointestinal parasitism is associated with economic losses, lowered productivity, reduced animal performance and mortality. This study takes into account parasites of economic importance and ways to eliminate these parasites. This paper also looks at environmental factors which include agro-ecological conditions, animal husbandry practices such as

housing system, deworming intervals and pasture management (Ratanapob et al, 2012). These environmental factors largely determine the type, incidence and severity of various parasitic diseases (Badran et al, 2012). Parasite species and intensity of the worm population have an effect on the development of gastrointestinal parasitic infections (Tariq et at, 2010).

1.3 OBJECTIVES

The main objective of the study was to estimate the prevalence of gastrointestinal parasites in goats and to access morbidity and mortality rates among small scale goat producers.

The specific objectives of the study were:

a. To determine prevalence of gastrointestinal parasites in relation to goats' age
b. To determine prevalence of gastrointestinal parasites in relation to goats' sex

1.4 HYPOTHESES

Ho- there is no significant association between the prevalence of gastrointestinal parasites and the goats' sex.

Ho- there is no significant association between the prevalence of gastrointestinal parasites and the goats' age.

CHAPTER 2

2:0 Literature Review

2.1 Background

A goat is a hardy domesticated ruminant mammal that has backward-curving horns and (in the male) a beard and is noted for its lively behavior. Its scientific name is Capra aegagrus hircus (Hirst, 2008).It was domesticated from the wild goat (C. aegagrus). The goat is a member of the animal family Bovidae and the tribe Caprini, meaning it is closely related to the sheep. Goats are among the earliest animals domesticated by humans (Zeder and Hesse, 2000). The most recent

genetic analysis (Naderi et al, 2008) confirms the archaeological evidence that the wild bezoar ibex of the Zagros Mountains is the likely original ancestor of probably all domestic goats today.

There are over 300 distinct breeds of goat (Hirst, 2008). Common breeds in Zimbabwe include the Matabele goats, Mashona goats, Boer goats and the Kalahari goats.Each recognized breed of goat has specific weight ranges, which vary from over 140 kg for bucks of larger breeds such as the Boer, to 20 to 27 kg for smaller goat does. Within each breed, different strains or bloodlines may have different recognized sizes. At the bottom of the size range are miniature breeds such as the African Pygmy, which stand 41 to 58 cm (16 to 23 in) at the shoulder as adults (Belanger and Bredesen, 2010).Life expectancy for goats is between 15 and 18 years (William, 1956). An instance of a goat reaching the age of 24 has been reported. Several factors can reduce this average expectancy; problems during kidding can lower a doe's expected life span to 10 or 11, and stresses of going into rut can lower a buck's expected life span to eight to 10 years.

While goats are generally considered hardy animals and in many situations receive little medical care, they are subject to a number of diseases. Among the conditions affecting goats are respiratory diseases including pneumonia, foot rot, internal parasites, pregnancy toxicosis, and feed toxicity. Feed toxicity can vary based on breed and location. Certain foreign fruits and vegetables can be toxic to different breeds of goats. Goats can become infected with various viral and bacterial diseases, such as foot-and-mouth disease, caprine arthritis encephalitis, caseous lymphadenitis, pinkeye, mastitis, and pseudorabies. They can transmit a number of zoonotic diseases to people, such as tuberculosis, brucellosis, Q fever, and rabies.

2:1 Parasites

Parasites are organisms which derive sustenance from its host while causing it harm (Poulin, 2007). They have evolved to integrate their life cycle with that of their host species. The two main groups of parasites are the micro parasites and the macro parasites. Protozoa are micro parasites as they multiply within the host. Macro parasites on the other hand, establish themselves in or on the host but produce eggs or larvae which are dispersed to the environment. Macro parasites include helminths and arthropods. The number of macro parasites in the body reflects the number which invaded the animal.While goats are generally considered hardy animals and in many situations receive little medical care, they are subject to a number of

diseases. Among the conditions affecting goats are respiratory diseases including pneumonia, foot rot, pregnancy toxicosis, feed toxicity and internal parasites.

2:1:1 Parasite Life Cycle

Goats ingest parasites while grazing pasture or in the confines of the goat pen. The adult worm lives in the host's gastrointestinal tract and lays large numbers of eggs that the goat excretes in the manure. The eggs then develop and hatch. This typically takes from six to 14 days, depending on weather conditions. Ideal conditions would be 50 degrees F or warmer and humid. The larvae need warm and wet conditions to develop, which is why parasite infections are more of a problem in the spring. However, we do see problems with parasites during other times of the year when the weather permits. Cold winter weather conditions, as well as hot and dry summers, are detrimental to the parasite life cycle. Direct sunlight and temperatures above 155 degrees F will kill larvae in the fecal pellet.

Once the larvae hatch, they develop through three larval stages and then must be ingested by the goats to complete the life cycle. During the first larval stage, the larvae eat bacteria found in the feces, grow and then molt, or shed their skin like a snake. The larvae then enter the second stage. Larvae in the first and second (L-1 and L-2) stages are susceptible to dying from heat and low humidity (Lok and Unnasch, 2013). During the L-2 stage the larvae continue to eat bacteria in the feces and grow to the L-3 stage. However, the larvae do not shed their skin at the L-3 stage, but instead have two layers that protect them from heat and low humidity. Larvae must be consumed by goats in the L-3 stage in order to continue their life cycle. During this stage, the larvae can survive on stored reserves for 30 to 60 days in hot weather and 120 to 240 days in cool weather.

The larvae are not very mobile and are highly concentrated in the area close to the ground. The larvae generally use rain or dew to move up the blades of grass in the pasture. They are generally found on the forage in the first one to two inches above the soil. Therefore, if goats are forced to graze short pastures, they can ingest large numbers of larvae very quickly. For this reason, animals should be moved out of a pasture when the forage has been grazed to four inches in height. Once the goats ingest the larvae, the larvae continue to develop to the L-4 stage and then molt to the L-5 stage. At this final stage, the larvae develop ovaries and a uterus. They then molt to adults with the ability to lay thousands of eggs per day.

During periods of the year when the weather does not support the parasite life cycle, parasites may enter an arrested, or dormant, state. Dormant larvae are not affected by most deworming products so treatment timing can be important. Coccidia differ from most parasites because they can infect goats directly from an egg-like stage, called an oocyst. Goats can be infected by oocysts while grazing or in the barn. Coccidiosis is a major cause of poor feed efficiency and poor growth (https://www.britishgoatsociety.com/). Coccidia can be present in all ages of goats but affects younger animals the most. Goats often exhibit clinical symptoms of coccidiosis when stressed. Stressful situations could include handling, weaning, or changing weather conditions.

2:2 Gastrointestinal Parasites

When the gastrointestinal tract, most often the intestine, is infected by a parasite, this is often referred to as gastrointestinal parasites. If not treated some parasites may linger for many years and cause long term problems.Types of gastrointestinal parasites found in goats are nematodes, cestodes and coccidian (Christensen, 2005).

2:2:1 Nematodes

These are by far the most important endoparasites of the goat, the majority of which live in the stomach and gut. They belong to the genera Ostertagia (Telodorsagia), Cooperia, Nematodirus, Oesophagostomum and Trichostrongylus and Haemonchus.With the exception of Haemonchus the main presenting signs in a goat with gut roundworm infestation are diarrhea and weight loss. Haemonchus contortus (Barbers Pole worm) however spends most of its time in the abomasum where it sucks blood, resulting in anemia and weight loss. One of the reasons that nematodes are so important in goats is that unlike cattle and sheep, they have evolved in such a way that they produce very poor immunity on exposure, and thus remain susceptible to re-infection throughout their lives and worm control therefore remains a constant priority.

2:2:1:1 Haemonchus contortus (barber pole worm)

Haemonchus contortus, also known as the barberpole worm, is the most prevalent, and often deadliest, parasite that infects goats. This parasite resides in the abomasum, the fourth chamber of the ruminant stomach, and feeds on blood, which causes anemia and bottle jaw. Goats succumbing to the anemia exhibit poor performance and may die if left untreated. This parasite produces up to 6,000 eggs per day and can complete its life cycle in as little as three weeks. Each worm consumes one to five drops of blood daily. Therefore, a goat infected with 1,000 of these

parasites will lose nearly a pint of blood in a week. Normal blood contains approximately 36% red blood cells. When the red blood cell volume drops below 20%, goats require deworming. Goats die by the time the red blood cell volume drops to 8%. Red blood cell volume is rarely measured on farms by producers. Therefore, FAMACHA scoring was developed to allow producers to assess anemia, or in essence red blood cell volume, at the farm (Kaplan, 2004). This scoring procedure will be discussed later in this section. Because of the high death loss associated with Haemonchus contortus, it is the most economically important parasite to the goat industry.

2:2:1:2 Teladorsagia or Ostertagia (brown stomach worm)

Teladorsagia or Ostertagia, also known as the brown stomach worm, penetrates the gastric glands in the abomasum, which causes a loss of plasma. Goats infected with this parasite show signs of diarrhea, reduced appetite, and poor performance.

2:2:1:3 Trichostrongylus

Trichostrongylus (bankrupt worms) Trichostrongylus, also known as the bankrupt worm, burrows into the mucosal crypts in the small intestine. Goats infected with this parasite show signs of diarrhea, reduced appetite and poor performance.

2:2:2 Cestodes (tape worms)

These flat, ribbon-shaped worms live in the intestines of animals. They are made up of segments that contain eggs. The main species found in goats is Moniezia. Unlike nematode worms in which worm eggs and most larvae in faeces are invisible to the naked eye, large tapeworm segments, (literally fragments that break off the end of the tapeworm) can appear in the faeces (often wriggling) and be a real cause for concern. They are relatively nonpathogenic unless large numbers of them are present in the gastrointestinal tract.

2:2:3 Coccidian

Coccidiosis is caused by protozoan parasites of the Order Coccidia. In goats, the disease is caused by coccidia of the genus Eimeria, which invade the cells of the intestinal wall. Coccidia are highly host specific, but sheep and goats may share some species of coccidia.Coccidiosis is the most common cause of diarrhea in goats between 3 weeks and 5 months of age. This is especially true when goats are housed in confinement. Coccidiosis commonly strikes young goats shortly after weaning because of the stress of being suddenly separated from their dam.

The coccidia invade and destroy intestinal cells, resulting in loss of blood and electrolytes and poor absorption of nutrients. The most common sign of infection is diarrhea, which may be severe and the faeces may contain blood. If the infection is very acute, goats may die within 24 hours without developing diarrhea. Affected animals also show a rough hair coat, poor weight gain (or actual weight loss) and weakness. Recovered animals may be left with scar tissue in the intestinal lining so they continue to show ill thrift, and production of milk, meat or fibre can be poor.

A goat becomes infected by ingesting mature oocysts of coccidia. Each oocyst ingested has the potential to destroy thousands of the host's intestinal cells. Once inside the intestine, the infective stage of the coccidia emerge from the oocysts and penetrate the cells of the intestinal wall. They then pass through further stages of development during which they multiply rapidly, rupture the host cells, and invade new cells. This process is repeated several times until finally new oocysts are formed and passed into the external environment via the infected goat's faeces. Once outside the animal the oocysts mature and are then capable of infecting other goats, which pick them up from contaminated food and water and from licking contaminated hair. A kid can readily pick up infective oocysts from a doe's udder.

The oocytes need adequate moisture and warm temperatures to stay active. Warm and humid spring weather conditions allow coccidia oocytes to thrive. Under ideal conditions, the life cycle of coccidia is between 2 to 3 weeks. The oocysts can survive for more than a year in a dark and moist environment. Direct sunlight and freezing temperatures kill most of the infective oocytes. Therefore, goat or sheep housing should be dry with adequate exposure to sunlight.

2:2:4 Cryptosporidia

Another protozoan parasite (similar to Coccidia) that can affect very young kids causing diarrhea, which if severe can be fatal. It is more commonly seen in kids that have not taken sufficient colostrum (and are immunocompromised), in kids where early artificial milk feeding is faulty or erratic, and as a result of dirty feeding utensils or moving young kids into a faecally soiled environment. Treatment is usually symptomatic that is keeping kids warm and dry and ensuringthey get sufficient fluids. This organism is zoonotic and can cause illness in humans, particularly young children who can develop very severe diarrhea.

2:3 Management of Gastrointestinal Parasites

The main goal in attempting to control internal parasites is to break the life cycle, which can be done in a variety of ways. The three methods that will be discussed in this study are use of anthelmintics, animal management and pasture management. Using a combination of these three will usually give the best results, and the best chance of breaking the life cycle of gastrointestinal parasites in the goat herd.

2:3:1 Pasture Management

Pasture management is a key aspect in breaking the lifecycle of internal parasites. As mentioned in the previous section, infective larvae can survive for long periods of time on pasture. The grazing habits of goats make them much more susceptible to parasites than other species. Goats tend to graze much closer to the ground than other animals and also show little aversion to grazing in areas with high fecal contamination. These two characteristics drastically increase the numbers of larvae that sheep are exposed to and also the number that they are likely to ingest. Although parasite problems cannot be entirely eliminated by good pasture management, using good rotational grazing techniques combined with an efficient anthelmintic program should significantly lower the parasite problem in the herd.

Allowing pasture to rest stops the land from having any more parasites deposited on it and it also allows for new growth, which lowers the risk that goats will ingest the larvae present in the pasture. When pasture is overgrazed, animals which tend to graze close to the ground, are exposed to even more of the larvae that live low down on blades of grass. When done properly, pasture management can reduce the number of parasites that sheep and goats are exposed to (Scarfe, n.d). The best way to avoid pasture related parasite problems is to avoid overgrazing areas of pasture and to implement a rotational grazing system. Rotational grazing implies that once a pasture has been grazed, animals are rotated to another paddock and the pasture is allowed a rest period. If cattle or horses grazing can be incorporated into the grazing system, parasite contamination can be reduced even further and this also breaks the parasite life cycle. Safe pastures can also be created by planting or utilizing summer annual forage crops. Examples of these would be sorghum x sudan hybrid forages. These forages grow quite tall and animals graze at shoulder or higher height. This reduces the opportunity to ingest larvae.

Another aspect of grazing management would be to incorporate plants that contain higher levels of condensed tannins into the pasture mix (Min et al, 2005). Tannins are naturally occurring compounds that reduce parasite larval development. Plants that contain greater concentrations of condensed tannins include birdsfoot trefoil (Jennifer et al, 2006) and sericea lespedeza (Shaik et al, 2006). Goats can adapt to consuming higher concentrations of tannins, however, plants with greater tannin concentrations may cause palatability and digestibility issues. Therefore, consider the total diet and use tannins in conjunction with other prevention methods.

2:3:2 Anthelmintics

Anthelmintics are drugs that either kill egg laying adults or kill larvae before they become adults and become capable of laying eggs. There are two major problems that arise when using anthelmintics. The first problem that affects mainlysheep and goat producers is that there are very few anthelmintics that are actually approved by the FDA for use in small ruminants. The second problem is the resistance that parasites have developed to many anthelmintics. Resistance occurs when a drug is overused and the parasites develop a tolerance to the drug, making it no longer effective in killing them (Terrill et al, 2001). Anthelmintics can be used in conjunction with rotational grazing and proper pasture management to lower the number of parasites that the herd is exposed to. It used to be a recommendation to deworm animals and then rotate to a new pasture.After treating animals for parasites they should be left in original pasture for a couple of days before rotating. Under some circumstances, it is recommended to keep animals on a dry lot for 12 to 24 hours after deworming. This ensures that the eggs and larvae that survived the anthelmintics are not deposited on safe pasture.. It is usually more important in goats than sheep, since goats tend to metabolize anthelmintics faster than sheep and have a faster passage rate through the intestinal tract.There are three main classes of drugs that are currently used as anthelmintics in goats (Rook, n.d). These three are avermectins, benzimidazoles and imidothiazoles. These classes contain all of the anthelmintics that are used in controlling and treating parasites in goats.

2:3:2:1 Benzimidazoles

Benzimidazoles contain the anthelmintics albendazole, fenbendazole, mebendazole, oxfendazole, and oxibendazole. Fenbendazole is approved for use in goats, and albendazole is approved for use in sheep. This class of anthelmintics is also known as the white drenches. While benzimadoles have a high margin of safety (meaning that it can safely be given at double or

triple the labeled dose) and are effective against many species of intestinal parasites, their efficacy against Haemonchus is fairly low. The other problem with benzimidazoles, which is more pronounced in this class of drugs than in others, is that if a parasite is resistant to one of the benzimidazoles, the resistance is most likely wide spread among all of the drugs in this class.

2:3:2:2 Avermectins

The main drugs in this class are ivermectin and moxidectin. Both drugs are effective against Haemonchus in normal situations, but they are only approved by the FDA for use in sheep, and requires extra-label use in goats. Extra-label use requires that the producer work with a veterinarian to get a prescription for the desired drug, as well as the proper doses and withdrawal times when using the anthelmintics. Sheep should be given the sheep drench form of ivermectin and moxidectin, and goats should receive a higher dose.

2:3:2:3 Imidothiazoles

The most important drug for sheep and goats in this class is levamisole. Levamisole is approved for use in sheep and is also shown to be very effective against Haemonchus. There is less of a resistance problem to levamisole than there is to benzimidazoles.

2:3:3 FAMACHA

According to Kaplan (2004), FAMACHA is a system that was developed in South Africa to aid farmers in combating the problems of parasite resistance and high treatment costs in goats. The goal of the FAMACHA system is to decrease and delay resistance by only selectively treating the animals in the herd that are showing symptoms of parasite infection. Haemonchus has already been described as a blood sucking parasite that causes severe anemia in its hosts. FAMACHA utilizes the color of the mucous membranes in the lower eyelid to determine the level of anemia that the animal is experiencing. The FAMACHA chart assigns a number from 1 to 5 to eachlevel of color in the eyelid. A normal eyelid of a healthy sheep or goat is dark red, indicating that no anemia is present and the animal is presumed to be free of dangerous levels of parasites. The range of colors used in the FAMACHA system goes from Red, to reddish pink, to pink, to pinkish white, to white. The numbers 1 to 5 are assigned to each of these values, respectively (Van Wyk and Bath, 2002). Although some dispute remains as to where the cut off for treatment should be, producers generally treat animals with a score of a 4 or a 5, and in some cases a 3. Since goats are affected more seriously by internal parasites than sheep, the cut offs for

treatment in goats may be lower than in sheep to prevent serious loss from occurring. Treatment also depends on class of animal and the relative susceptibility of that class of animal e.g. kid or doe. . The FAMACHA system can be a valuable tool in helping to delay resistance issues in sheep and goat herds.Animals that require treatment most often should be culled from the herd. The ability to withstand parasite infection is moderately heritable. So, over time, culling practices can help to genetically improve parasite resistance of the herd.

2:3:4 Alternative Control Options

Duddington flagrans is a fungus that has recently been approved for reducing internal parasite contamination on pastures in the United States of America. The product does not have any impact on parasites within the animal and therefore animals exhibiting signs of parasitism will still require treatment using an effective deworming product. Product directions recommend treating animals with a chemical dewormer prior to turning out onto pastures with a low potential for worm larva. Duddington flagrans is administered as a feed supplement. It should only be fed to the most susceptible livestock, most notably does in late pregnancy or nursing kids and young weaned kids. The product should be consumed by these animals for a minimum of 60 days while they are grazing pastures when internal parasites are most active. The fungal spores in the product pass through the animals and become active along with parasite larva. The fungus works by forming a fungal web that traps, paralyzes and consumes roundworm larva. The product is not effective against other types of parasites.

CHAPTER 3

3.0 Study Site

The study was conducted in Mumhurwi, Bindura district. Mumhurwi is located 60km north-east of Harare, which is the capital city of Zimbabwe. Bindura district is one of the seven districts found in Mashonaland Central. According to ZIMSTAT census (2012), Bindura district has a population of 156 842. The coordinates of Bindura district are $17^{o}8^{1}0^{11}$S and $31^{o}21^{1}0^{11}$E.

Mumhurwi is 1,249m above sea level. Bindura district is found in NR 2b, which receives rainfall ranging from 750mm to 1200mm per annum (Mugandani et al, 2012). In Mumhurwi, the researcher visited three villages which are Mapuranga, Ruvanika and Nyamadzawo.

3:1Materials and Methods

The methodology used in this study was explanatory research with using laboratory techniques to examine the prevalence of gastrointestinal parasites in goats in Mumhurwi, Bindura district, Zimbabwe. Target population sample was 86 Mashona goats but selected and collected sample of 55 goats instead of 100. Researcher used sample calculation at Confidence level 95% and Confidence Interval 5%.Sample size was determined using the equation $\boldsymbol{n} = 1.96^2\boldsymbol{pq}/\boldsymbol{L}^2$, where $\boldsymbol{n}$ = sample size, $\boldsymbol{p}$ = expected prevalence, $\boldsymbol{q} = 1 - \boldsymbol{p}$ and $\boldsymbol{L}$ = limits of error on the prevalence (absolute precision at 95% confidence interval).The expected prevalence was estimated at 80%. This led to goats of different ages being sampled depending on availability per farm.

3:2 Study Population

The study population was both kids and adult Mashona goats (Caprus aegagrus hircus) of smallholder farmers in Mumhurwi, Bindura district. The research made collection of faeces and examined for the presence of eggs or oocysts of gastrointestinal parasites.The animals from Mumhurwi were owned by smallholder farmers who had small flock sizes, ranging from 1 to 10. Animals from these areas were maintained under extensive management systems, where they foraged in farm land or in communal pastures during the day with minimum supplementation and kraaled during the night. In these areas, veterinary care was low to non-existent, with goats not treated/dewormed. Animals mated indiscriminately in communal grazing areas. Goats in these areas had contact with other animal species such as cattle and sheep in the communal grazing areas.

3:3 Animal Ethics

The Department of Livestock and Veterinary Services in Zimbabwe's Animal Ethics subcommittee allowed the use of animals for research in accordance with international standards; clearance certificate number 001/15/Animal. Ethical concerns were taken into account by adhering to the local animal welfare regulations and practices, and experiments conformed to the ethical guidelines for animal usage.

3:4 Sample Collection

Researcher collected sample of feces of goats with the help of stockmen and Animal Science students from BUSE. Researcher used plastic gloves to collect the fecal sample from goats. About 10g fecal samples from each animal were collected once in each season directly from the rectum into airtight containers. For that box, the researcher wrote date, place, and sex of animal for identification method. Samples were maintained at about 4^{o}C in cooler boxes and were transported to the laboratory at University campus. Samples were to be examined within 24 hours of collection.

3:5 Examination of Sample

The fecal samples were examined for the presence of GIP eggs. The procedure was Direct Smear Fecal Exam as mentioned by Johannes Kaufmann 2013, but little simplified (Kaufmann, 2013), which is to take some fecal sample and put in a beaker (plastic), add sodium chloride then mixing and filter (tea filter) after that take small drops and put in the glass slide and covered with cover slide. Light microscope was used for identification of parasite eggs and oocytes, with 10x or 40x objective magnification. The fecal samples were ground into five drops of bloat guard to prevent bubbles when counting the eggs. The GIPs were identified based on the morphological appearance and size of helminth eggs and protozoa cysts (Zajac, 2006).Distinguishable nematode, trematode and cestode eggs were identified directly. A sample was considered positive when a minimum of one GIP egg was detected under the microscope.The following equation was used to calculate prevalence:

Prevalence (%) = $\frac{a}{b} x100$

Where, “a” = Number of individuals having a disease at a particular time; “b” = Number of individuals in the population at risk at that point in time (Thrusfield, 2005).

3:6 Statistical Analysis

Descriptive statistics of mean and range were used for data pertaining to goat fecal samples. Researcher listed all parasite eggs and oocytes, then used quantitative methods e.g. percentage, and classified with base on region and sex, presented variation in both types, Researcher used P value at confidence level 95%, P value ≤ 0.05. Researcher calculated prevalence by dividing the number of positive fecal samples by the total number of samples examined. MS Excel

Windows® 2007 data base and SPSS (Version 20) were used to store and analyze data obtained from the fecal samples using One Sample t-test.

CHAPTER 4

4.0 RESULTS

55 fecal samples were examined for the presence of gastrointestinal parasites in goats in Mumhurwi communal area and the findings from this research are elaborated in this chapter giving out every detail obtained during the research period.

4.1 DETERMINING THE PREVALENCE RATE OF GASTROINTESTINAL PARASITES IN MUMHURWI

The overall prevalence rate of gastrointestinal parasites for Mashona goats in Mumhurwi was 72.72% which implies that 40 goats were positive of gastrointestinal parasites and 15 goats were negative of gastrointestinal parasites, giving a total of 55 goats. Researcher found that prevalence

varies among the three villages, with Ruvanika village having the most prevalence of 75% (15 out of 20 cases), followed by Nyamadzawo village which had a prevalence rate of 72.2% (13 out of 18) and lastly Mapuranga village with 70.6% (12 out of 17 cases). Table 1 below is showing the prevalence rate of the three villages.

			Prevalence	
		N	N of positive	Percentage %
Mumhurwi	Mapuranga	17	12	70.6%
	Nyamadzawo	18	13	72.2%
	Ruvanika	20	15	75%
Total		55	40	72.72%

Table 1 *showing the prevalence of GIP in Mumhurwi*

4.2 DETERMINING THE PREVALENCE RATE OF GASTROINTESTINAL PARASITES IN RELATION TO GOATS' SEX

The number of male goats was 35 more than the female goats which were 20, but prevalence of parasite was high in female goats having 75% (15 out of 20), while male goats had parasite prevalence of 71.4% (25 out of 35), as shown in fig 1 below.

			Prevalence	
		N	N of Positive	Percentage
Sex	Female	20	15	75%
	Male	35	25	71.4%
		55	40	

Table 2 *Prevalence of GIP on male and female Mashona goats*

4.3 DETERMINING THE PREVALENCE RATE OF GASTROINTESTINAL PARASITES IN RELATION TO GOATS' AGE

Of all the 55 cases of goats sampled, only 14 goats were kids. Only 10 goats were positive of gastrointestinal parasites and the prevalence rate of gastrointestinal parasites in kids were 18%. The total number of adult goats sampled were 41 and out of that number 30 adult goats were all positive of gastrointestinal parasites. The prevalence of gastrointestinal parasites in adult goats were 54.5% higher than the prevalence rate of young goats. However, young goats had a higher prevalence rate in coccidia as compared to adult goats as shown by fig 1 below. Young goats had a prevalence of 71.4% (10/14) and adult goats had 36.6% (15/41) for coccidia.

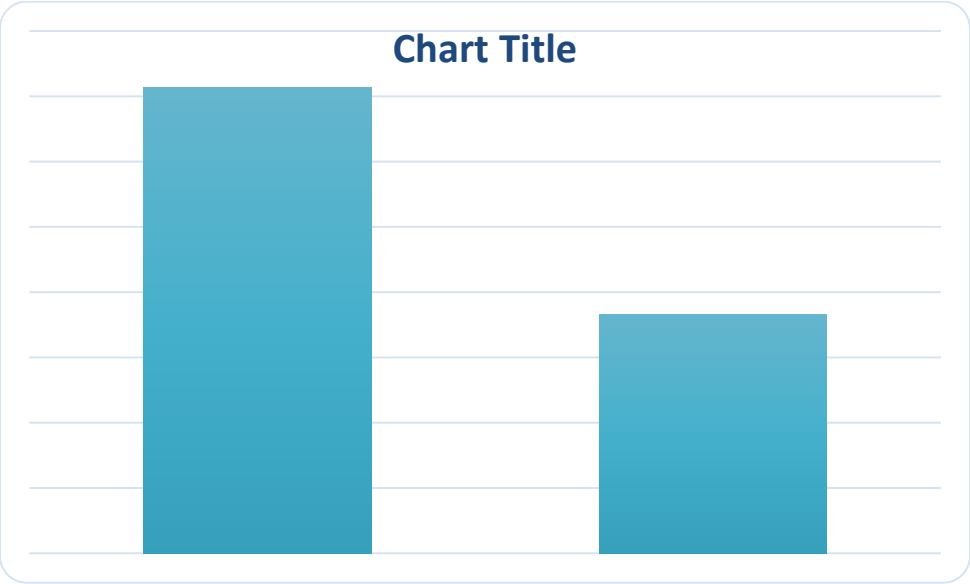

Fig 1 *Prevalence of Coccidia in young and adult goats*

4.4 PREVALENCE OF HELMINTHES AND PROTOZOA

4.4.1 NEMATODES

The nematode group of parasites was found to be the second most prevalent after coccidia. Four different species of nematodes were identified and these were Haemonchus contortus, Strongyloides, Trichostrongylus and Trichus. Haemonchus had the highest levels of infestation 14 (25.45%), followed by Strongyloides which had 12 (21.81%), on third place is Trichostrongylus with 10 (18.18%) and the last parasite was Trichus with 3 cases (5.45%). Table 3 below is summarizing the prevalence of nematode worms in goats.

	Prevalence of Nematodes				
	Nematodes				Total
	Haemonchus	Trichus	Strongloides	Trichostrongylus	
Mapuranga	6 (35.3%)	1 (5.88%)	4 (23.5%)	2 (11.8%)	13(33.3%)
Nyamadzawo	4 (22.2%)	0	4 (22.2%)	3 (16.6%)	11 (28.2%)
Ruvanika	4 (20%)	2 (10%)	4 (20%)	5 (25%)	15 (38.5%)
Total	14 (25.45%)	3 (5.45%)	12 (21.81%)	10 (18.18%)	

Table 3. *Prevalence of nematodes in Mashona goats in Mumhurwi*

Mapuranga village had highest prevalence of Haemonchus with 6 cases out of 17 and a prevalence of 35.3%. Ruvanika village had highest prevalence of nematodes 15 out of 39 cases with 38.5% prevalence rate followed by Mapuranga with 33.3% and lastly Nyamadzawo with 28.2%. The overall prevalence of nematodes in Mumhurwi was 29.1% of all the nematodes identified in this area.

4.4.2 TREMATODES, CESTODES AND COCCIDIA

According to Table 4, the researcher found out that each group has only one species with faciola for trematoda, monieza for cestoda and Eimeria for coccidia. The researcher found only 1 case of faciola (trematode) in Ruvanika village with 1 out of 20 cases (5%) and overall faciola had a prevalence of 1.8% (1 out of 55 cases). Monieza (cestode) was found in all the three villages with the same frequency of 2 but with different prevalence. Mapuranga village had a prevalence of 11.76% (2 out of 17), Nyamadzawo village had prevalence of 11.1% (2 out of 18) and lastly Ruvanika village with 10% (2 out of 20). The overall prevalence of Monieza was 10.9% (6 out of 55 cases).

	Trematoda,	Cestoda	and Protozoa	
	Faciola	Monieza	Coccidia	Total
Mapuranga	0	2 (11.76%)	7 (41.2%)	9
Nyamadzawo	0	2 (11.1%)	8 (44.4%)	10
Ruvanika	1 (5%)	2 (10%)	10 (50%)	13

Total	1 (5%)	6 (10.9%)	25 (45.45%)

Table 4. *Prevalence of Trematoda, Cestoda and Coccidia*

Coccidia had the highest prevalence rate of all the parasites recorded in Mumhurwi with 45.45% (25 out of 55 cases). It was most common in young goats in all the villages with Ruvanika village having the highest prevalence of 50% (10 out of 20), followed by Nyamadzawo village with 44.4% (8 out of 18) and with the least prevalence was Mapuranga village with 41.2% (7 out of 17).

There were also mixed infections of two or more parasites in one goat, with prevalence of 41.8% (23 out of 55 cases), total of all gastrointestinal parasites found in goats in Mumhurwi.

Table 5, showing P value of all data in SPSS one-sample test with test value 0. Researcher used the rule, if P > 0.05, the test is not significant.

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Age	3.317	11	.007	.50000	.1682	.8318
Gender	3.317	11	.007	.50000	.1682	.8318
Haemonchus	5.534	5	.003	2.33333	1.2495	3.4172
Place	4.062	11	.002	1.00000	.4582	1.5418
Strongloides	4.707	4	.009	2.40000	.9843	3.8157
Trichostrongylus	7.071	6	.000	1.42857	.9342	1.9229
Monieza	5.196	3	.014	1.50000	.5813	2.4187
coccidia	6.197	11	.000	2.08333	1.3434	2.8232

Table 5 *showing significance P value.*

Source: Primary data

The result in Table 5 shows that P value or Sig. (2-tailed) for all the variables is P < 0.05 which means that the test is significant. Since P < 0.05, P value for sex is P = 0.007, we accept the null hypothesis that there is significant association between the prevalence of gastrointestinal

parasites and the goats' sex. For age P = 0.007, so we accept the null hypothesis that there is a significant association between the prevalence of gastrointestinal parasites and the goats' age.

CHAPTER 5

5.0 DISCUSSION

This study evaluated 55 fecal samples of goats in Mumhurwi communal area, indicating an overall prevalence of Gastro-intestinal parasites of 72.72%, which means 40 samples were positive, and 15 samples were negative of gastro-intestinal parasites, and there are mixed infections having more than two parasites in one sample, and 23 samples were mixed (41.8%).

Of all the 40 positive samples obtained, Coccidia (Eimeria) and Haemonchus (nematodes) were the most prevalent with Coccidia having 45.45% (25 out of 55) and Haemonchus 25.45% (14 out of 55). The second-highest groupings were all nematodes, with percentages of Strongyloides 21.81% (12 out of 55) and Trichostrongylus 18.18% (10 out of 55). Its higher prevalence could be due to that adult females are capable of producing thousands of eggs per day, which can lead to rapid larval pasture contamination and associated outbreaks of haemonchosis (Roeber et al., 2013). One drawback of Haemonchus contortus is that it can become very resistant to anthelmintic drugs, which makes control difficult (Kotze and Prichard, 2016). In a study conducted in Malaysia by Yusof, A. M., & Isa, M. L. M. (2016), it was discovered that Eimeria and nematodes were widely dispersed in the goat population, increasing the risk of morbidity and mortality. Gadahi, J. A., et al. (2009) discovered that the prevalence of haemonchosis was substantially greater in goats than in sheep in Pakistan. Strongyle nematodes and Eimeria spp. were discovered to be the most abundant parasites in Cameron, according to research by Ntonifor, H. N., et al. (2013).

The study observed that females of all age groups were more susceptible to infections than males as shown by fig 2. These findings were similar to those of Emiru et al. (2013) and Vieira et al. (2014) in Ethiopia and Brazil, where females were more vulnerable to parasite infection than males. This was attributed to female animals' reduced resistance as a result of their reproductive processes and an inadequate or unbalanced diet compared to their greater needs.There were different parasitic infections in different areas. These differences can be explained by varying environmental and animal factors and also management systems in these areas.

Monieza was the only cestode found in the study area. The consumption of mites carrying larvocysts of Monieza is linked to the presence of this parasite in tropical regions (Diop et al.,

2015). Results for Faciola were as low as those reported by Khanjari et al. (2014). Goats may have had less infection because of their browsing and foraging habits, which reduce the likelihood that they may ingest the metacercaria, which are found on plants closer to the ground.

High prevalence of Coccidia was found mainly in young goats compared to adult goats.These results were consistent with other research (Lone et al., 2012; Ayaz et al., 2013) that suggested naive animals were more prone to infections. Therefore, it is thought that the protective effect in older animals is due to acquired immunity from repeated exposure (Odoi et al., 2007).

CHAPTER 6

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

The results from the study indicated that Coccidia and Haemonchus are the most prevalent parasites in Mumhurwi and that Coccidia infections are mostly common in young goats as compared to adult goats. Female goats were more susceptible to infections more than their male counterparts due to their biological nature. The animal may look health, some of them have poor body condition, which apparently cause to less production and to be weak animal, and also it is possible to have high morbidity, but not making any surveillance to detect the cases. Knowledge on these gastrointestinal parasites is of great importance in the development of appropriate control strategies. This has a potential to reduce production losses and improve rural livelihoods.

6.2 RECOMMENDATION

The researcher recommends interval deworming of goats per se two times a year that is deworming after every 6 months. Also farmers are recommended to practice co-grazing among their livestock so as to break the life cycle of parasites. The researcher also recommends farmers to use the correct anthelminthes in correct quantities and also at the right time so as to prevent the issue of anthelminthic resistance in goats. Farmers are recommended to establish or introduce pastures that are rich in tannins.

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