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GASTROINTESTINAL PARASITES IN RUMINANTS AT SELECTED ABATTOIRS IN THE GREATER ACCRA REGION, GHANA.

BY

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MPHIL MICROBIOLOGY DEGREE.

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DECLARATION

I do hereby declare that apart from references to the work of other investigators which I have duly acknowledged, the work presented in this thesis is original, and it was carried out by me under the joint supervision of Rev. Professor Patrick F. Ayeh-Kumi, Dean of School of Allied Health Sciences and Dr. Simon K. Attah, Department of Microbiology, University of Ghana Medical School, Korle-Bu.

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DEDICATION

This work is dedicated with love and utmost regard to the memory of my late and beloved father

Mr. Clement Bannerman-Williams.

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ACKNOWLEDGEMENT

My greatest thanks and appreciation to the almighty God who made it possible for this work to be accomplished. My sincere appreciation goes to my supervisors and my head of department; I am indebted to them for their guidance and excellent supervision.

I am grateful to Mr. Adjaidoo Hugo of Accra Abattoir Company Limited. Also, I am thankful to Mr. Ohene and his colleagues at Amasaman slaughter house. I would also like to thank the Staff of Animal Research Institute for their assistance given to me. My sincere thanks to Prof. Awumbilla of the Animal Science Department, University of Ghana for assisting me with enough literature and advice on how to go about the research, and all the staff of the Department of Microbiology, UGMS for their profound advice and the knowledge they imparted into my life. Finally, I acknowledge with much pleasure the kind cooperation, endurance, understanding and support of my family. May the almighty God reward you all abundantly.

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LIST OF ABBREVIATIONS

AIDS	Acquired immune deficiency syndrome
CDC	Centers for disease control and prevention
CNS	Central nervous system
GI	Gastrointestinal
H&E	Haematoxylin and eosin staining
HIV	Human immune deficiency virus
L3	Third larval stage
L4	Fourth larval stage
MLNC	Mesenteric lymph node cell
P- value	Probability value
SPC	Stomatitis pneumo enteritis complex
UGMS	University of Ghana Medical School

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ABSTRACT

The main source of animal protein is livestock and their products. Livestock plays a crucial role in the economy of most nations. Parasitism is one of the main constraints limiting livestock productions. Control of parasitic diseases communicable from animals to men under natural conditions is very necessary to improve the health status of Ghanaians. The research was aimed at determining different parasites and compares the prevalence of infections at certified and uncertified abattoirs and quantifies them. Macroscopic and microscopic examinations were done on the parasites identified to confirm structures of the various parasites. Wet mount preparation was done to identify some of the cyst of the parasites. The parasites found at the Tema abattoir were tapeworms, rumen flukes and hydatid cysts. Those found at the Amasaman slaughter house were hookworms, tapeworms, and rumen flukes. The percentage of infection at Tema abattoir was 71.7% in cattle, 82.2% in goats and 53.3% in sheep. On the other hand, the percentage of animals infected at Amasaman slaughter house were 67.1% for cattle, 67.5% for goat and 66.7% for sheep.

The results of this study could be due to the fact that most of the goats used were from lowland and mid altitude areas which are thought to be suitable for survival of larval stage of the parasites. Another reason could be due to the fact that, there is poor veterinary infrastructure and medication to goats. Most of the animals examined during the study had high number of tapeworms infestations, followed by rumen flukes. There is a need to do this study throughout the year so as to get a complete picture which will cover the gastrointestinal parasites in both the wet season and dry season to enable veterinarians control the parasites.

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CHAPTER ONE

1.0 GENERAL INTRODUCTION

The main source of animal protein is livestock and their products (Domke *et al*., 2011). Livestock plays a crucial role in the economy of most nations. It increases the economy of the rural poor. It is an obvious statement that, world-wide, parasitic infections are one of the greatest causes of disease and lost productivity and that control is an absolute necessity. Economic assessments have repeatedly demonstrated that these losses can be enormous (Sibbald *et al.*, 2009), and this was recently reviewed by Perry and colleagues (Perry and Perry, 2009).In the developed world, clinical parasitic infections are more and more infrequent, mainly due to the availability of a range of highly effective broad-spectrum parasiticides, and by far the greatest losses associated with parasitic infections are sub-clinical or economical.

Anthelmintics are thus less used to treat clinically sick animals, and more to maximise profits. However, often producers use blanket treatment programmes to control parasites without considering the basic epidemiological information needed for an optimal strategic control, or questioning the relevance of the vast volumes of anthelmintic drugs administered to food producing animals (Sibbald *et al.*, 2009). Due to improper care, unhygienic environment, extreme climate and close contact with infected animals, the care takers get infected with a variety of parasites. Parasitism is one of the main constraints limiting livestock production and, for that matter, resulting in financial loss to farmers across the nation.

Mortality of animals from parasitic diseases may not at all times be as alarming as the negative effect it has on the production of milk, meat , wool and hyde. Infertility and loss of stamina in

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the case of working animals and particularly the zoonotic impact on human health are considerably greater (Maddison *et al*., 2009). Control of diseases communicable from animals to men (zoonosis) under natural conditions is an important task for veterinarians. There are so many important zoonotic parasitic diseases such as hydatidosis, fascioliasis, settariosis, trichinellosis, ascariosis and amphistomiasis etc. (Zimmermann *et al.*, 2009). The management of endoparasites, especially *Haemonchus contortus* (the barberpole worm, the stomach worm), is of primary concern to the majority of small ruminant farmers owing to the resistance they have developed to nearly all available dewormers. The cost of internal parasite infection includes treatment expense, reduced animal weight gains, and even animal death. Resistance to dewormers is now seen worldwide (Kaplan *et al*., 2009). Producers of livestock can no longer rely on drugs alone to control internal parasites. Rather, an integrated approach which includes good hygienic practises that relies on sustainable methods to manage internal parasites should be employed.

Accurate assessments of the economic losses and the main justification to control parasites from parasitic infections are hampered by several factors namely, incomplete information on the extent to which production is adversely affected by infection, variation in importance of productive indices from place to place, variation between animal breeds in their resilience and resistance to infection and extent to which production loss is influenced by level of nutrition, age, sex and concurrent infection of exposed animals with other parasites and infectious agents. Even if we could assess the economic importance of a parasite, we then face the problem of which treatment is needed and how to implement it in the local husbandry system. For most parasite- host relationships there exists a level of infection where the effect of infection on the

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development of immunity on the one hand, and production characteristics on the other, are balanced. Often, we cannot ascertain this "optimal" level of infection and the conditions under which it can be found. Although, it is very difficult to define one magic threshold for treatment versus non-treatment in a particular host–parasite relationship, we will try to introduce a certain number of observations and decision-making points which should help to estimate these thresholds. Before doing this we should first make clear some important definitions and/or constraints.

The main justification for trying to define a treatment versus non-treatment threshold is to promote a better use of anthelmintics. At the moment, a large part of anthelmintics are used inconsequentially because parasite levels are not high enough to justify a (therapeutic) treatment or because the (preventive) anthelmintic treatments are not correctly programmed, resulting in under protection or over protection. We should be aware that eradication of parasites is, in most cases, not feasible, and that a low level of parasitism must be tolerated to allow for a protective immune response in the host animal. The treatment versus non-treatment threshold is thus not a zero option. Although, with the development of the current generation of anthelmintics, clinical parasitism has become less common, it is still a reality and we need thus to define first a therapeutic threshold. A "therapeutic" threshold is intended to identify an animal with such levels of parasites that immediate treatment is necessary to avoid further production losses and even death, and immunity is not an issue.

The key question here is how to relate clinical symptoms with infection levels. More and more the threshold in parasitism that is tolerable becomes an economic issue. An "economic" threshold is intended to measure, at an early stage, the effects of sub-clinical or economic

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parasitism and immunity is normally not a primary issue such as weight gain, milk production, feed conversion, etc., with parasite levels. Finally one may consider a "preventive" threshold. This threshold is intended to assess future (on a group basis) control programmes, considering immunity development. The importance of parasitic diseases as a public health hazard, particularly in rural areas where a close association exists between man and domestic animal is well established (Ortega *et al*., 2009). These parasites infect the gastrointestinal tract, the liver, the lungs, the circulatory system, the lymphatic system and the skin causing severe symptoms such as diarrhoea, weight loss and death in the animals (Gasbarre *et al.*, 2001).

Many slaughter houses and village markets where animals are slaughtered have no veterinary supervision. At these places dogs and other carnivores congregate and feed on waste products from the slaughtered animals that are placed in containers and, in doing so, become infected by hydatidosis. Important groups of the gastrointestinal parasites known to infect livestock especially include the coccidian parasites, nematodes, cestodes, and trematodes (Onaga *et al*., 2009). These animals are commonly affected by hydatid cyst, cysticercus and coenurus. The conditions they cause result in considerable economic losses owing to mortality, stunted growth, unthriftiness and partial or complete condemnations of the carcasses at the slaughter houses (Konold *et al.*, 2010). Increasing recognition of the burden of human fascioliasis has occurred and it is now recognized as an emerging zoonosis by the World Health Organization (Poindexter *et al.*, 2009). The zoonotic disease has a serious impact on both public health & transmission through infected fomites or ingestion of infected milk and meat (Rautureau *et al.*, 2010). Livestock get exposed to these pathogenic parasitic organisms very early under natural grazing

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conditions and the effects of infections are influenced by the environment, nutrition, climate and management practices (Blackburn *et al*., 2011).

Outbreaks of parasitic infections are most severe in warm, humid climates; the optimum temperature for larval growth is between 50° and 80° Celsius and the optimal rainfall is at least 5 centimeters.(Aboagla *et al*.,, 2011). A climate that is too hot or dry can kill most larvae on the pasture. Larvae numbers peak in late winter and early spring. *Haemonchus* has a life cycle lasting approximately four weeks (Mandonnet *et al*., 2001). When ingested, the larvae travel to the abomasum of the animal, where they burrow into the mucosa and develop into true adults in 21 days (Nundy *et al*., 2011). While in the abomasums, female adults can lay over 5000 eggs per day. Roughly 10,000 adult *Haemonchus* worms can kill a sheep. The eggs are deposited in faeces. After approximately 24 hours, the eggs hatch on grass in pastures and under optimal conditions, become infective in five to seven days (Meng *et al.*, 2010). *Haemonchus* spp are among the most pathogenic helminth species of ruminants in Australia. *Haemonchus contortus* is mainly a parasite of sheep and goats (sometimes cattle) and *H. placei* is mainly a parasite of cattle (sometimes sheep and goats). Female worms are 18-30 mm long and are easily recognised by the 'barbers pole' appearance of the white ovaries and uteri twisting for the length of the worm around a red blood-filled intestine. Males are 10-20 mm long and uniformly reddish-brown. Both the developing 4th larval stages (L4s) and adults cause punctiform haemorrhages at sites of feeding on the abomasal mucosa which may be oedematous. The ingesta may be reddish brown and fluid. Worms may be attached to the mucosa and free in the lumen. Clinical signs include anaemia and hypoproteinemia (manifested as submandibular oedema). In South Africa, the Famacha system of standard colour charts is used for assessing/scoring the level of anaemia

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by comparison of the colour of the inner lower eyelid and is used for tactical treatment of heavily infected sheep. Scouring is not a feature in sheep and goats unless the parasite infection is mixed and includes 'scour worms' (notably *Ostertagia* and *Trichostrongylus* spp). *Taenia saginata* is a large tapeworm that causes an infection called taeniasis. It is commonly known as the beef tapeworm or cattle tapeworm because it uses cows as intermediate hosts. Humans are the only definitive hosts. Taeniasis occurs worldwide and is relatively common in Africa, Eastern Europe, Latin America and the Philippines(Morgan, 2011).

1.1 Life cycle of *Taenia saginata*

The life cycle of *Taenia saginata* starts, when eggs contained in tapeworm segments (proglottids) are passed in the faeces of an infected human. They can survive a few months out in the environment. If a cow (the intermediate host) feeds on contaminated vegetation, it ingests the matured eggs or gravid proglottids. In the small intestine the larvae known as oncospheres hatch, penetrate the intestinal wall, enter the bloodstream and migrate to the muscle tissue (rarely to the liver or other organs), where they encyst into cysticerci. The pea-sized cysticerci can survive for years and still be infective when humans eat the meat. If the beef is not cooked properly, cysticerci excyst in the small intestine and develop into adults within two months. Adults attach to the intestinal wall with their scolex by means of their four suckers. The scolex has a pear-shaped and cup-like appearance reaching 1–2 mm in diameter. It is attached to the neck which produces the proglottids which consists of flat, long, segmented body also known as strobila. The proglottids mature and grow bigger as they get further from the neck. They are about 16–20 mm long and 5–7 mm wide and each proglottid has its own reproductive organs. They absorb nutrients through their membranes and produce up to 100 000 eggs per day. Proglottids break off

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from the tail and move with the stool out of the human body. A full-grown *Taenia saginata* is whitish in colour and has about 1000–2000 proglottids and about six of them detach every day.

The eggs usually stay inside the proglottids until they are out in the environment. When the proglottid dries up, it ruptures and releases the eggs. The eggs are embryonated, walnut brown and about 35 micrometers in diameter having a 6-hooked oncosphere inside its thick shell. If the faeces land on grazing ground for cattle, a cow might accidentally ingest proglottids or eggs. *Taenia saginata* can live up to 25 years. It can grow up to 5 metres but in some cases it can reach lengths of over 10 metres (coiled in the intestinal tract).

1.2 Life cycle of *Taenia solium*

Infected humans (definitive host) excrete the eggs or gravid proglottids in their feces, passing the parasite from the gastrointestinal tract onto nearby vegetation. In egg or gravid proglottid form, *T. solium* is able to remain viable. *T. solium* can be diagnosed at this point in the life cycle. Autoinfection can also occur at this point in the life-cycle via fecal-oral contamination. In this case, eggs or gravid proglottids re-enter the body through the mouth and often travel to the central nervous system (CNS), the muscles or the eye, where they develop into cysticerci. The presence of cysticerci in these locations leads to cysticercosis (neurocysticercosis in the CNS). Pigs (intermediate hosts) acquire infection by eating and digesting the eggs or gravid proglottids along with the vegetation parasitized. The eggs or gravid proglottids migrate to the pig's intestine and as oncospheres, break through the intestinal wall. Then, via the circulatory system, they embed themselves in the muscles of the pig and develop into cysticerci (the infective form of *T. solium*). Humans acquire the infection by eating the undercooked or raw flesh of an

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infected animal. Cystercerci migrate to the small intestine of the human host and develop into adult tapeworm normally within two months. By attaching to the intestinal wall with their scolices (hooked structures), these adult tapeworms may persist for long periods of time, even years (but not more than 2 years).

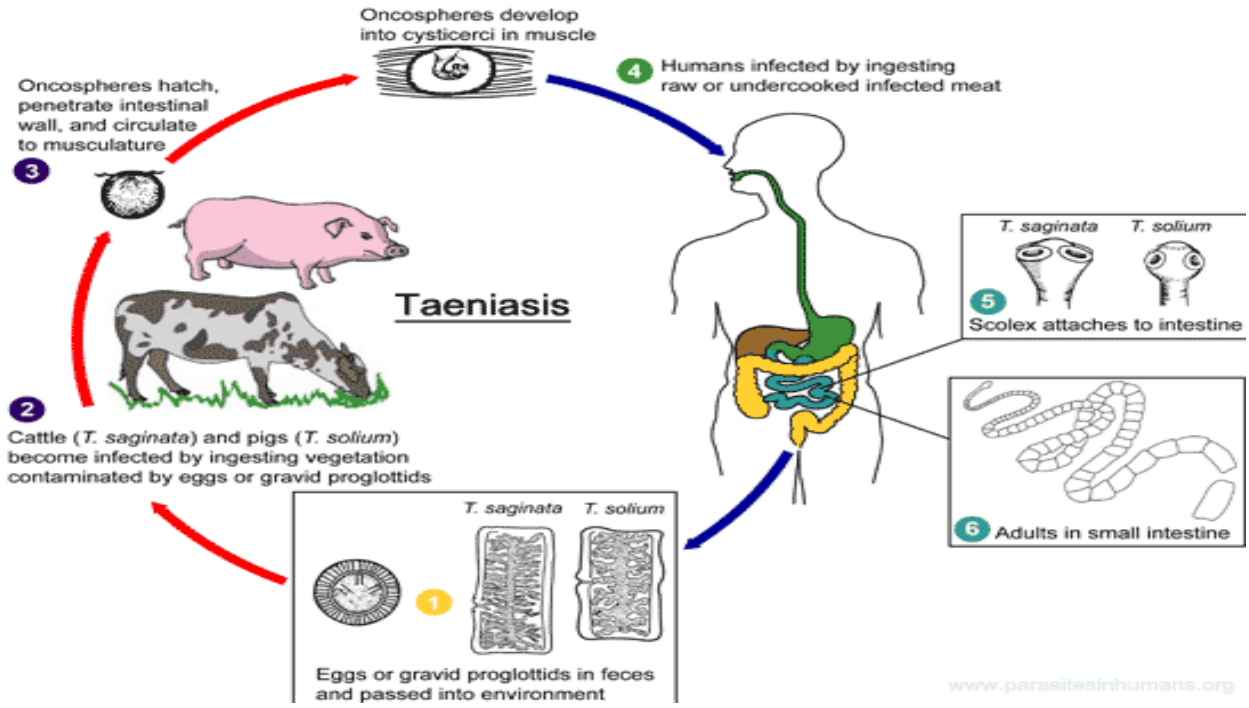


Figure 1.1 Life cycle of *Taenia Saginata* and *Taenia solium*

Source; http://www.dpd.cdc.gov/dpdx

The disease is often asymptomatic. Taeniasis caused by *Taenia saginata* is more noticeable than that of *Taenia solium* (although *T. solium* is overall more dangerous because of the risk of cysticercosis). Some symptoms of infection of *Taenia saginata* are allergic reactions, chronic indigestion, constipation, diarrhoea, dizziness, headache, loss of appetite, nausea, obstruction of the bowel, stomach ache and weight loss. Migrating proglottids can cause inflammation of the

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appendix, and inflammation of the bile duct. Health care providers make the *Taenia saginata* diagnosis by identifying eggs or proglottids. Eggs and proglottids start appearing in stool samples after three months of the start of the infection. During the first three months antibody detection methods can be used to find antibodies from a blood sample. Eggs of both *Taenia* species are morphologically identical and so identification can only be done at the genus level. For academic purposes the identification can be made by examining the gravid proglottids.

The diagnosis can also be done during an endoscopic examination. Treatment is traditionally done with praziquantel which is administered orally. This drug causes paralysis of the worm by opening its membrane calcium channels, and then through peristaltic movements the tapeworm is defecated out. Alternatively niclosamide can be used for treatment. Both drugs especially praziquantel have some side effects that are similar to the symptoms that are manifested by the infection itself. In some areas endoscopic treatment is available. By this treatment a drug is injected straight to the small intestine. This causes all tapeworms in close proximity to be expelled. If the scolex (and neck) is left behind, it might produce new segments. Preventive measures can be taken by cooking beef at least at 60 degrees celcius until it is thoroughly cooked. Alternatively, the meat can be frozen at -5 degrees celcius or below for a few days. Also cattle must be prevented from grazing in areas where the vegetation might have been contaminated with human faeces.

Human echinococcosis (hydatidosis, or hydatid disease) is caused by the larval stages of cestodes (tapeworms) of the genus *Echinococcus.* *Echinococcus granulosus* causes cystic echinococcosis, the form most frequently encountered; *E. multilocularis* causes alveolar echinococcosis; *E.*

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vogeli causes polycystic echinococcosis; and *E. oligarthrus* is an extremely rare cause of human echinococcosis.

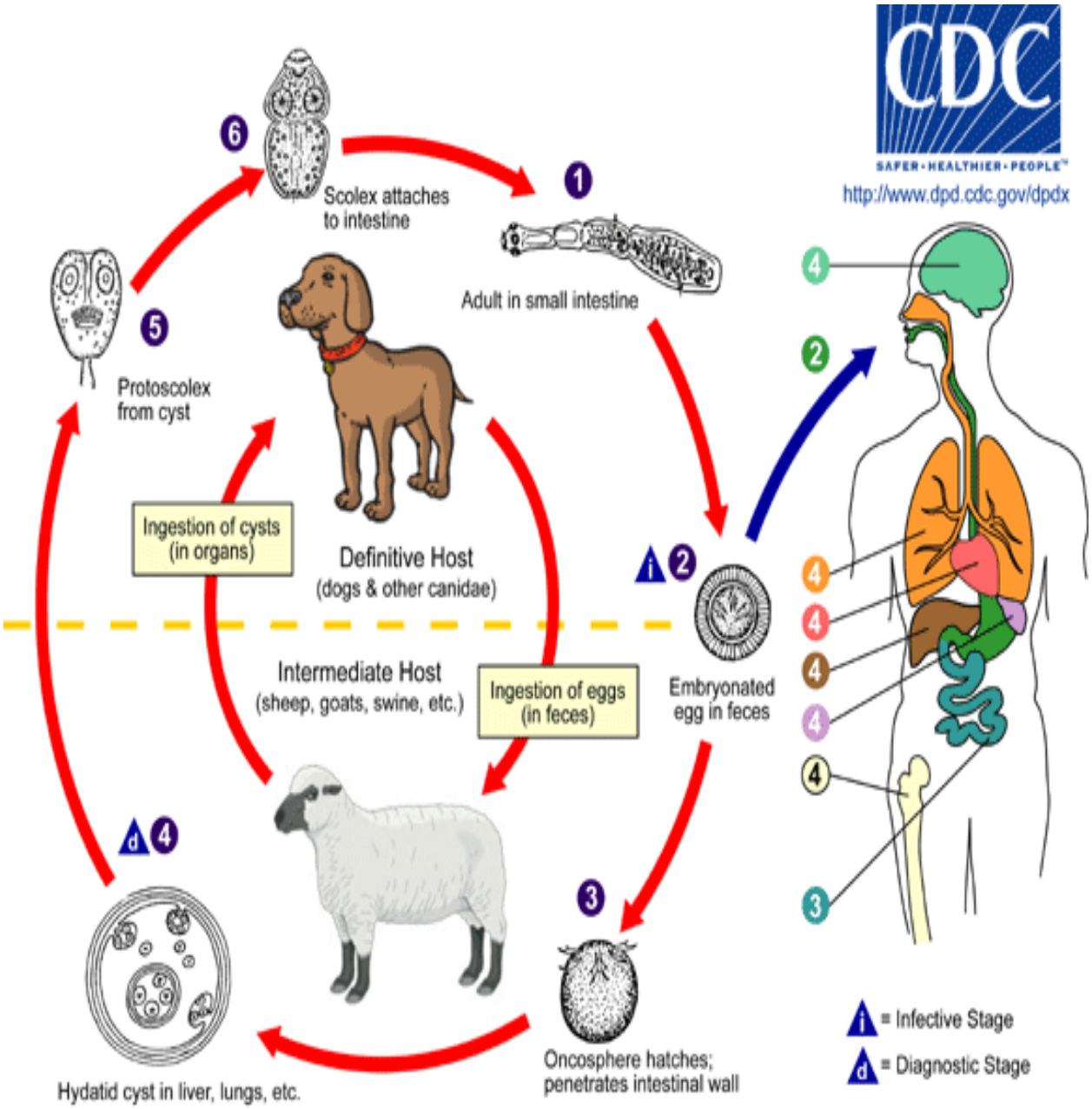


Figure 1.2: Life cycle of *Echinococcus granulosis*

Source: http://www.dpd.cdc.gov/dpdx

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1.3 Life cycle of *Echinococcus granulosis*

The matured *Echinococcus granulosis* is about (3-6) mm long and stays in the small bowel of the definite hosts which can be either dog or canids. Eggs are released by the gravid proglottids and are passed in the faeces. The eggs hatches in the small bowel after ingestion by a suitable intermediate host and releases an oncosphere that penetrates the intestinal wall and moves through the circulatory system into some organs mainly the liver and lungs and later develops into cyst in these organs. It produces protoscolices and daughter cysts that fill the interior of the cyst. The definitive host acquires the infection by ingesting the cyst containing organs of the infected intermediate host. The protoscolices evaginate after ingestion and attach to the intestinal mucosa and develop into adult stage within 32-80 days. A similar life cycle occurs with *Echinococcus multicularis*, however the following differences are observed, the definitive hosts are foxes and to a lesser extent dogs, cats and wolves. The intermediate host are small rodents and larval growth occurs in the liver and remains indefinitely in the proliferative stage and eventually results in invasion of the surrounding tissues. *E. granulosus* occurs practically worldwide, and more frequently in rural, grazing areas where dogs ingest organs from infected animals. *E. multilocularis* occurs in the northern hemisphere, including central Europe and the northern parts of Europe, Asia, and North America. *E. vogeli* and *E. oligarthrus* occur in Central and South America.

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1.4 Life cycle of *Trachinella spiralis*

Trichinellosis (trichinosis) is caused by nematodes (roundworms) of the genus Trichinella. In addition to the classical agent *T. spiralis* (found worldwide in many carnivorous and omnivorous animals) several other species of trichinella are now recognized including T.pseudospiralis (mammals and birds worldwide), *T. nativa* (Arctic bears), *T. nelsoni* (African predators and scavengers), *T. britovi* (carnivores of Europe and western Asia), and *T. papuae* (wild and domestic pigs, Papua New Guinea and Thailand). *Trichinella zimbabwensis* is found in crocodiles in Africa but to date there are no known associations of this species with human disease.

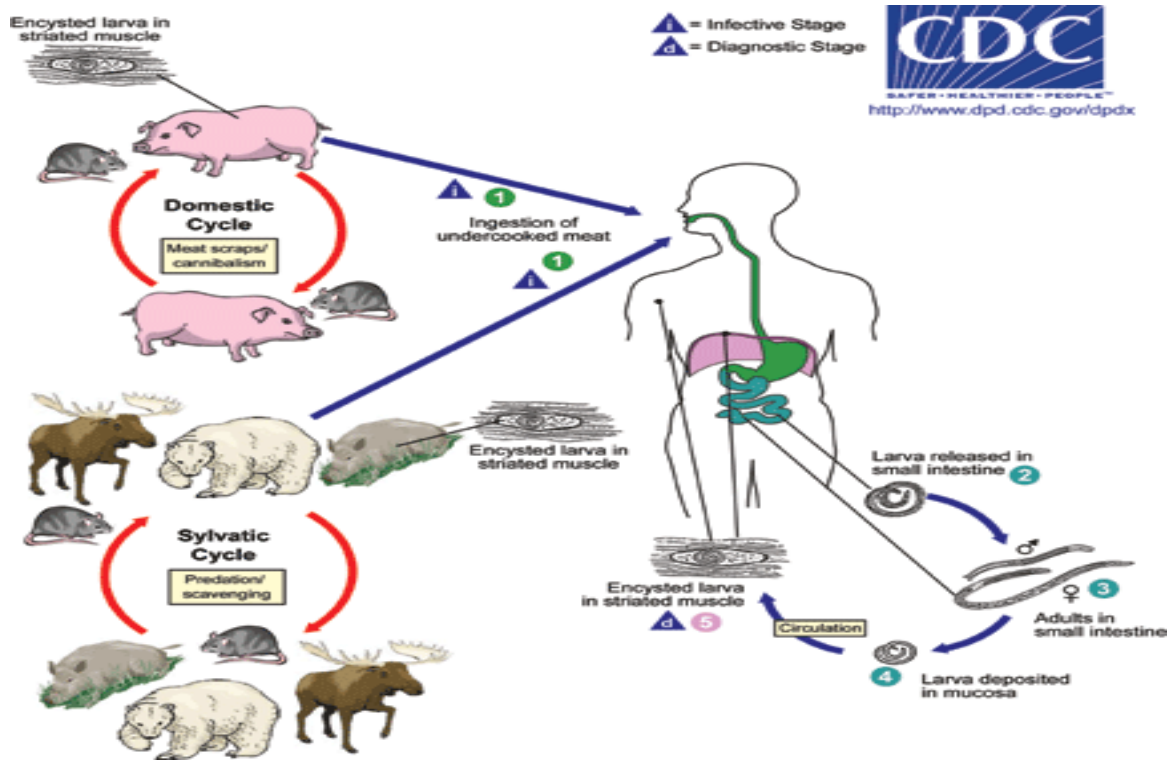


Figure 1.3: Life cycle of *Trichinella spiralis*

Source: http://www.dpd.cdc.gov/dpdx

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Depending on the classification used, there are several species of *Trichinella*: *T. spiralis*, *T. pseudospiralis*, *T. nativa*, *T. murelli*, *T. nelsoni*, *T. britovi*, *T. papuae*, and *T. zimbabwensis*, all but the last of which have been implicated in human disease. Adult worms and encysted larvae develop within a single vertebrate host, and an infected animal serves as a definitive host and potential intermediate host. A second host is required to perpetuate the life cycle of *Trichinella*. The domestic cycle most often involved pigs and anthropophilic rodents, but other domestic animals such as horses can be involved. In the sylvatic cycle, the range of infected animals is great, but animals most often associated as sources of human infection are bear, moose and wild boar.

Ingestion of undercooked meat containing encysted larvae results in trichinellosis. However *Trichinella pseudospiralis* and *Trichinella papuae* do not encyst. The larvae are released from the cyst after exposure to gastric acid and pepsin. The larva invades the small bowel mucosa and develops into adult worms. The females are 2.2mm in length whiles the males are 1.2mm. The life span in the small bowel is about four weeks. The female release larvae that migrate to striated muscles after a week and they encyst. Trichenellosis is usually diagnosed based on clinical symptoms and is confirmed by serology or identification of encysted or non-encysted larvae in biopsy or autopsy specimen.

In conclusion knowledge of the life cycle of the various parasites is important to help control the parasites and hence reduce the spread of diseases.

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1.5 Problem Statement

Animals carry a lot of parasitic burden and hence serve as sources for parasitic infections. Parasitic infections contribute greatly to increases in morbidity and mortality rates in sub-saharan Africa and the world as a whole. The understanding of the epidemiology of parasitic infections at abattoirs in Africa remains incomplete across the spectrum and its concomitant infections with other pathogens. As intervention coverage expands, communities will expect a change over in the spectrum of transmission among other infection outcomes. Most of our restaurants and chop bars obtain meat from these animals and this can lead to the spread of parasitic infections. In some instances the intestine and other internal organs such as the liver, lungs etc are not washed adequately and can serve as sources of transmission of parasitic infections. This leads to sickness and animal losses that have impacted negatively on the protein intake of the population. Parasitic infections of pigs and cattle such as *Taenia solium* and *Taenia saginata* can lead to disease like taeniasis.

1.6 Justification

Parasitic infections contribute greatly to increases in morbidity and mortality rates in sub-saharan Africa and the world as a whole. Due to this, efforts have been put in place at specific abattoirs to reduce parasitic infections. Since most people depend on meat for their source of protein, people may get infected when they consume meat from infected animals. There is therefore the need for proper characterization of parasitic infections in ruminants and their involvement with anaemia for Ghanaians and other people in endemic areas. Not enough work has been done on this research topic in Ghana, or the few researches done similar to it are yet to be published and

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hence the need for further work to be carried out. It is expected that this study will provide some data that will serve as basis for management and control guidelines formation.

1.7 Hypothesis

There is no difference between the percentages of parasitic infections in ruminants slaughtered at the Tema abattoir and the Amasaman slaughter house.

1.8 Alternate Hypothesis

There is difference between the percentages of parasitic infections in ruminants slaughtered at the Tema abattoir and the Amasaman slaughter house.

1.9 Aims and Objectives

The overall aim of this study is to determine the various types of gastrointestinal parasites that affect ruminants (cattle, sheep and goats) slaughtered at the selected abattoirs and provide information on minimizing parasitic infections of ruminants and humans.

The specific objective of the proposed project is to

1. Determine the prevalence of gastrointestinal parasites at the Tema abattoir and the Amasaman slaughter house.

2. Compare the prevalence of gastrointestinal parasites at the Tema abattoir and Amasaman slaughter house.

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CHAPTER TWO

2.0 LITERATURE REVIEW

The public health importance of diseases, particularly in rural areas where a close association exists between man and domestic animal is well established. Supervision and maintenance of hygienic conditions are unsatisfactory within most of the abattoirs. Parasitic infections of pigs and cattle, such as *Toxoplasma gondii, Cryptosporidium parvum, Ascaris suum* and *Balantidium coli* are increasingly attracting attention due to their pathogenic and zoonotic impacts. (MacKinnon *et al.*, 2010)**.** The prevalence of *Entamoeba species* in Korea in the 1980's was 55.4% *Balantidium coli was 66.6%, Ascaris suum,*was 25.6%, *Eimeria* and *Isospora spicies*, was 55.4% and *Giardia lamblia* was 1.0% (Song and Kim, 2011). Also, the infection rates of nematodes, all coccidian parasites, and trematodes in cattle were 49.0%, 10.9% and 14.6% respectively (O'Donnell *et al.*, 2009)**.**

Gastrointestinal parasite infections are a world-wide problem for both small- and large-scale farmers, but their impact is greater in sub-Saharan Africa in general and Ethiopia in particular due to the availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species. Economic losses are caused by gastrointestinal parasites in a variety of ways: they cause losses through lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production, treatment costs, and mortality in heavily parasitized animals. In Bangladesh for instance, cattle and buffalo supply the bulk of meat and milk to meet the daily requirement of protein to the population, but these animals are commonly affected with hydatid cyst, cysticercus and coenurus. These cause mortality, stunted growth, unthriftiness and partial or complete condemnations of the carcasses at

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the slaughter houses **(**Domke *et al*., 2011**)**. Recognition of the burden of human fascioliasis as a serious impact on both public and animal health is now on the increase. The common modes of transmittion of animal diseases to man include direct contact with animals, handling of infected fomites or ingestion of infected milk and meat. Many diseases such as echinococcosis, amphistomiasis, trichinellosis, are zoonotic and can therefore be can be transmitted from animals to human beings. (Magona *et al*., 2011). Indiscriminate slaughter of animals, sale of meat without ante-mortem and post-mortem examinations by a qualified veterinarian does not only jeopardize human health but also cause wide spread environmental pollution. My objective in relation to the present study is to determine the prevalence of zoonotic parasitic diseases in domestic animal which are of public health importance. Endoparasites result in huge economic losses amounting to 19.7 million per year (Cooper and Brodersen, 2010**)** and the estimated losses due to lowered meat and wool production in slaughtered sheep and goats (Javed *et al*., 2011). The diseases they cause in humans range from mild and self-limiting to fatal. Livestock, such as pigs and cattle, are known to be important sources of zoonoses.

Parasitism in sheep and goats is a substantial problem plaguing farmers across Ghana. As gastrointestinal parasite infection is the most important limiting factor of sheep productivity, parasitism has a highly detrimental effect on the sheep industry (Jones and Langemeier, 2010). Production potential of livestock development programs is plagued in tropical and subtropical areas due to prevalence of helminths which causes high mortality and great economic losses (Harfoush *et al*., 2010)**.** The prevalence of gastrointestinal helminths is related to the agro-climatic conditions like quantity and quality of pasture, temperature, humidity and grazing behaviour of the host (Rodriguez-Palacios *et al*., 2011). Amongst the parasitic diseases,

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endoparasitic coccidia, roundworms, tapeworms, and liver flukes are the most pathogenic (Bassetto *et al.*, 2009). Sheep is considered as one of the most favourite animals slaughtered in the abattoir of El-mahalla El kubra, and the meat has achieved the aim of meat products supplies for the largest city in Egypt (Maranon *et al*., 2011) of Egypt. The prevalence of infectious diseases in animals is related to several factors, including types of food and water, food supply systems, hygienic conditions, location of pens, administration of drugs or vaccinations, and so on.

Immunity against gastrointestinal nematodes can be manifested as expulsion of adult parasites and reduction in worm length, decrease in female worm fecundity, failure of infective larvae to establish and arrested development of larvae. Rapid expulsion of adult worms following primary infections occurs in most rodent nematodes but the phenomenon is uncommon in large animals and man (Bouwstra *et al*., 2010). The only exception is *Nematodirus* species in which adult worms from primary infections of sheep with *N. battus* were expelled in periods ranging from 18-21, 24-28, up to 72 days post infection depending on the dose of infective larvae given (Meeusen *et al*., 2005). Most of the works on rapid expulsion of adult nematodes following primary infections have been in rodents using *T. spiralis, N. brasiliensis, Strongyloides* species and *T. muris*. Each of these parasites occupies a different niche in the gut and, as will be reviewed subsequently, evokes slightly different effector mechanisms; thus important differences exist in the ability of the rodent hosts to expel a primary infection with each of them (Alonso-Fresan *et al.*, 2009). *T. spiralis, N. brasiliensis, S. ratti* and *S. venezuelensis* all have tissue migratory larval stages and their adults live in the small intestinal lumen from where they are expelled within 2-3 weeks after primary infection (Fritz *et al.*, 2009). *T. Muris,* on the other

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hand, occupies a niche in the large intestine where it induces syncitium formation and lives partially or completely within the intestinal epithelium and the ability to expel the adult in a primary infection is genetically determined (Kamaraj *et al*., 2010). Thus, in some strains the worms are eliminated before they reach sexual maturity and produce eggs while in others a proportion fails to do so and allows the parasites to mature and establish a chronic infection (Ishikawa and Watanabe, 2011). Observations on the changes in morphology of GI nematodes as an index of protective immunity have largely described reduced size (stunting) of adult nematodes although the loss of vulval flap in some adult female worms have been documented (Ishikawa and Watanabe, 2011).

2.1 Parasites of the forestomach

Paramphistomosis occurs occasionally in cattle and rarely in sheep, with significant disease mainly due to duodenitis caused by migrating immature fluke. Paramphistomes occur commonly in cattle throughout the sub-tropical and wet tropical areas of eastern Australia and the Kimberley region of Western Australia, although infections have been reported elsewhere, including Victoria. Paramphistomes or stomach flukes are conical shaped trematode parasites. Adult flukes are found mainly in the reticulum but also in the rumen. They have a fleshy, pear-shaped body, 5-12 mm by 2-4mm in diameter, and are pink or light red. Juvenile fluke are small (1-2mm long). Most infections of adult fluke are harmless although large numbers of fluke can cause a chronic ulcerative rumenitis with atrophy of ruminal papillae. Peak conical fluke numbers are usually seen in late summer or early winter following prolonged inundation of pasture (Rolfe *et al*., 2001).

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Clinical paramphistomosis is usually diagnosed in cattle 4-18 months of age and is associated with invasion of the duodenum and upper jejunum by large numbers of immature fluke. Counts of up to 30,000 immature paramphistomes may be associated with diarrhoea after 8 weeks grazing in tracer calves (Rolfe *et al.*, 2001). Juvenile fluke are attached to the intestinal mucosa and, being small, are easy to overlook at necropsy. Catarrhal to necrotic and haemorrhagic duodenitis with little thickening may be seen in the early stages, progressing to thickening (mucosal oedema, submucosal hypertrophy), haemorrhages and ulceration. Anaemia, hypoproteinemia (manifested as submandibular oedema) and emaciation of the host ensue. After juvenile fluke migrate to the rumen, the intestine repairs, leaving a thickened duodenum and jejunum as a result of diffuse mucosal and submucosal hypertrophy and fibrosis. Oxyclozanide, present with levamisole in Nilzan, is the most effective anthelmintic for the treatment of acute and subacute paramphistomosis with two treatments given two days apart (Rolfe *et al*, 2001) and combined with fencing to restrict access to wet snail habitats. However, there are currently no anthelmintics, including Nilzan, registered for specific use against stomach.

2.2. Parasites of the abomasums: Haemonchus ('barbers pole worm')

Haemonchus spp are among the most pathogenic helminth species of ruminants. *Haemonchus contortus* is mainly a parasite of sheep and goats (sometimes cattle) and *H. placei* is mainly a parasite of cattle (sometimes sheep and goats). Haemonchus are most dominant in summer rainfall areas. Female worms are 18-30 mm long and are easily recognised by the 'barbers pole' appearance of the white ovaries and uteri twisting for the length of the worm around a red blood-filled intestine. Males are 10-20 mm long and uniformly reddish-brown.

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Both the developing 4th larval stages (L4s) and adults cause punctiform haemorrhages at sites of feeding on the abomasal mucosa which may be oedematous. The ingesta may be reddish brown and fluid. Worms may be attached to the mucosa and free in the lumen. Clinical signs include anaemia and hypoproteinemia (manifested as submandibular oedema). In South Africa, the Famacha system of standard colour charts is used for assessing/scoring the level of anaemia by comparison of the colour of the inner lower eyelid and is used for tactical treatment of heavily infected sheep. In heavy and rapid infections, even animals in fat condition may die relatively quickly. Scouring is not a feature in sheep and goats unless the parasite infection is mixed and includes 'scour worms' (notably Ostertagia and *Trichostrongylus spp*).

Ostertagia ('small brown stomach worm')

Ostertagia spp in small ruminants and cattle tend to be more important in winter and non-seasonal rainfall areas. Heavy infections (particularly if accompanied by *Trichostrongylus spp* in sheep & goats) can cause profuse scouring, ill thrift and possibly deaths. *O. ostertagi* is considered to be the most pathogenic cattle nematode in southern Australia and other temperate cattle raising regions in the world. The free living stages of *Ostertagia spp* can develop at lower temperatures than most other trichostrongylid species. Ostertagia are small, brown hair-like worms. Adult females are 8-12mm long and males are 7-9mm long. Type 1 O. ostertagi infections are composed almost entirely of adult worms resulting from the majority of ingested larvae developing normally to adults in 18-20 days. White, raised, umbilicated nodules (containing developing L4 worms) occur mainly in the fundic mucosa. As the larvae develop and emerge from gastric glands, hyperplasia of gastric epithelium may cause enlargement and

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coalescing of nodules, the mucosa classically referred to as having a 'Morocco leather' appearance (Agyei, 1999). Mucosal congestion and oedema is also evident, with thickening of abomasal folds. In Australia, type 1 infections occur mainly in dairy calves 3-10 months of age and weaned beef calves 6-12 months of age during late winter and early spring. Clinical signs include inappetence, profuse watery diarrhoea (scours) and rapid weight loss. Pre-type II infections consist of large numbers of inhibited (hypobiotic) early L4s in the gastric glands with minimal tissue reaction and clinical signs apart possibly from ill thrift. This form occurs mainly in beef cattle during spring and summer, with inhibited larvae resuming development 4-6 months later in late summer / early autumn.

Type II infections consist of adult worms arising from simultaneous maturation of many inhibited early L4s, with glandular hyperplasia, loss of gastric structure, abomasitis, impairment of protein digestion, and leakage of plasma proteins especially albumin into the gut lumen. The mucosa appears thickened and oedematous. Outbreaks of type II ostertagiosis with diarrhoea and rapid weight loss may be seen in 18 month old beef cattle in autumn and in heifers and cows soon after calving. However, the incidence of type II and other forms of clinical ostertagiosis has tended to decrease with the introduction of anthelmintics with greater efficacy against inhibited and other stages of parasitic worms. These drenches include the third generation benzimidazole carbamates (fenbendazole, oxfendazole, albendazole etc.), but more particularly the macrocyclic lactones (ivermectin, abamectin, moxidectin, doramectin, eprinomectin), which tend to have consistently high efficacy, especially with respect to against inhibited stages, as well as persistent activity against incoming ingested L3s.

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Trichostrongylus axei (‘stomach hair worm’)

Trichostrongylus axei occurs commonly in ruminants, often in association with Ostertagia, and also in other host species, such as horses, but appears to be relatively non-pathogenic. Adult *T.axei* are very small, (smaller than Ostertagia), slender, hair-like and reddish-brown. Females are 5-8 mm and males 4-7 mm long. In heavy infections, aggregations of worms occur mainly in the fundus, with localised hyperaemia progressing to catarrhal inflammation with white raised circular plaques. Heavy burdens (40-70,000 or more worms) may exacerbate Ostertagia - associated gastritis and accompanying clinical signs. The seasonal pattern of larval availability is similar to that for *O. ostertagi*.

2.3. Parasites of the Small Intestines

Trichostrongylus spp (‘black scour worms’) *Trichostrongylus colubriformis* and *T. vitrinus* occur commonly in sheep in Australia, the former tending to be more important in summer rainfall areas and the latter in winter rainfall areas. Commonly they occur in mixed infections with Ostertagia, producing similar clinical signs (inappetence, weight loss and scouring). *T.axei* may also be found in the intestines of sheep and cattle. Sub-optimal nutrition exacerbates pathogenicity. Intake of *Trichostrongylus* larvae is believed to be the primary agent responsible for ‘hypersensitivity scouring’ in sheep. *Trichostrongylus colubriformis* and *T. longispicularis* are recorded in Australian cattle (the latter more so in Western Australia). Small numbers are relatively harmless to young cattle and are usually mixed with larger numbers of *Cooperia spp*. *Cooperia spp* are widespread but relatively uncommon and non-pathogenic parasites in sheep. Adult Cooperia are small (females 6-10mm and males 5-9mm long), reddish hair-like worms. *Cooperia punctata, C. pectinata* and *C. oncophora* occur commonly in the proximal half of the

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small intestine of cattle in Australia, with the first two being more pathogenic and occurring together as a complex particularly in subtropical and tropical areas Besier *et al*, (2002). *Cooperia oncophora* occurs mainly in cooler southern regions of Australia and appears to be relatively non-pathogenic. From 6 months of age, most cattle become increasing resistant to re infection with *Cooperia* larvae. Gross pathology and clinical signs are those of parasitic gastroenteritis, and includes inappetence, intermittent watery diarrhoea and weight loss. Mucosal inflammation and thickening, epithelial erosions (with leakage of plasma proteins into the gut lumen) and profuse mucous exudates may be found at necropsy. Large worm burdens in cattle often in excess of 500,000 may be acquired over a short period, with inhibited early L4s comprising up to 50% of the population, but even such large numbers are not usually particularly pathogenic on their own.

Nematodirus spathiger is a very common parasite of young Australian sheep, and usually relatively non-pathogenic unlike the situation in New Zealand where this parasite inexplicably become more essential from the 1960s. Heavy infections, scouring and ill thrift with mortalities seen in young sheep under or soon after drought conditions in Australia.

Nematodirus is whitish, relatively long (females 18-12mm, males 10-17mm long) compared to other trichostrongyle nematodes, with the anterior portion thinner than the posterior end (hence 'thin–necked intestinal worm'). *Nematodirus helvetianus* occurs commonly but in small numbers in dairy calves, usually mixed with much larger numbers of Cooperia. Alone they appear to be of little significance although in the United States they have been regarded as an important parasite.

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Bunostomum trigonocephalum is a potentially pathogenic parasite of sheep but is relatively uncommon and burdens tend to be light and of little consequence. Anaemia has been attributed to this parasite in New Zealand (Boray *et al.*, 2006). These reddish worms are one of the larger intestinal parasites of cattle (females 24-28mm and males 10-18mm long). *Bunostomum phlebotomum*, the hookworm of cattle, occurs principally in the proximal small intestine. It mainly occurs in mixed infections in dairy calves (Besier *et al.*, 2007). Worms attach to the mucosa by a large buccal capsule, causing mucosal inflammation, thickening and punctiform haemorrhages. Clinical signs include anaemia, inappetence, ill thrift, a dark scour, and submandibular oedema. Infection in calves maintained in wet/muddy conditions can be associated with skin penetration by the infective larvae.

Strongyloides papillosus eggs are often seen in faecal counts in sheep, but this parasite is of doubtful significance. Its importance if any is overshadowed by parasites such as Ostertagia and Trichostrongylus. Female adults are very small (3-6mm long) and parasitise the proximal small intestine, deep in the mucosal crypts, and so are usually overlooked on necropsy except by the most diligent pathologist. *Strongyloides papillosus* can infect animals by ingestion, skin penetration (in wet conditions) and through the milk of lactating ewes. Only female worms occur as parasites in the small intestine and these are parthenogenetic.

Clinical signs reported in experimental infections include anorexia, weight loss, variable anaemia, lassitude, dyspnoea (due to larvae migrating through the lungs) and lameness. Losses in lambs with heavy natural infections during a wet period following a drought have been reported

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from Kenya (Love, 2002). *Strongyloides papillosus* is commonly found in young dairy calves. Clinical parasitism is seen rarely and usually when animals are confined or under wet, muddy conditions. Clinical signs include dull demeanour, inappetence, harsh cost and diarrhoea.

Migrating immature paramphistomes can cause duodenitis. Moniezia and less commonly *Thysaniezia giardi* infect sheep. These tapeworms are generally regarded as relatively harmless. However, anthelmintic combinations containing praziquantel, which is highly effective in removing tapeworms, are actively promoted. *Moniezia benedini* and *M. expansa* are similar in appearance and may reach a length of 600cm. Where as *M. expansa* occurs mainly in sheep, *M. benedeni* is found chiefly in young cattle, and is believed to be of little significance.

Coccidiosis is a parasitic enteritis of small and large intestines of ruminants caused by *Eimeria species*. Oocyst counts may not correlate with severity of infection. Infection may be exacerbated by various stressors and other pathogens (viruses, bacteria and worms). The stress of weaning, even (for example) in calves grazing in extensive conditions under dry tropical conditions, has been known to precipitate clinical disease. Coccidiosis usually occurs in younger animals or in adults introduced to higher rainfall areas from the drier pastoral zones and with high stocking rates or overcrowding under wet and cool conditions. Lesions in acute and subacute coccidiosis include a catarrhal enteritis (mucosa appears velvety), multiple well-defined whitish lesions ranging in size from less than 1mm to patches 7mm in diameter, and whitish, polyp-like lesions or cone-shaped spots depending on the species of Eimeriaand the stage of parasite (schizonts, meronts or gamonts) contained within the lesion. Infections with a mixture of species are common but clinical disease is normally associated with only a small number of species, for

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example *Eimeria zuernii* and *E. bovis* in cattle. In clinical disease, characteristic bloody diarrhoea is often seen.

Once considered a benign coccidium, *Cryptosporidium species* is now regarded as a cause of disease in birds, reptiles and various mammals including man. Cases in farm animals in Australia have mainly involved calves, with isolated diagnoses in lambs, birds and other species (Rolfe *et al.*, 2001). Calves are clinically affected mainly in the first 3 weeks of life with the enteritis being self limiting due to rapid development of host immunity. A diagnosis of cryptosporidiosis is suggested by demonstration of moderate to large numbers of the very small (~5µm diameter) oocysts in faeces of affected animals, or identification of *Cryptosporidium species* in ileal mucosa post-mortem. These oocysts are easily confused with yeasts and usually appropriate stains or interference microscopy to confirm the diagnosis. Clinical signs include profuse non-haemorrhagic diarrhoea of variable colour (often creamy-yellow). Other causes of neonatal diarrhoea need to be considered.

2.4 Parasites of the Large Intestine

Oesophagostomum spp ('nodule and large bowel worms'). *Oesophagostomum columbianum* (nodule worm) and *O. venulosum* (large bowel worm) occur in sheep and goats. Until the introduction of improved pastures (better nutrition) and more efficacious anthelmintics (eg thiabendazole, *O. columbianum* was second in importance only to *H.contortus* in summer rainfall areas. *Oesophagostomum columbianum* has virtually disappeared from higher rainfall areas, which have relatively cold winters and relatively frequent anthelmintic treatments (drenching). However, the parasite still occurs in pastoral zones, and processors sourcing sheep

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from those areas can suffer significant economic losses due to condemnation of intestines ('runners') affected by *Oesophagostomum*-associated 'pimply gut' Histiotrophic phases of larval stages (L3/L4) of *O. columbianum* cause caseous nodules 0.5 – 1cm diameter (histologically *Eosinophilic granulomata*) in small intestines and colon, although small intestinal nodules may be more 'gritty' than 'cheesy'. Nodules can also be found in the lung, liver, mesentery and mesenteric lymph node. Clinical signs in heavy infections include variable diarrhoea, emaciation, a humped appearance and stiff gait. *Oesophagostomum venulosum* is a mildly or non-pathogenic species, prevalent in winter rainfall areas.

It also seems to have partly filled the niche vacated by *O. columbianum* in summer rainfall areas. *Oesophagostomum venulosum*-associated nodules occur infrequently, are small, and occur mainly in the caecum and colon. *Oesophagostomum radiatum* ('nodular worm') and *O. venulosum* occur in cattle, the former being the significant parasite and the most frequently encountered large bowel parasite of cattle. *Oesophagostomum radiatum* particularly favours subtropical and tropical zones and adults (14-22mm long) are whitish and found in thick mucus in the caecum and proximal colon (McLeod, 1995).

Numerous nodular lesions, 3-6mm diameter and resulting from the histiotrophic phase, appear scattered on the serosa of the small intestine and to a lesser extent the caecum and colon. In heavy infections, the caecal and proximal colonic mucosa is congested, oedematous and thickened with excessive amounts of turbid mucus being produced. Such infections may cause severe clinical disease in young animals with signs including in appetence, ill thrift, intermittent diarrhoea, anaemia, emaciation and death. Infections are usually mixed including *H. placei* and

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Cooperia spp. As with *O. venulosum* (large bowel worm) in small ruminants, this parasite in cattle is relatively harmless and prefers cooler, winter rainfall climates. Adults are 10-25 mm long and are found in the caecum and proximal colon. There is a histiotrophic phase but little nodule formation.

Chabertia ovina ('large-mouthed bowel worm')

This parasite widely occurs in sheep, cattle and goats, usually in low numbers, and with a preference for winter rainfall zones. It has little pathogenic significance in cattle and occasionally causes clinical disease in small ruminants. Adult females are 17-20 mm and males 12-14 mm long. Like *Oesophagostomum species*, there is a histiotrophic phase, with L3s entering the wall of the small intestine, re-emerging and then maturing in the caecum and proximal spiral colon. Adults take a plug of mucosa into the buccal cavity, causing haemorrhage, protein loss and oedema. Faeces of affected sheep are soft, mucoid and perhaps blood-flecked.

This parasite occurs commonly in Australia and throughout the world. The most common species in Australian cattle, sheep and goats are *T.ovis* and *T.globulosa*. Adults are 50-8- mm long, creamy-white, with the anterior three-quarters of the body being very slender. Larvated ova are resistant to environmental effects and are ingested with soil. L3 larvae are released from ingested eggs, enter the small intestinal mucosa, and then re-emerge to undergo maturation in the caecum. They attach by their filamentous anterior ends to the mucosa. The eggs are lemon shaped with bipolar plugs. *Trichuris spp* are considered harmless except in very heavy infections (eg large soil intake by grazing animals in drought) in which case there may be a sub acute typhlocolitis, diarrhoea and ill thrift).

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2.5 Parasites of the Liver

Fasciola hepatica (liver fluke) distribution is determined by that of its lymnaeid snail intermediate host. The parasite is generally limited to high rainfall and irrigation areas of, Victoria and Tasmania, with pockets also in South Australia. *Fasciola species* is absent from Western Australia and importation of livestock requires pre and post import faecal sedimentation examinations plus border treatment with triclabendazole. This fluke was inadvertently introduced to West Africa in horses infected with drug-resistant *F. hepatica* from the Goulburn valley of northern Victoria in the early 1990s (Rolfe, 2001), *F. hepatica* is an important parasite of cattle, but more particularly sheep and goats. Patent infections can develop in other wild and domestic animals and in humans. These flukes are leaf shaped and approximately 25 mm long in sheep and slightly larger in cattle.

Adult flukes are found in the main bile ducts of the liver, but occasionally small adults are found encapsulated in caseous nodular lesions in the lungs. Juvenile fluke (8-12mm long) can be squeezed from cut surfaces of the liver. Being hermaphroditic, only one fluke is required to establish a patent infection. Egg production is up to 20,000 per adult per day. Individual fluke may live several years or more. Migrating juvenile fluke cause haemorrhagic tracts in liver parenchyma, with associated peritonitis. Some juveniles become encysted in the parenchyma. Healing proceeds and the tracts are replaced by scar tissue. Heavy infestations by immature flukes may cause death in the stage of acute hepatitis (acute fasciolosis). Black disease (*Clostridium novyi* intoxication) may result during the acute stage also. Acute fasciolosis is not common but occurs in sheep. Mature flukes in bile ducts cause cholangiohepatitis, with changes most severe in the left lobe. From the visceral surface affected ducts may stand out as whitish,

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firm, branching cords due to distension by flukes and bile. Connective tissue proliferates, particularly in cattle, resulting in fibrosis.

Mineralisation of old lesions is also common in affected cattle livers. Acute and sub-acute forms of fasciolosis develop 2-3 weeks after massive infections and signs include anorexia, abdominal pain, yellowish and pale conjunctivae, weight loss and sudden death. Clinical signs develop more slowly in the chronic form and include ill thrift, anaemia, and submandibular oedema ('bottle jaw'). Production losses can be economically significant even in relatively light fluke infections. Clinical signs are less well-defined in cattle, particularly adult cattle, which are more resistant to fasciolosis than sheep.

2.6 Other Internal Parasites

Hydatid cysts (metacestodes of *Echinococcus granulosus*) are fluid filled cysts, some up to the size of oranges or grapefruits, found in the lungs and livers, and rarely free in the peritoneal cavity of cattle and sheep. Recent studies suggest a decreasing occurrence, probably associated with increased awareness of the dangers of feeding uncooked sheep. Hydatid cysts have a typical multilaminar wall which is characteristic even if the cyst is degenerating, necrotic or caseous. In cattle cysts are mostly sterile (devoid of the protoscolices, "hydatid sand"), and are probably derived from accidental ingestion of *E.granulosus* eggs from the sylvatic cycle involving dingos and macropods. In sheep hydatid cysts are usually smaller, are fertile and contain protoscolices.

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Adult worms arising from challenge infections of mice that had previously experienced one or more infections of *H. polygyrus* or from naive mice that had received immune serum prior to challenge were stunted and anaemic with female worms being more severely affected than males. Similarly, adoptive transfer of immune mesenteric lymph node cells (MLNC) induced reduction in adult worm size in recepient rats challenged with *S. ratti* (Robertson *et al*., 2010) and (Shinozaki *et al*., 2010) showed a dose dependent reduction in worm length following single and repeated inoculations of rats with *S. ratti*. Stunting of adult worms as a result of acquired immunity has also been reported for the livestock parasites *Cooperia* spp., *H. contortus*, *O. ostertagi*, and *Trichostrongylus* spp. (Domke *et al*., 2011). Immune-mediated reduction in female worm fecundity is a very important epidemiological factor and in sheep has been implicated as a major regulatory force for GI nematode populations (Stear *et al*., 2009). It has been suggested that reduced female worm fecundity can also be as a result of density-dependent intraspecific parasite competition although data on the role of density dependence are conflicting (Meeusen *et al*., 2005).

Depending on the species of parasite and animal model, reduction in female worm fecundity as a result of developing or acquired immunity can be measured either by reduced faecal egg output, number of eggs in-utero or number of newborn larvae/female worm (Assoku, 2000). In rodent models and ruminants, the first evidence of developing protective immunity to a primary infection and acquired protective immunity following challenge infection (Meeusen *et al.*, 2005) is usually a decreasing egg output and no egg output in faeces respectively. Although faecal egg count is the only parasitological parameter of immunity that can be obtained sequentially and regularly in the same animal in the course of an infection, it does not strictly reflect the fecundity

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of the female worm population (Domke *et al.*, 2011) as a lot of other factors may affect the faecal egg count.

However, a very good correlation between faecal egg counts and the number of eggs in utero was found in *C. oncophora* and *O. Circumcincta (Stear et al., 2009)* infections in calves and sheep respectively. In rodents infected with *Strongyloides* or *N. brasiliensis* faecal egg count as an index of immunity is feasible only in a primary infection as the immunity that develops is very strong and ablates any challenge infection prior to the enteric stage or before maturation and egg production if any larva reaches the gut. Several studies in our laboratory have shown that in such primary infections, development of immune-mediated effect on the female worms is usually manifested as decreasing number of eggs in faeces followed by adult worm expulsion. However, because the decrease may also be related to a gradual decrease in the number of female worms due to expulsion, determining the number of eggs in utero is a better index of decreased fecundity. According to (Perez-Pardal *et al.*, 2010) gastrointestinal parasitism is more severe in goats than in sheep; the main signs included anaemia, weight loss and bottle jaw. High mortality of the young resulted from farmers failure to separate the young stock from adults as well as from the overgrazing of infested pastures coupled with inappropriate or inadequate use of anthelmintics. Helminthiasis occurred all year round, as the larval stages continuously present in pastures were ingested during grazing. Gastro-intestinal parasitism has been ranked with stomatitis pneumo-enteritis complex (SPC) and pneumonia as a major constraint to increased small ruminant production in the humid zone. The commonly identified helminth species from coproscopy and larval cultures were *Haemonchus contortus, Trichostrongylus spp, Oesophagostomun columbianum, Monieza expansa* and *Strongyloides spp* (Agyei, 1999).

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During heavy rains, goats find it difficult to graze in wet pasture, hence there is apparent starvation during the heavy rainfall periods , conversely in the dry season sheep starve owing to the lack of green pastures for grazing (Bertagnoli *et al*., 2011). Ticks pose many problems, mainly neonatal septicaemia. Most farmers complained of their animals voiding blood –tinged urine which is a sign of babesiosis , a tick-borne infection and dermatophilosis. In certain post mortem examination, about 15 to 25 *Oestrus ovis* larvae were recovered from nasal turbinates, sinuses and in some cases even along the pulmonary tract. While mortalities obviously have a severe economic impact, productivity losses owing to morbidity are often underestimated because they are difficult to quantify in different epidemiological situations. These losses, however are very significant and become apparent only when fatal epizootic diseases are contained by vaccination or good management practices (Greiser *et al.,* 2009). *B. coli* is the largest protozoan parasite and the only ciliate parasitic to humans. Ingestion of *B. coli* cysts from pig faeces through water and food intake results in transmission (Toner *et al.*, 2011). Its prevalence among pigs has been reported as 47.2% in China (Kassa *et al*., 2011) and 1.6% in Turkey (Alemayehu *et al*., 2010), but the highest prevalence is found in tropical and subtropical regions of the world. In a study from Denmark, the prevalence of *B. coli* was found to increase from 57% to 100% with increasing age (Nmorsi *et al*., 2006).

It is thought that contaminated feed buckets or pens as well as a lack of careful treatment of faeces from infected animals are the reasons for the high prevalence of these parasites. Further study is needed to evaluate the key factors involved in the high prevalence of *B. coli* in pigs. Estimates of the worldwide prevalence of *B. coli* infection are usually less than 1% (Silva *et al*., 2010). However, the infection rates among swine herders and slaughterhouse workers are as high

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as 28% in Papua New Guinea (Aksoy *et al*., 2007). In recent years, there have been some reports of *B. coli* infection in immunocompromised patients, including HIV/AIDS patients, patients with malignancies, and patients who have undergone organ transplantations (Komaromy, 2010).

A. suum is a causative agent of visceral larva migrans in humans. Humans with liver and lung lesions as well as cases and epidemics of eosinophilic pneumonia have been reported, and *A. suum*-specific antibodies were present in all cases (Kebede, 2008). In Japan and Turkey, 14.7% 3 and 3.7% of pigs, respectively, were estimated to be infected with *A. suum* (Che *et al*., 2005). *Ascaris suum* in pigs is an important zoonotic parasite, as genetic analysis has indicated that pig Ascaris may infect humans (Jimenez et al., 2010). Thus, we need a detailed epidemiological survey to clarify the relationship between environmental factors and the prevalence of parasites on farms. Cattle are known to be important sources of zoonotic parasites, such as *C. parvum*. (Matsubayashi *et al.*, 2009). Recently reported that the prevalence of parasite infections in cattle were 76.5% for *Eimeria* spp., 7.0% for *Capillaria bovis,* and 3.8% for *Trichuris spp*. The prevalence of infectious diseases in animals is related to several factors, including types of food and water, food supply systems, hygienic conditions, location of pens, administration of drugs or vaccinations, and so on. However, cysts of *Cryptosporidium* spp. were not detected in either pigs or beef cattle because acid-fast staining was not performed on the faeces. Gastrointestinal helminthosis deleteriously affects mainly growing cattle.

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CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

This study was designed to be a field and a laboratory based research. Parasites were sampled and sorted from two areas namely; the Tema abattoir and the Amasaman slaughter house. The parasites were identified with the assistance of veterinary officers at the above mentioned abattoirs. After slaughtering the animals, the abomasa and intestines were washed thoroughly and examined for the presence of adult nematodes and cyst of parasites. All recovered parasites were washed thoroughly with saline and stored in 10% formalin in plastic transparent containers. Samples of intestinal contents were also taken and examined macroscopically for the presence of worms or proglottids. The samples were collected in the dry season from August, 2011 to April, 2012. Methods that were used for the analysis are wet mount preparation and formol ether sedimentation. The final analysis included the classification and enumeration of the common parasites, diseases they cause to both the animals and humans. Haematoxylin and eosin staining was done to identify some tissue parasite. Some of the worms were permanently mounted and stored.

3.2 Study Area

The study areas are the Tema abattoir and the Amasaman slaughter house which are located in the Greater Accra Region of Ghana. Ghana lies in the coastal belt of West Africa. Togo shares border with Ghana to the East, Burkina Faso at North, Cote d'Ivoire at the West and the Atlantic Ocean and Gulf of Guinea at the South. The country's climate as a whole is warm and humid. The study areas were chosen based on the fact that one at Tema is certified and well established

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whiles that of Amasaman is not certified and not well established. Tema abattoir is situated along the Tema motorway. The environment is walled with well trimmed grass. It has a store house were the animals are kept when brought to the abattoir before slaughtering. The workers are neatly dress in their attire when working. Most of the processes involved during slaughtering to processing of the meat are highly mechanised. The abattoir has a sales centre where some of the meats are kept in refrigerators for sale to the public. People also bring their own animals to be slaughtered at a fee. It has a qualified veterinary officer who examines the animals after slaughtering. The animals slaughtered are from Ashaiman, Bolgantanga and Techiman.

The Amasaman slaughter on the other hand is located at Amasaman and the environment is walled. The environment is not well clean because the disposal system is not well planned. There is a qualified veterinary officer who examines the animal after slaughtering. The entire slaughtering and processing is manually done. The sources of the animals are mainly Burkina Faso, Navrongo and Tamale.

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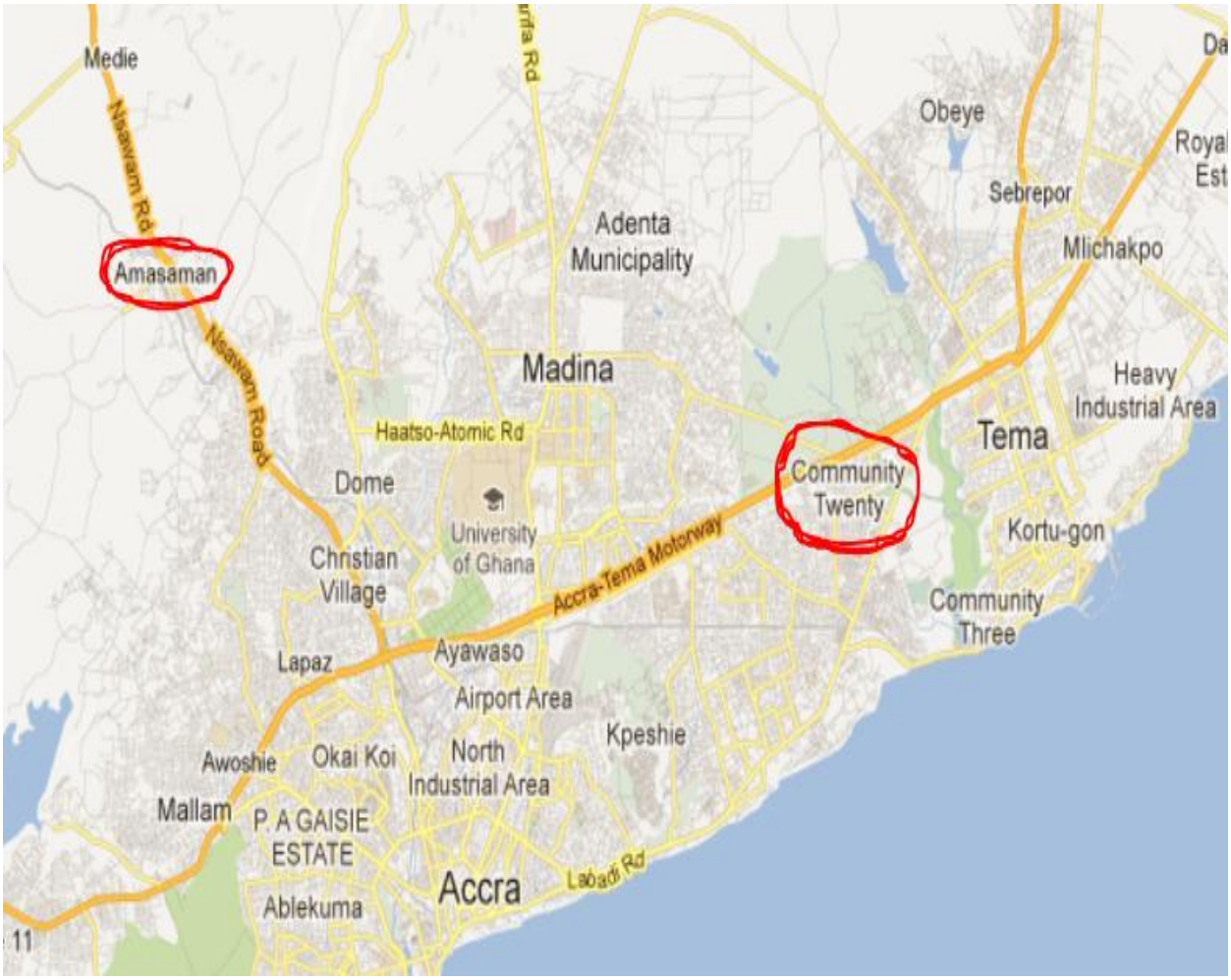


Figure 3.1 Map of Accra showing the location of the study sites (Amasaman and Community Twenty are circled in red).

Source: Greater Accra goggle satellite map.

3.3. Transport of Samples

The samples were collected into plastic containers and transported from the field to the parasitology laboratory of the Microbiology department of the University of Ghana Medical

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School. The samples were stored in plastic containers containing 10% formalin and finally kept in the parasitology museum.



Figure 3.2 *Taenia species* kept in formalin after it has been removed from cattle.

3.4 Sample Size

A total of five hundred samples (two hundred and fifty samples from each of the two sites were collected.

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3.5 Haematoxylin and Eosin Staining for Infected Rumen Tissue

The preserved tissue was dewaxed in two changes of xylene for two minutes. It was then hydrated in decreasing grades of alcohol that is from absolute to 80%, then into 70% and finally in water for two minutes each. The tissues were removed from the formalin and put in water for some few minutes. It was then stained with haematoxylin solution for about five minutes (Figure 3.2). The specimens were then washed briefly in water and differentiated in acid-alcohol. It was then washed again in water and blued for 10-30seconds. The tissues were examined microscopically to ensure that the nuclei were stained deep blue with the vesicular nuclei showing a well-marked chromatin pattern. It was also ensured that the background was showing only weak residual haematoxylin colouration. The specimen was then washed in water and stained with eosin solution for 5 minutes. Finally it was then quickly washed in water, differentiated and dehydrated in alcohol. The specimens were mounted as desired.

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Figure 3.3 Haematoxylin and Eosin staining techniques.

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3.6 Preparation of Permanent Mounts for Rumen Flukes

A drop of Bayer preserved specimen of the rumen fluke was placed on a dry and oil free glass slide. A cover glass was then placed on it gently to prevent air bubbles from forming. An absorbent tissue was used to remove the excess fluid from around the cover glass. A drop of DPX was placed on a microscope slide. The cover glass was gently placed on it. The preparation was turned over to ensure the mountant spreads uniformly. The mountant filled the area around the small cover glass and sealed in the specimen. Finally the preparation was left to air-dry over night and it was completely sealed by applying clear nail varnish.

3.7 Preservation of Worms

Protective gloves and eye shields were worn and fixative solutions of the following volume were prepared. 95% v/v ethanol, 50ml distilled water, 45ml concentrated formaldehyde Solution, 10ml glacial acetic acid.

The fixative solution was transferred into a beaker and heated to sixty to sixty five degrees celcius. The tapeworm or fluke was flatted between two slides which were held loosely together with an elastic band. The specimen was placed in the fixative and stirred gently for a few minutes. It was left in the fixative overnight.

3.8 Ethical Clearance

This work received ethical clearance from the Ethical and Proposal Review Board of the University of Ghana Medical School (UGMS).

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3.9 Statistical Analysis of Data

Results were entered in the Statistical Package for Social Sciences (SPSS) (Version.16, 2007) and analyzed to address the objectives of the study. This comprised descriptive analysis such as comparison of parasites found at the selected areas and the classification. Association between parasites as identified at the two areas was analyzed using logistic regression multivariate analysis.

Pearson chi-square test was used to assess the following null hypothesis:

I. that there is no association between parasites found at the selected abattoirs

II. that there is no difference between the prevalence of the parasites found in ruminants at the Tema abattoir and Amansaman slaughter house. All differences in which the probability of the null hypothesis was $p< 0.05$ were considered significant.

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CHAPTER FOUR

4.0 RESULTS.

4.1 Breeds of animals and parasites found at the Tema abattoir

The source of animals slaughtered at the Tema abatttoir were mainly from Ashiaman, Bolgatanga and Techiman. Table 4.1 below shows the breeds of animals and parasites found in them at the Tema Abattoir. The Sanga breed of cattle had the highest infestation of tapeworms (hydatid cysts and the segments form). It also had the highest number of rumen flukes infestation. The Sahelian breed of goat had higher parasite infestation than the local dwarf breed. The rumen flukes identified were of the same species. The Local breeds of goat are usually from the southern part of Ghana whilst the Sahelian breeds are from the northern part of Ghana.

Table 4.1 Breeds of animals and parasites found at the Tema abattoir

Animal/Breed	**Tapeworms**			**Total (%)**
Animal (550)	**Hydatid cysts**	**Segments**	**Rumen Flukes**	
CATTLE(460)				
Ndama(180)	12	28	13	29
West African (50)	16	2	5	46
Sanga(230)	23	99	24	63
GOAT(60)				
Local dwarf(45)	24	5	2	69
Sahelian(15)	2	7	4	87
SHEEP(30)				
Djallonkey	5	9	14	93

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4.2 Breeds of animals and the percentage infected at the Tema abattoir

Out of 460 cattle slaughtered the Sanga breed were the highest infected with a percentage of 78.3%. Among the goats, 62.2% of the local dwarf goats were infected as compared to 60.0% of the Sahelian type of goat. About 53.3% of the Jalonkey sheep were infected. The Local dwarf breeds of goats are mainly from the southern part of the country whiles the Sahelian breed of goats are from the northern parts of the country (Table 4.2).

Table 4.2 Breeds of animals and the percentage infected at the Tema Abattoir.

BREED OF ANIMAL	INFECTED	UNINFECTED	PERCENTAGE INFECTED (%)
CATTLE(460)			
Ndama (180)	120	60	66.7
Sanga (230)	180	50	78.3
West African(50)	30	20	60.0
GOAT(60)			
Local dwarf(45)	28	17	62.2
Sahelian(15)	9	6	60.0
SHEEP(30)			
Jalonkey	16	14	53.3

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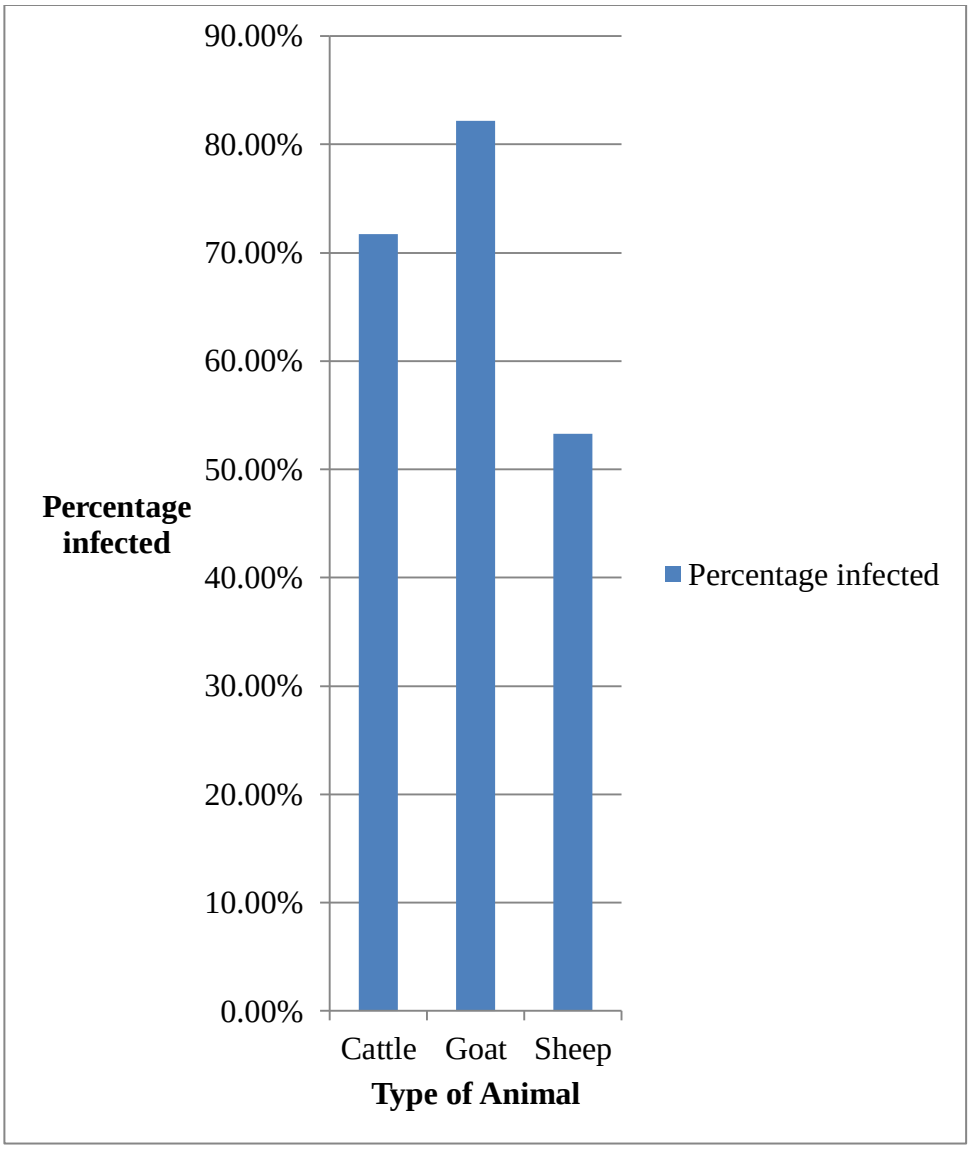


Figure 4.1 Total percentage of animals infected at the Tema Abattoir.

4.3 Percentage of animals infected at the Tema Abattoir

Among all the animals slaughtered at the Tema abattoir goats were the highest infected with a percentage of 82%, followed by cattle with a percentage of 72% whilst sheep were the least infected with a percentage of 52% (Figure 4.1).

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4.4 Breed of animals and type of parasite found at the Amasaman slaughter house.

The source of animals slaughtered at the Amasaman slaughter house were mainly from Burkina Faso, Niger and Navrogo. Table 4.3 below shows the breed of animals and type of parasites found in them at the Amasaman slaughter house. Out of the total of 495 animals slaughtered, 300 were cattle, 165 were goats and 75 were sheep. The Zebu breed of cattle had the highest infestation of tapeworms and hookworms. On the other hand the Sanga breed of cattle had the highest number of rumen fluke infestation whilst the Zebu breed had the least. The local dwarf breed of goats had higher number of tapeworm infestation as compared to the Sahelian breed of goats.

Table 4.3 Breed of animals and type of parasite found at the Amasaman slaughter house.

ANIMAL/BREED(495)	**PARASITES**			**TOTAL (%)**
CATTLE(300)	Tapeworm	Hookworm	Rumen flukes	
Zebu(180)	65	20	12	54
West Africa.Horn(40)	6	8	5	50
Sanga(80)	10	12	20	52
GOAT(120)				
Local dwarf(90)	50	18	20	97
Sahelian(30)	3	9	8	66
SHEEP				
Jalonkey(75)	30	18	15	84

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4.5 Breeds of animals and percentage infected at Amasaman slaughter house.

Out of 300 cattle slaughtered, the Zebu breed had highest percentage infected with a value of 71.7% whilst the Sanga breed had the least percentage infected with a value of 65.0%. The local dwarf breed of goat had 70.0% infected as compared to 60.0% of the Sahelian type (Table 4.4).

Table 4.4 Breeds of animals and percentage infected at Amasaman slaughter house.

BREED OF ANIMAL	INFECTED	UNINFECTED	PERCENTAGE INFECTED (%)
CATTLE(300)			
Zebu (180)	129	51	71.7
Sanga (80)	52	28	65.0
West African(40)	27	13	67.5
GOAT(120)			
Local dwarf(90)	63	27	70.0
Sahelian(30)	18	12	60.0
SHEEP(75)			
Jalonkey	50	25	66.7

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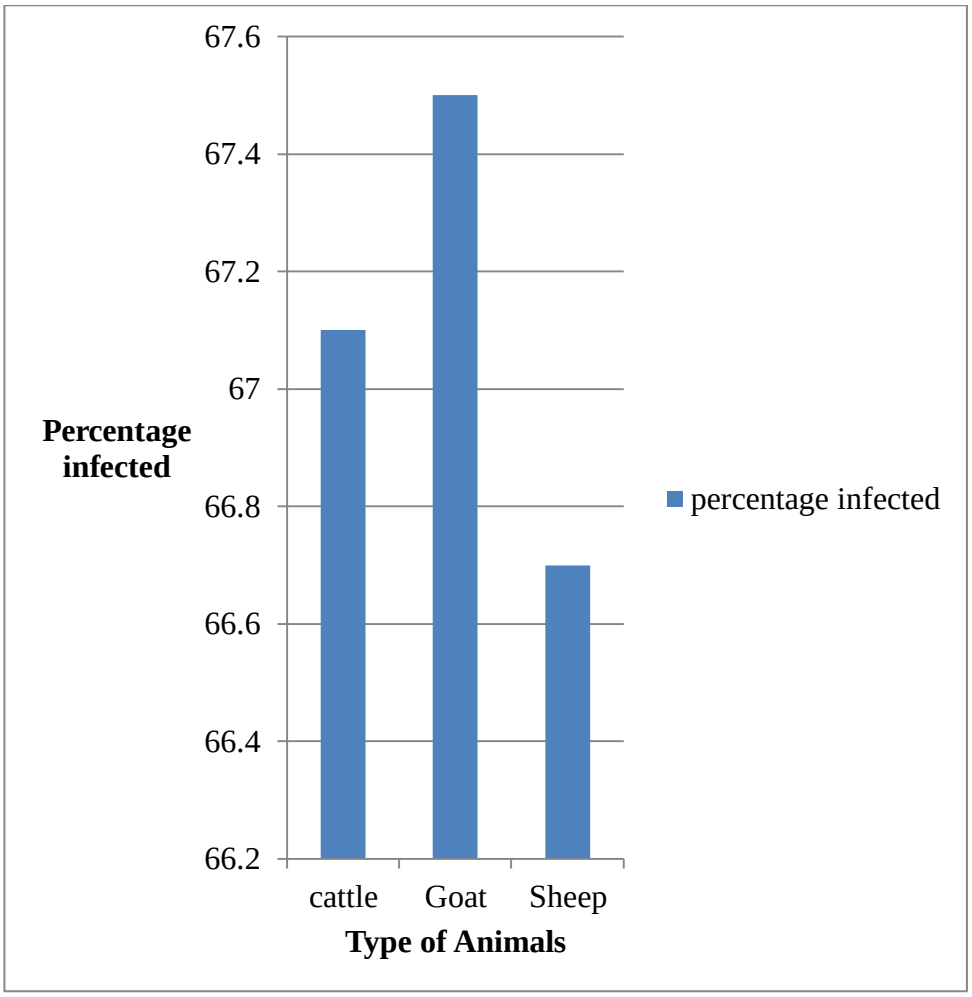


Figure 4.2 Percentage of animals infected at the Amasaman slaughter house.

4.6 Animals infected at the Amasaman slaughter house.

Among all the animals slaughtered at the Amasaman slaughter house, goats were the highest infected with a percentage of 67.5, followed by cattle with a percentage of 67.1 whilst sheep were the least infected with a percentage of 66.7(Figure 4.2).

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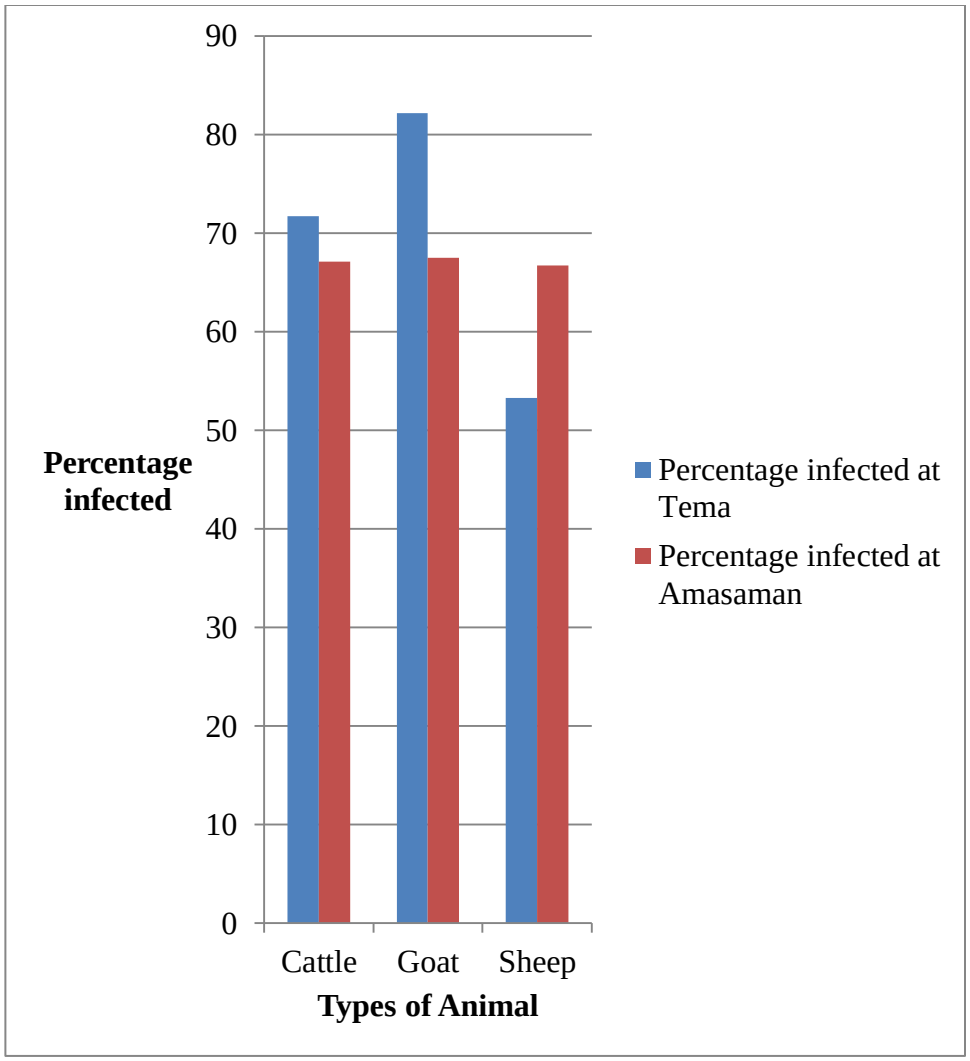


Figure 4.3 Comparison of infections at the Tema abattoir and the Amasaman slaughter house.

4.7 Comparison of infections at the Tema abattoir and the Amasaman slaughter house.

Among all the animals slaughtered at the Tema abattoir and the Amasaman slaughter house, more cattle and goats were infected at Tema abattoir as compared to the Amasaman slaughter house, whilst more sheep were infected at the Amasaman slaughter house than the Tema abattoir (Figure 4.3).

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Table 4.5 Species of tapeworms found in cattle

Cattle	**Tapeworm species**
	Taenia pisiformis
	Taenia ovis

4.8 Species of tapeworms found in cattle

Table 4.5 shows species of tapeworms found in cattle. More of the *Taenia pisiformis* were found as compared to the *Taenia ovis*. This could be due to the fact that one of the species is dominant during the rainy season.

Table 4.6 Species of tapeworms found in goats and sheep

Sheep and Goats	***Tapeworm species***
	Taenia multicep
	Taenia serialis
	Taenia glomerata
	Taenia brauni

4.9 Species of tapeworms found in goats and sheep

Table 4.6 shows species of tapeworms found in goats and sheep. *Taenia glomerata* were dominant as compared to the other species of taenia found in goats and sheep.

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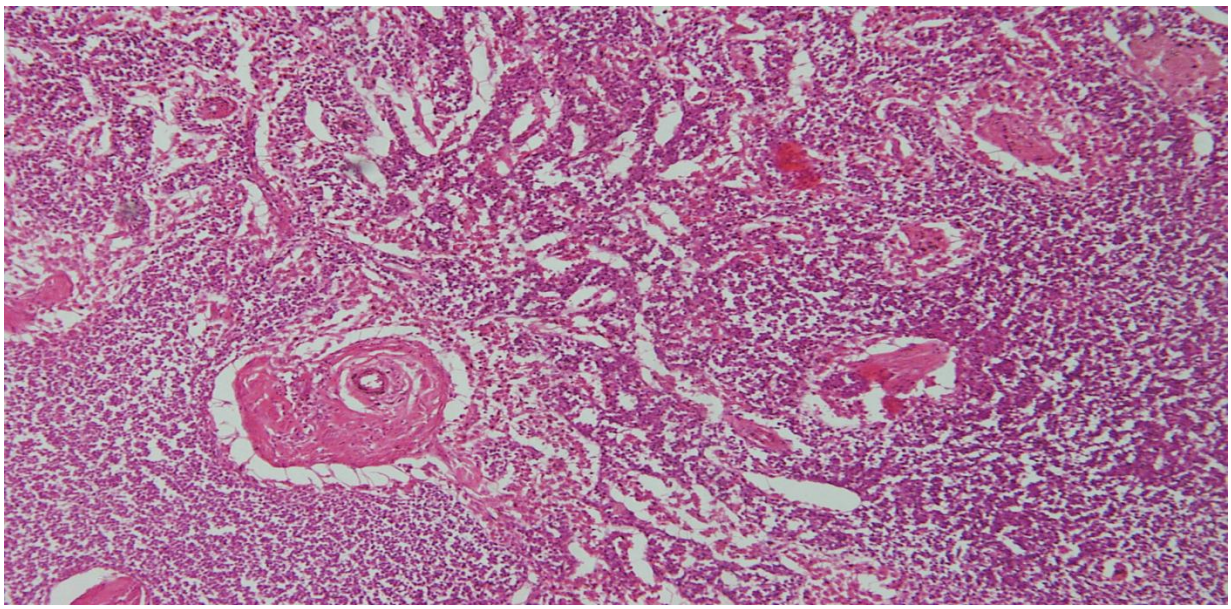


Figure 4.4 Haematoxylin and eosin staining of large intestine tissue showing negative result.

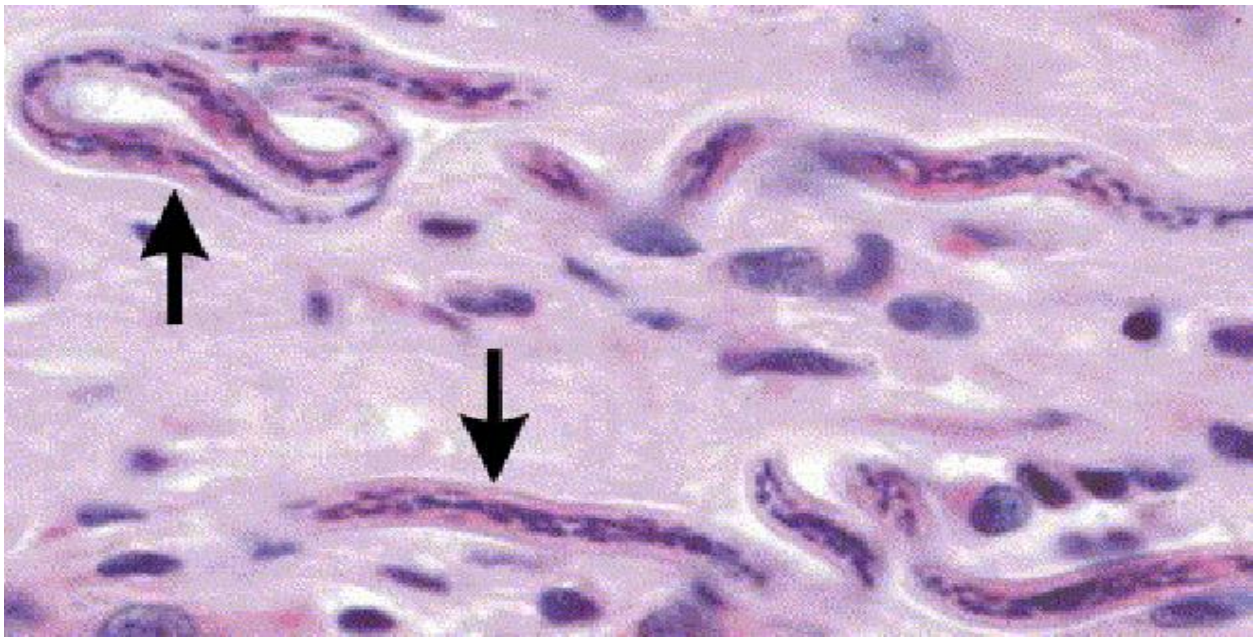


Figure 4.5 Haematoxylin and Eosin staining of large intestine tissue with arrows showing intestinal parasite.

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CHAPTER FIVE

5.0 DISCUSSION

The study indicates that at the Tema abattoir the various breed of cattle slaughtered were Ndama, West African short horn and Sanga, whiles the breed of goats slaughtered were the local dwarf and the Sahelian type but the sheep had only the Jalonkey breed . On the other hand the breed of cattle slaughtered at the Amasaman slaughter house were the Zebu breed replacing the Ndama type but the other breeds were the same. The results also indicate that the overall prevalence of gastrointestinal parasites of ruminants examined at both sites was highest in cattle followed by goats and sheep had the least. It was also observed that regardless of the species of ruminants, the animals were infected with a variety of parasites of which tapeworms and rumen flukes were the most abundant. However different prevalence rate was reported in other parts of East Africa by (Maichomo *et al.,* 2004). The high prevalence rate recorded in the study by (Maichomo *et al* 2004) could be due to the fact that their sample collections were done in both the dry and wet season. It could also be due to differences in management system of the animals. Some livestock owners practise extensive pastorialism in which large numbers of the animals are kept together and this could increase the degree of pasture contamination.

The higher prevalence rate recorded in sheep compared to goats is in conformity with report from eastern Ethiopia by Alemu et al., 2006 . However it contradicts the assumption of initial works in other parts of East Africa by Waruiru *et al*., 2005 that higher parasite prevalence is more common in sheep than goats due to the gazing habit of sheep. The results in this study could be due to the fact that most of the goats used were from lowland and mid altitude areas which are thought to be suitable for survival of larval stage of the parasites. Another reason

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could be due to the fact that, there is poor veterinary infrastructure and medication to goats. More importantly, the condition could be due to less or slow development of immunity in goats to gastrointestinal parasites compared with the situation in sheep and cattle. Another factor that affected the parasites numbers could be insufficient moisture during the dry season which does not favour the survival of infective larvae in the pasture and lower uptake of infective larvae leading to lower prevalence rate. On the contrary the presence of sufficient feed during rainy seasons could in turn increase nutritional status and these well fed animals will develop immunity that suppressed the fecundity of the parasite. A study by Adjei *et al* in 2003 also showed that rainfall is important in the pre-parasitic development of strongylate nematodes and that it promotes their emergence from the faecal pellets or parts. Also the prevalence of infectious diseases in animals is related to several factors, including types of food and water, food supply systems, hygienic conditions, locations of pens and administration of drugs.

In addition increase in prevalence of parasite in an animal is the prevailing agro-climatic conditions like overstocking of the animal, grazing of young and adult animals together with poorly drained land provide ideal condition for the transmission of endoparasites to build clinical manifestation of the host. Comparing the results of the Tema abattoir and the Amasaman slaughter house, the Zebu breed of cattle harboured more tapeworms than hookworm whilst at the Tema abattoir the Sanga breed of cattle harboured more tapeworms. This could be due to the source from which the animals were brought and the prevailing environmental conditions. Most of the animals from the Tema abattoir were brought from the Northern part of Ghana and quite a few from Ashaiman whilst those of Amasaman were from Burkina Faso and Niger. Another significant difference in the parasites found in the various breeds of cattle was that there were

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more rumen flukes in the cattle at Tema abattoir than that at the Amasaman slaughter house. The results also reveal that more tapeworms were found in the local dwarf breed of goats than the Sahelian type at both study sites. This could be attributed to the fact that most of the goats were not kept under good hygienic conditions and veterinary supervision was low.

Comparing proportions of gastrointestinal parasite infections recorded among cattle at the Tema abattoir and the Amasaman slaughter house, the difference is not statistically significant (P=0.47). Also there was no statistically significant in proportions of parasitic infections in goats at both abattoirs (P=0.44). However the proportions of parasitic infection among sheep in both abattoirs were the same (P=0.21)

The results on the haematoxylin and eosin staining were negative for the micrographs taken. Some of the parasites like *Trichinella spiralis* are embedded in the tissues of animals and haematoxylin and eosin staining can confirm their presence.

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CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The parasites identified were tapeworms, hookworms, rumen flukes and hydatid cysts. However the tapeworms were the dominant species and the least were hydatid cysts. Most of the parasites found were at the Amasaman slaughter house and it could be due to the fact that veterinary supervision is low and hygienic conditions were poor. However, sub-clinical infections may be very important economically leading to retarded growth; reduced productivity and animals that are more susceptible to other infections. The animals will also continuously contaminate pastures.

6.2 Recommendation

There is a need to do this study throughout the year so as to get a complete picture which will cover the gastrointestinal parasites in both the wet season and dry season to enable veterinarian's control the parasites. The results from the research shows that some control measures for gastrointestinal parasites needs to be undertaken to reduce the severity of the parasitic infections. In this regard, it is suggested that practice of separate grazing of animals with low stocking rate may be adopted. Furthermore, during the rainy season climatic factors like temperature and humidity are favorable for the development and survival of pre parasitic stages of nematodes. It is, therefore, suggested that anthelmintic treatment on quarterly basis may be implemented to reduce the risk of re-infection; however, resistance to these drugs has recently been observed on several occasions. In order to delay the development of drug-resistant parasite strains, anthelmintics must not be overused.

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Finally appropriate GIT parasite control strategies are needed which should be based on cost effective studies to optimise production.

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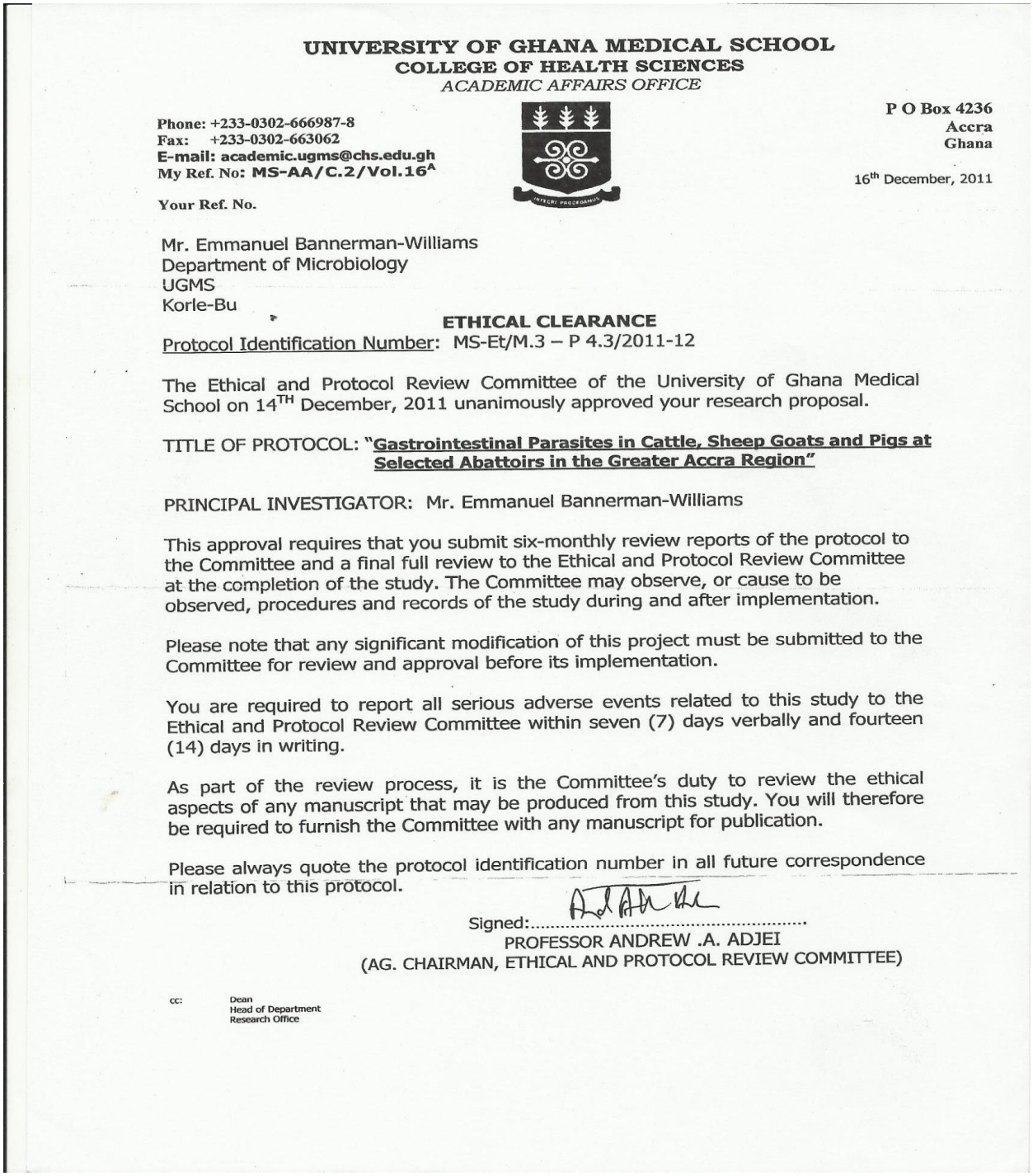
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APPENDICES

APPENDIX A: Ethical clearance from the University of Ghana Medical School.



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Your Ref. No.

P O Box 4236
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16th December, 2011

Mr. Emmanuel Bannerman-Williams
Department of Microbiology
UGMS
Korle-Bu

ETHICAL CLEARANCE

Protocol Identification Number: MS-Et/M.3 – P 4.3/2011-12

The Ethical and Protocol Review Committee of the University of Ghana Medical School on 14TH December, 2011 unanimously approved your research proposal.

TITLE OF PROTOCOL: **"Gastrointestinal Parasites in Cattle, Sheep Goats and Pigs at Selected Abattoirs in the Greater Accra Region"**

PRINCIPAL INVESTIGATOR: Mr. Emmanuel Bannerman-Williams

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Ethical and Protocol Review Committee at the completion of the study. The Committee may observe, or cause to be observed, procedures and records of the study during and after implementation.

Please note that any significant modification of this project must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this study to the Ethical and Protocol Review Committee within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this study. You will therefore be required to furnish the Committee with any manuscript for publication.

Please always quote the protocol identification number in all future correspondence in relation to this protocol.

Signed:.....
PROFESSOR ANDREW .A. ADJEI
(AG. CHAIRMAN, ETHICAL AND PROTOCOL REVIEW COMMITTEE)

cc: Dean
Head of Department
Research Office

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APPENDIX B: Tema Abattoir

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APPENDIX C: The Amasaman slaughter house.