HELMINTH AND BLOOD PARASITES OF THE LOCAL BREEDS OF CHICKENS IN KHARTOUM STATE SUDAN

BY

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Dedication

To my parents, brothers specially Nadir and sisters.

To my husband with my great and deep respect.

To my friends who made this work possible.

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Acknowledgements

In the beginning I Thank Almighty ALLAH who gave me the strength and patience through the period of the study. Then I would like to sincerely thank and gratitude paid to my supervisor Prof Mahamoud Musa Mahamoud about his patience and to express my deep appreciation for his help, advice and guidance during this study.

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Abstract

This study was conducted in the local breeds of poultry in the three towns of Khartoum State (Myou market) in Khartoum, (Omdurman market) in Omdurman and (Elhag yousif market) in Bahrey were served.

The main objective of this study to undergo a survey on helminthes and blood parasites of local breeds of poultry in Khartoum State.

A total of samples were a hundred and one of viscera of chickens were examined for helminthes parasites. Sixty blood smears Giemsa stained were examined for blood parasites. Results revealed two species of cestodes infected the local breed of chicken in Khartoum State these are *Choanotaenia infundbulum* and *Railitina tetragona*. *Choanotaenia infundbulum* had a high prevalence (66.1) in Myou market in Khartoum locality followed by Omdurman market in Omdurman (63.3%) and (Elhag yousif market) in Bahrey (52.3%). The total mean prevalence of *Choanotaenia infundbulum* was 59.4%. *Raillietina tetragona* was recorded in high prevalence in Myou market in Khartoum (14%) followed by Omdurman (6.7%) and Elhag yousif market in Bahrey.
(4.5%). The total mean prevalence of *R. tetragona* was (7.9%) in Khartoum State. Cestode worms recorded in a high prevalence in Myou market in Khartoum (81.4%), followed by Omdurman market in Omdurman (70%) and Elhag yousif market in Babrey (56.8%). The total mean prevalence of cestodes was (67.3%) in Khartoum State table 2 Fig 1.

The results revealed two species of nematodes infected local breeds of chicken in Khartoum State were *Ascaridia galli* was only found in (Elhag yousif market) in Bahrey (4%). The total mean prevalence of *A. galli* was (20%). *Subulura brumpti* was recorded in high prevalence in (Myou market) in Khartoum (59%) followed by Elhag yousif market in Bahrey (43.2%) and Omdurman market in Omdurman (20%). The total mean prevalence of *S. brumpti* was (40.6%). Nematode worms was recorded in high prevalence in Myou market (59%) in Khartoum, followed by Elhag yousif market in Bahrey (47%) and Omdurman market in Omdurman (20%). The total mean prevalence of nematodes was (42.6%) table 3 Fig 2. The results revealed that there was mixed infection (two species of helminth worms) in the viscera of the local breeds of chicken in Khartoum State were *Railietina tetragona* with *Choanotenia infundibulum* recorded in low prevalence in Elhag yousif market in Bahrey locality (2.3%). *R. tetragona* with *C. infundibulum* was not recorded in other study area.
Subulurabrumpeti with Choanotenia infundibulum recorded in high prevalence in Myou market in Khartoum locality (33.3%) followed by Elhagyousif market in Bahrey locality (22.7%) and Omdurman market in Omdurman (13.3 %). Subulura brumpti with Raillietina tetragon were recorded (3.7%) prevalent rate in Myou market in Khartoum locality, (2.3%) in Elhag yousif market in Babrey locality and (3.3%) in Omdurman market in Omdurman locality. However, the highest prevalence of mixed infection was (22.77%) of Subulura brumpti with Choanotaenia infundibulum in Khartoum State.

Plasmodium spp reported in high prevalence in Omdurman market in Omdurman (35%). While in Bahrey and Khartoum both registered (20%). The total mean prevalence of plasmodium spp was (25%) in Khartoum State table 5 Fig 4.
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INTRODUCTION

Poultry are kept in backyards or in commercial production systems in most areas of the world. Compared to a number of other livestock species, more rural communities are involved in the production, marketing and consumption of poultry products. Poultry products have become one of the most important protein sources for man throughout the world. Poultry suffer losses from predators and from diseases caused by viruses, bacteria and parasites. The losses attributable to morbidity are not known but it has been estimated that more than 750 million chickens and ducklings in Africa die each year as a result of various infections (Sonaiya, 1990c). In addition, predators particularly hawks, snakes, dogs, cats, and rats kill or wound an approximate 75 million poultry every year. In Africa, there are over 800 million chickens and of these, more than 80% are rural chickens. In rural areas where subsistence peasantry farming is the main occupation, the rural chickens assume great importance economically, nutritionally and socially (Minga et al., 2006). They cited that, there is a general belief that the rural chicken is resistant to chicken diseases. This belief is well founded in the sense that the rural chicken survives in a harsh environment with a host of pathogens and without any
veterinary intervention. The infection with internal and blood parasites cause decrease of production levels, emaciation, loss of appetites, anaemia and jaundice. Also poultry would take time to achieve a high level of production. The objectives of this study are:

(I) to determine prevalence rates of helminthes species and blood parasites infecting local breeds of chickens in Khartoum State.
Chapter One

LITERATURE REVIEW

1. Poultry helminths and blood parasites

1.1. Introduction

Reid (1984 & 1995) reported that over 1400 species of internal parasites of 193 genera belonging to 17 families have been identified from birds. As many as 45 species of tape worms, belonging to 10 genera have been reported to parasitize domestic fowl (Elowni, 1977).

An investigation into helminths infection of domestic fowl in Meghalaya, India based on an autopsy of 532 chickens, revealed 90.9% prevalence of infection (Yadav et al., 1992). Ten species of helminths were encountered of which *Capillaria contorta* was recorded for the first time from fowls in India; *Ascaridia galli* was the most prevalent species followed by *Railietina* spp (*R. tetragona, R. echinobothrida and R. cesticillus*) and *Heterakis gallinae*. Other helminths found were *C. annulata, Echinolepis carioca, Echinostoma* spp and *strongloids* spp. Trematode infections appeared to be very rare helminths of fowls in this climatic area (affected the presence of their intermediate hosts) (Yadav et al., 1992).
1.2. Life cycle of poultry tape worms

Life cycles of poultry tape worms require intermediate hosts. Reid, (1984) found that such intermediate hosts may be swallowed. Eggs in the faecal mass or the entire proglottid were swallowed by the intermediate host after being attracted by odour or movement. The eggs hatch in the digestive tract and the larvae penetrate the intestinal wall, and enter the body cavity.

The hexacanth embryo develops into a white, bladder - like spherical body known as cysticercoids in the following several weeks. The cysticercoids usually remain alive in the invertebrate intermediate host and become infective to the bird host for many months, for example *Raillietina cesticillus* retains its infectivity for five and a half months (Elowni, 1984). Mechanical or chemical actions within the gut of the definitive host free the cysticercoids. The scolex evaginates, and attaches to the intestinal wall. The cyst wall degenerates and is lost, while the strobila proliferates from the neck region to form a new tapeworm. Most tape worms require 2-3 weeks prepatent period in the bird to mature and release the first proglottids in the faeces (Reid, 1984).
1.3. Pathogenicity of Cestodes

Raillietina tetragona and R. echinobothrida penetrate with their anterior ends deeply into the mucosa and sub mucosa of the duodenum causing formation of nodules which are visible from the peritoneal surface and contain tissue and leucocytes. The young worms of R. tetragona and R. echinobothrida can be found hanging out into the lumen of the gut and later the adult tape worms may be observed in the posterior part of the small intestine. Heavy tape worm infestation often causes enteritis, diarrhoea, emaciation and paralysis of the limbs (Ali, 1994).

1.4. Clinical pathology

Segments of tape worms may be visible macroscopically in the manure and microscopically by examination of floatation specimens and the thick walled embryonated eggs may be present or in egg capsule (Hofstad. M. S, et al 1978).

1.5. Transmission of Tape Worms

Nadakal et al. (1971) and Ali (1994) studied the role of different species of ants in the transmission of poultry tapeworms. They observed that some individuals of the same species harboured concurrently more than one type of cysticercoids - Raillietina tetragona and R. echinobothrida.
1.6. Predisposition factors

1.6.1. Host age

Regarding to the role played by age of chickens affecting the resistance to the helminths infection, Chirinos et al. (1981) found that chickens over 6 months old showed resistance to Heterakis gallinae infection. Devada and Sathianeson (1989) reported Most of the *Syngamus tracheae* infections in birds belonged to the chick age group of 1-2 months. The infection was more frequent in younger birds than in older birds (Soulsby, 1982).

1.6.2. Breed

Movsesyan (1984) found that certain breeds of chicken were relatively resistant to Ascaridia infection, that Erevan race were more resistant to Ascardia galli infection than white Russian race. There are many types, breeds and strains of indigenous poultry which are well adapted to their environment. There is need for their genetic improvement in order to improve their productivity within their local environment (Movsesyan, 1984).
1.6.3. Husbandry

Fowls maintained under free — range conditions became more heavily parasitized with worms than fowls under other systems as reported by many authors (Busa et al. (1970a), Jansen and Pandey (1989), Devada and Sathianesan . (1989), found that the presence of the intermediate host was reduced through good management. Where there is moisture and shade, contamination with worm eggs was encouraged. The system of management appears to have an influence on the susceptibility to parasites.

1.7. Major tapeworms

Out of 193 genera belonging to 17 families which have been identified from birds, two families Davinidae, Dilapidae and two genera Raillietina and, Choanotaenia.

1.7.1. Raillietina tetragona

1.7.1.1. Morphology

Raillietina tetragona is a large fowl tape worm, the adult of which reaches up to 25cm in length. It is characterized by small scolex, with retractile rostella with very small hooks, armed oval suckers and a long slender neck. The genital pores are single, unilateral and located in the anterior of the segments (Elowni 1977, Soulsby 1982)
1.7.1.2. Life cycle and transmission

Raillietina tetragona has an indirect life cycle and its transmission requires an intermediate host in which the cysticercoids stage occurs. Ants transmit R. tetragona belong to genera: Pheidole, tetramarium Nadakal et al. (1971b); Soulsby (1982); Monno morium; Mohammed et al. (1988) discovered that the ants Pachycondyla sennaarensis acted as an intermediate host in the Sudan. Ackert and Reid, (1936) also found that the housefly acts as an intermediate host of R. tetragona. The prepatent period of R. tetragona was up to three weeks (Soulsby, 1982). Mohanined et al. (1988) found that the prepatent period ranged from 13.5 to 18.5 days. Elowni (1977) reported that R. tetragona occupies the posterior upper ileum and the posterior region of the small intestine as well as the large intestine.

1.7.2. Choanotaenia infundibulum

Choanotaenia infundibulum is occurs in the upper half of the small intestine of the fowl and turkey. It may reach 23 cm in length and the segments are markedly wider posteriorly than anteriorly giving the worm a characteristic shape. The rostellum is armed with 16 to 20 slender hooks. Genital pores regularly alternate. The uterus is sac-like, the proglottids leave the body before they are completely gravid and there is doubt as to whether the uterus is
replaced by egg capsules. The eggs have distinct elongate fimaments.

1.7.2.1. Life cycle and transmission

The intermediate hosts of this worm are the house fly (Musca domestica), beetles of the genera Geotrupes, Aphodius, Calathus and Tribolium. The former is the most common host in the United States the latter is common in India (Dut and Sinha 1961). A wide variety of other insects including 9 families of beetles, grasshoppers and termites have been proven to be experimental hosts (Soulsby, 1982). Chickens produce gravid proglottids 13 days after swallowing an infected fly. Elowni and ElBihari (1979) reported natural infection of the beetle Alphitobius diaperinus with cysticercoids of the poultry tape worm Choanotaenia infundibulum. Both the adult and the larvae of this beetle were found to be infected. The susceptibility of the flour beetle, Tribolium castaneum to the infections by the poultry tape worms Raillietina cesticillus and Choanotaenia infundibulum was experimentally evaluated in Khartoum by Elowni (1977), the possible intermediate hosts that are found in the same environment as the poultry tape worms include beetles, ants, flies, grasshoppers, cockroaches, termites, snails, slugs and earthworms (Soulsby, 1982). Elowni and Elbihari (1979) demonstrated natural infections of Choanotenia infundibulum cysticercoids in Alphitobius diaperinus; the infection rate was 14.4 % and 0.75% in adults and
larvae, respectively. Srivastava and Pande (1967) examined various species of ants including Pheidole rhombinoda and Monomorium floricola and demonstrated cysticercoids of Raillietina tetragona in these ants. Other species of ants involved in the life cycle of R. tetragona were Pheidole fossulata and Monomorium salmonis indicum (Mohamed, 1986).

1.8. Diagnosis of the cestode

Diagnosis is usually made at necropsy. Representative members of the flock are examined. Since some cestodes are very small, mucosal scrapings are examined microscopically.

1.9. Anticestodal drugs

Treatment and prophylaxis are associated with control measures directed against the intermediate hosts. Butynorate (75-150mg I kg body weight) is widely used. Niclosarnide and Hexachlororophene are also effective. The latter can depress egg production. Praziquantel and the broad — spectrum Benzimidazole anthelmintics such as albendazole and Oxfendazole are yet to be assessed (Soulsby, 1982). High levels of anticestodal activity were obtained in chicks which had been dosed with Praziquantel (100% efficacy) and Tapinex gave 75-87.5% efficacy. Efficacy of Albendazol against R. tetragona infection in chickens ranged from 37.149. (Dosage at 2.5 mg \( \text{kg}\ \text{day} \) to 73, 7 % efficacy (dosage at 12.5 mg\( \text{kg}\ \text{day} \) (Abdel Hafiz., 1994). Niclosamide causes
spastic and paralytic action on the motility of parasitic Cestodes, Trematodes, Nematodes and (Sano et al., 1982).

1.10. Major Round worms (nematodes)

1.10.1. Subulura brumpti

Subulura brumpti occurs in the caeca of the fowl, turkey, Africa and Asia. The males are 6.9 - 10 mm long and the females 9 - 17.5 mm, lateral alae are present. The small bucal capsule has three teeth at posterior, followed by deep constriction and then spherical bulb. The tail of the male is provided with large lateral alae and it is curved ventrally. The pre — cloacal sucker is an elongate slit, surrounded by radiating muscle fibers. There are ten pairs of small caudal papillae. The spiracles are equal. The alae are 1.3 - 1.5 mm and the vulva is situated just anterior to the middle of the body. The eggs are sub globular with smooth shells, and contain fully developed embryos when laid. They measure 52 — 64 by 41-49im. The intermediate hosts are various beetles of the general Blaps Gonocephalum, and Dermestes and the Cockroach Blatella germanica (Soulsby 1982).
1.10.1.1. Life cycle and transmission

Eggs pass from the definitive host in the caecal droppings. They contain embryos infective to beetles and cockroaches which are the reported intermediate hosts. The larvae hatch in 4-5 hours, penetrate the intestinal wall, and enter the body cavity where further development occurs (Cuckler and Alicata 1944; Barus 1970a). The first larvae moult on the 4th or 5th day after infection, and by the 7th or 8th day the larva encapsulate on the intestinal wall and the moult to the second stage occurs between the 13th and 15th days after ingestion. Shortly thereafter the larvae contract in length and coil in shape with the capsule, becoming the third or infective stage. When the definitive host swallows an infected intermediate host, the larva migrates to the caeca and proceeds to develop to the fourth stage within about 2 weeks. The final molt takes place on about the 18th day after infection. The young adults continue to grow and develop and eggs appear in the faeces in about 6 weeks after infection.

1.10.1.2. Pathology

Cram et al. (1931) did not observe any noticeable lesions produced by this worm in the caeca of quail. Cuckler and Alicata (1944) and Barus and Blazek (1970) reported that the caecum showed no evidence of larval penetration.
1.10.2. Genus Ascaridia

This worm occurs in the small intestine of the fowl, guinea —fowl, turkey, goose, and various wild birds in most parts of the world. Male are 50-76 mm, female 72 — 116 mm long. There are three large lips and the oesophagus has small alae and bears ten pairs of papillae, most of which are short and thick. There is circular precloacal sucker with a thick cuticulum. The eggs are oval shaped, with smooth shells and are unsegmented when laid. They measure 73 — 92-by 45- 57r.m.

1.10.2.1. Life cycle and transmission

The life history is simple and direct. The infective eggs hatch in either the proventriculus or the duodenum of the susceptible host. Ackert (1931) observed that the young larvae, after hatching, live free in the lumen of the posterior portion of the duodenum for the first 9 days, following which they penetrated the mucosa and cause haemorrhages. The young worms enter the lumen of the duodenum by the 17 th or 18 th day and remain there until maturity, in approximately 50 days after ingestion of the embryonated eggs. Tugwell and Ackert (1952) reported that the larvae may enter the tissues as early as the 1St day and remain there as late as the 26th day after infection. They stay there from the 8th to the 17th day in the intestinal mucosa. However, later workers have shown that a few of the larvae penetrate deep into the tissue while the majority
undergoes only brief and shallow association with the intestinal mucosa during the “tissue phase” A. galli eggs ingested by grasshoppers or earthworms hatch and infect chickens, although no development to the larvae stage occurs. Under optimum conditions of temperature and moisture, eggs in the droppings will develop to infectivity in 10-12 days. Under less favorable conditions longer time is necessary. The eggs are quite resistant to low temperature. Farr (1956) recovered Ascaridia galli larvae from experimental birds fed embryonated eggs of this worm which had been exposed continuously to outdoor conditions at Bettsville and Maryland for 66 weeks. Twelve hour exposure to 43°C proved lethal for eggs in all stages of development.

1.10.2.2. Pathology

Ackert (1940) found that chickens infected with a large number of Ascardia suffer from loss of blood, reduced blood sugar content, increased urates, shrunken thymus gland, retarded growth and increased mortality. One of the most readily apparent effects of Ascaridia galli infection is a weight depression in the host, which correlates with increasing worm burden (Reid and Carmon 1958). The nutritional state of the host is also important, since weight depression from infection is greater with higher dietary levels of protein (15%) than with low levels (12.5%). While (Ikeme, 1971c) found no effect of infection on blood protein level, packed cell volume, or hemoglobin levels. Ascardidia galli also has detrimental
effect through interaction (synergism) with other disease conditions such as coccidiosis and infectious bronchitis. A.galli eggs have been also shown to contain and transmit avian reovirus. Vegad et al. (1979) found that Ascairdia galli inhabits the small intestine of chickens, causing obstruction and interfering with digestion which results in retarded growth, emaciation and even death of the infected birds. The worm seldom perforates the intestine producing plueruoperitonitis with the cavity containing putrid exudates.

1.10.2.3. Treatment and control

When birds are reared on a free-range system and ascaridiosis is a problem, the young birds should if possible be segregated and reared on a ground previously unused by older poultry. Since nematodes may be a problem in deep litter houses, feeding and watering systems which will limit contamination of food and water by faeces should be used. In either case treatment with piperazine salts such as levamisole, albenzimidazole or flubendazole can be administered either in drinking water or feed.
1.11. Blood parasites (Haemoparasites)

1.11.1. Classification of blood parasites affecting poultry

Homberg et al. (1964) from a committee on taxonomy of the society of protozoologists has proposed a revised classification that had general acceptance by many protozoologists. They divided the phylum to 4 subphyla of which 2 (Sporozoa and Sarcomastigophora) containing the protozoan parasites of birds. Microfilarias which are nematodes belonging to the phylum and the suborder Filariata have been recorded in poultry. Moreover, they reported that it has been found convenient to divide the parasites into three broad groups with subgroups. These groups are Endoparasites, Ectoparasites and Haemoparasites. The subphylum sporozoa (Apicomplexa) now contains 4 families and 1 igenera that have been reported from birds:

(i) Eimeriida: Eimeria, isospora, tyzzeria and wenyonella.

(ii) Cryptosporidiidae: cryptosporidium

(iii) Sarcocytidae: Toxoplasma, Sarcocystis

(iv) Plasmodidae: Haemoproteus, Leucocytozoan and Plasmodium.

The haemoparasites or blood parasites are mainly found in poultry in tropical areas and the following genera plasmodium spp., Leucocytozoon spp., Aegyptianella spp., Eperythrozoon spp,
and *Trypanosoma* spp. Many recent studies have focused on avian blood parasites (Bensch et al., 2004; Hellgren et al., 2004; Ricklefs et al., 2005). Sehgal et al. (2006) cited that avian trypanosomes are widespread worldwide, but they have only been reported sporadically in chickens in the tropics of the Old World. Interestingly, a single report of *T. calmettei* and a few reports of *T. gallinarum* are known only from Vietnam and Uganda respectively did (Mathis and Léger, 1909; Duke, 1912). Unidentified trypanosomes were reported in chickens from Borneo, Indonesia (Bennett *et al*., 1982). Permin *et al*. (2002) reported trypanosomes identified as *Trypanosoma avium* in chickens in Zimbabwe, but provided no evidence for the species identification. Sehgal et al. (2006) reported that based on the current taxonomy, 3 species of *Leucocytozoon* and 3 species of *Trypanosoma* are found in domestic chickens Gallus gallus domesticus, mainly in tropical and subtropical regions. They thought that *Leucocytozoon caulleryi* is especially virulent; infected chickens frequently show severe signs of anorexia, ataxia, and anemia and have difficulty of breathing. They frequently die because of haemorrhages as a result of rupture of blood vessels that may develop in all organs and tissues (Garnham, 1966; Morii, 1992)
1.11.2. Blood parasites transmission

The majority of Leucocytozoon spp. is transmitted by black flies (Simuliidae). Only L. caulleryi (a chicken-specific parasite) is spread by biting midges belonging to the Ceratopogonidae (Morii, 1992; Vallciunas, 2005). The most common vectors of avian trypanosomes are Hippoboscidae, Culicidae, Ceratopogonidae, and Simuliidae (Olsen, 1974; Baker, 1976). In addition, dermanyssid mites have been identified as avian trypanosome vectors (Molyneux, 1977) also.

1.11.3. Control and prevention of haemoparasites

Nyalie et al (2003) reported that haemoparasites are transmitted by mosquitoes, flies, biting nudge s etc. Control of the arthropods is thus of crucial importance. Screening of the poultry houses may help avoid transmission of the haemoparasites. Also, insecticides may be used to minimize the vectors. A number of drugs are available for treatment against avian malaria. Treatment of Leucocytozoonosis and Aegyptianella spp is not effective.
1.12. Avian malaria

Avian malaria parasite is intracellular parasites in the suborder Haemosporina within the protozoan phylum Apicomplexa. Members of the phylum receive their name from an apical complex of organelles that aids in cell penetration. It also shares developmental characteristics related to its life cycle of alternating phases of sexual and asexual reproduction that require both a vertebrate host and an arthropod vector (Gamham 1966). Avian malaria is caused by protozoa belonging to the genus Plasmodium. About 38 species have been described as members of the genus Plasmodium, which can be pathogenic to penguins, domestic poultry, ducks, canaries, falcons, and pigeons, but is most commonly carried asymptotically by passerine birds. Avian malaria may also infect primates, rodents, reptiles, and birds. Many birds can serve as definitive hosts for these parasites.

1.12.1. Distribution and transmission

Sylvia et al. (2003) cited that both haemoproteus and avian Plasmodium parasites are globally distributed (Atkinson and van Riper 1991). The primary vectors for haemoproteus parasites are biting midges of the genus Culicoides (Diptera: Ceratopogonidae). Avian Plasmodium is transmitted most commonly by Culex mosquitoes (Forrester et al. 1980; Atkinson and van Riper 1991; Schall and Marghoob 1995).
1.12.2. Economic importance

Avian Plasmodium causing malaria has a great economic significance as to the poultry industry. Organisms such as P. gallinaceum, P. juxtanucleare and P. durae may cause up to 90% mortality in poultry.

1.12.3. Clinical signs and pathogenicity

Sehgal et al. (2006) reported that, depending on the strain, clinical signs range from no apparent signs to severe anaemia and death. P. gallinaceum and P. juxtanucleare are most pathogenic and may cause high mortality up to 90%. The presence of extra-erythrocytic stages of P. gallinaceum may block capillaries in the brain producing CNS symptoms and sudden death (Hamza and Elamin, 1995). They reported that the signs are general weakness, emaciation, nervous signs as the result of blocking of capillaries that supply the brain, and parasite hemolytic anaemia, often accompanied by leukocytosis; lymphocytosis and haemoglobinuria, may also be present. Coma and death may occur quickly when the parasite burden is high. Moreover, enlargement of liver and spleen were seen while in chronic cases the liver would atrophy and the liver would fibrose. However, many birds, especially passerines, do not become ill and play an important role as asymptomatic carriers of the parasite.
1.12.4. Plasmodium spp life cycle

Plasmodium may exploit several genera of mosquitoes (Culex, Anopheles, Culiceta, Mansonia, and Aedes) as vectors and intermediate hosts. The mosquito inoculates the bird with sporozoites that enter the bird’s reticuloendothelial system. Each sporozoite develops into thousands of merozoites (pre-erythrocytic cycle). These merozoites rupture their host cell and invade endothelial cells or other cells of the reticuloendothelial system to complete another cycle of replication. This initiates the intraerythrocytic cycle. Merozoites multiply in the RBC, forming a schizont (shizogony stage). The schizont ruptures, killing the RBC and releasing the merozoites to infect more RBCs. During schizogony, the parasites feed on the RBC cytoplasm, ingesting haemoglobin which produces brown pigment granules. The intra-erythrocytic cycles continue until the host dies or the parasites are suppressed by host immunity. After the initial cycles in erythrocytes, a few merozoites develop into sexual cells (microgametes and macrogametes) with each new cycle. The sexual cells are maintained in the RBC until they are consumed by a mosquito with its blood meal. The sex cells are released in the mosquito’s midgut. Fertilization and zygote formation occurs when a microgamete encounters a macrogamete. The zygote matures into an elongated mobile cell that crosses the midgut wall. This cell is called an ookinete. The ookinete forms an locust on the outer
wall of the midgut. The nucleus of the locust divides into thousands of spindle shaped sporozoites. The oocyst then bursts and releases the sporozoites, some of which migrate to the salivary glands where they are injected into a bird during the mosquito’s blood meal. While most avian infections occur through the bite of a mosquito, it is possible for a direct bird-to-bird transmission to occur. Schizogony occurs in the RBCs and, therefore, blood-to-blood transfer without the intermediate host can result in infection. The life cycle of avian malaria is very similar to that seen in malaria infected human beings. However, birds (unlike mammals) suffer from repeated cycles of pre-erythrocytic merogony with reinvasion of reticuloendothelial cells by erythrocytic forms.

1.12.5. Clinical pathologic features and diagnosis

Sehgal et al. (2006) reported that the diagnostic techniques which can be performed by most laboratories are:

- Clinical examination of chickens

- Microscopic identification

Direct microscopic identification of gametocytes or schizonts and initial bodies (Aegyptianella spp.) in erythrocytes or leucocytes in thin blood smears.

- Post mortem inspections
Post mortem of a number of the flock must be conducted if conclusions concerning the disease status of the flock are to be made experimental infection of domestic fowl resulted in peak parasitism six days post-infection in most birds. The birds become febrile and anemic (haematocrit < 24%). Approximately eight days post-infection, dysproteinemia characterized by hypoalbuminemia and a decreased x-2 globulin concentration, with increased y1 and y-2 globulins, would be noted. Biochemical profiles reveal increased serum activities of aspartate aminotransferase, glutamate dehydrogenase, and \( \gamma \)-glutamyltransferase, and a decreased creatinine concentration. Microscopic examination of a Wright’s-stained thin blood smear is a sensitive method to detect Plasmodium intraerythrocytic trophozoites, Schizonts or gametocytes. The trophozoite is a stage of the parasite that develops following invasion of the red blood cell by the merozoite. It is a small round to oval structure with a large vacuole that forces the erythrocyte nucleus to one pole. This results in a “signet-ring” appearance. Schizonts are round to oval inclusions in the red cells containing darkly-stained merozoites. The intraerythrocytic gametocytes of Plasmodium can easily be confused with those of Haemoproteus because they both contain refractive yellow to brown pigmented granules. Features that can help distinguish between the two infections include:
Plasmodium gametocytes are smaller in size than Haemoproteus organisms, usually occupying less than one-half of the host cell cytoplasm. Some Plasmodium gamonts displace the RBC nucleus (Haemoproteus does not) plasmodium may undergo schizogony in the peripheral blood (Haemoproteus does not) Plasmodium parasites can be found in cells other than erythrocytes (thrombocytes, leukocytes, and endothelial cells). In birds that die per acutely, organisms may be few to sparse in the blood. In these cases, schizonts can be found in capillaries by examining impression smears of brain, lung, liver, and spleen. PCR has also been used to diagnose Plasmodium infection. However, this diagnostic test is most often used in a research setting

1.12.6. Control and treatment of avian malaria

Hamza and Elamin, (1995) reported that the control of avian malaria is done by control of the vector (mosquito) by using Lindane, or DDT and the disease can be treated by using Paluderine or Chloroquine.
Chapter Two

MATERIALS AND METHODS

2. Description of study area

The survey was conducted in local breed of chickens all over Khartoum state at three selected localities in Khartoum at Mayu market, Omdunnan at Omdurman market and at Elhaj Yousif in Bahrey. The study area has been selected according to the density of chickens local breed.

Description of local breeds varying colours, size and production, they natural brooders which maintain itself by hatching eggs after the hen broods, over its eggs. There are a high degree of inbreeding in certain flacks kept by farilies. They are important in rural communities for egg and meat production and sometimes an easy sources of cash.

- Chicken samples:
- Internal organs
- Vicera
- Blood samples
- Reagents
2.1. Chicken helminthes survey

A hundred and one viscera of Chickens of local breeds were collected from chickens raised in Khartoum state (Omdurman, Bahry, Khartoum). These organs of the alimentary canals were separated to many parts which included the crop, the proventriculus, the intestine and the two ceca were ligated to prevent transfer of parasite between those organs. Each of these organs was opened and immersed in normal saline in Petri dishes, examined grossly and under magnification and the parasites encountered were collected. The worms collected from each organ identified and recorded then preserved in rounda bush for cectodes in 5% glyerin alcohol for nematodes for further identification. The numbers of nematode parasites encountered were recorded, these worms were cleared in lacto phenol when examined. Depending on the fact that helminths eggs have a lower specific gravity than mast of the fecal matter, this was utilized in order to separate them from the feces (Manual of Veterinary Parasitological Laboratory Techniques) according to the following method:

About 45 glass balls were put in the 120 nil bottle, then 42 ml of water was added. Thereafter 3g of feces putted in each bottle, after that each bottle was shaken until all the fecal matter was broken down. Then few drop of saturated salt are added, until a
meniscus is formed. After that each tube covered with a slide cover. The slide to which the eggs adhered was removed from the tube by lifting vertically with deliberate movement. Then the cover glass was placed on the microscope and examined for worm eggs.

2.2. Survey of blood parasites

2.2.1. Parasitological examination

Sixty Local breed of chicken has been examined from Khartoum state twenty samples from each locality (Omdurman, Bahry and Khartoum). Thereafter, Thin blood film made by dropped small amount of fresh blood in the middle of slide, then other clean slide putted at an angle of approximately 30 and spread right across the slide and then air-dried. The slide was labeled.

Blood films where fixed in 100% absolute methyl alcohol for two minutes, stained in 5% diluted Giemsa for 45 minutes and washed in distilled water and then dried. Immersion oil was put on the blood film and examined microscopically for the detection of the blood parasites at 10x100 magnifications.
Chapter Three

RESULTS

3. Survey of internal parasites

3.1. Cestodes recovered from survey

The study showed the presence of cestodes burden in local breed of chickens in Khartoum state are (R. tetragona, C. infundibulum) as shown in table 1. The results revealed that Choanotaenia infundibulum plate (1) had a high incidence in anterior half of small intestine and it was found in the large intestine and duodenum. R. Tetragona plate (2) had a high incidence in posterior half of the small intestine of chickens as a predilection site and was not found in the duodenum and caeca. The result revealed that Khartoum locality were highly infected by C. infundibulum (66.1%) and lower prevalence of R. tetragona (14%). Similarly, Bahrey locality was highly infected with C. infundibulum (52.3%) and had low prevalence of R. tetragona (4.5%). Omdurman locality appeared to show similar result to Bahry and Khartoum C. infundibulum recorded (63.3%) and R. tetragona (6.7%). The total mean prevalence of C. infundibulum (59.4%) and R. tetragona (7.9%) table2, figure1
### Table (1): Distribution of cestodes in the intestine of local of chicken naturally

<table>
<thead>
<tr>
<th>Cestodes</th>
<th>Duodenum</th>
<th>Anrerior half of small intestine</th>
<th>Posterior half of small intestine</th>
<th>Latestine</th>
<th>caeca</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. tetragona</td>
<td>0</td>
<td>(+++)</td>
<td>(+++)</td>
<td>(+)</td>
<td>0</td>
</tr>
<tr>
<td>C. Infundibulum</td>
<td>0</td>
<td>(+++)</td>
<td>(+)</td>
<td>0</td>
<td>(+)</td>
</tr>
</tbody>
</table>

Intensity of parasitic burden

+++ high intensity

++ Medium intensity

+ low intensity
<table>
<thead>
<tr>
<th>Area</th>
<th>Chickens No.</th>
<th>R. tetragona +ve (%)</th>
<th>C. infundibulum +v (%)</th>
<th>Total +ve (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khartoum</td>
<td>27</td>
<td>4(14)</td>
<td>18(66.1)</td>
<td>22(81.4)</td>
</tr>
<tr>
<td>Bahrey</td>
<td>44</td>
<td>2(4.5)</td>
<td>23(52.3)</td>
<td>25(56.8)</td>
</tr>
<tr>
<td>Omdurman</td>
<td>30</td>
<td>2(6.7)</td>
<td>19(63.3)</td>
<td>21(70)</td>
</tr>
<tr>
<td>Total</td>
<td>101</td>
<td>8(7.9)</td>
<td>60(59.4)</td>
<td>68 (67.3)</td>
</tr>
</tbody>
</table>

Table (2) Cestode worms burden in local breed of chicken in Khartoum state..
Fig (1) Cestode worms burden in local breed of chicken in Khartoum state.
3.2. Nematode worms

The result revealed that tow species of nematodes Ascaridia galli plate (3) & (4) and Subulurabrumpli plate (5). Khartoum locality were highly infected by S. brumpti (59%), and A. galli not recorded. In Bahrey locality S. brumpli recorded (43.2%) and A. gaul (4%). In Omdurman locality S. brumpti (20%) and A. galli not reported. The total mean prevalence of S. brumpti was (40.6%) and A. galli was (2%) in Khartoum State Table 3 and Figure 2. On the other hand, mixed infection has been recorded; these infections of two different species such as Subulurabrumpti with Choanotaenia infundibulum were 22.77% as highest prevalence in Khartoum State, shown in Table 4, Figure 3. The survey revealed that trematodes worms not found during the study period at selected area.
<table>
<thead>
<tr>
<th>Area</th>
<th>Chickens No.</th>
<th>Subulura +ve (%)</th>
<th>Ascaridia +ve (%)</th>
<th>Total +ve (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khartoum</td>
<td>27</td>
<td>16(59)</td>
<td>(0)</td>
<td>16(59)</td>
</tr>
<tr>
<td>Bahrey</td>
<td>44</td>
<td>19(43.2)</td>
<td>2(4)</td>
<td>21(47)</td>
</tr>
<tr>
<td>Omdurman</td>
<td>30</td>
<td>6(20)</td>
<td>(0)</td>
<td>6(20)</td>
</tr>
<tr>
<td>Total</td>
<td>101</td>
<td>41(40.6)</td>
<td>2(2)</td>
<td>43 (42.6)</td>
</tr>
</tbody>
</table>

Table (3): Nematodes worms burden in the local breed of chicken in Khartoum state
Fig (2): Nematodes worms burden in the local breed of chicken in Khartoum state

![Graph showing the percentage of nematode worms burden in different localities: Khartoum, Bahrey, Omdurman, and Total. The bar graph compares the percentage of S. brum, A. galli, and the total percentage across these localities.](image-url)
Table (4) shows two genera of helminthes detected in the local breeds of chicken in Khartoum state

<table>
<thead>
<tr>
<th>Area</th>
<th>Sample No</th>
<th>R/ch +ve (%)</th>
<th>S/Ch +ve (%)</th>
<th>S/R +ve (%)</th>
<th>S/A +ve (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khartoum</td>
<td>27</td>
<td>0</td>
<td>9 (33.3)</td>
<td>1 (3.7)</td>
<td>0</td>
</tr>
<tr>
<td>Bahrey</td>
<td>44</td>
<td>1 (2.3)</td>
<td>10 (22.7)</td>
<td>1 (2.3)</td>
<td>2 (4.5)</td>
</tr>
<tr>
<td>Omdurman</td>
<td>30</td>
<td>0</td>
<td>4 (13.3)</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>101</td>
<td>0.99</td>
<td>22.77</td>
<td>2.97</td>
<td>1.98</td>
</tr>
</tbody>
</table>

Table (4) shows two genera of helminthes detected in the local breeds of chicken in Khartoum state

**CH:** Choanatoaenia infundibulun  
**R:** Raillientina tetragona  
**A:** Ascardia galli  
**S:** Subulura Braumpti
Fig (3): Shows two genera of helminthes detected in the local breeds of chicken in Khartoum state

CH: *Choanatoaenia infundibulun*  
R: *Raillientina tetragona*

A: *Ascardia galli*  
S: *Subulura Braumpti*
3.3. Blood smears

The survey showed that Plasmodium spp was detected in the local breed of chickens, but there was some variation between localities. Omdunnan farms had the higher incidence of Plasmodium parasites in their local breed of chickens with 7 positives samples (35%) and 13 negative samples (65%), whereas Bahrey and Khartoum farms both registered 4 positive samples (20%) and 16 negative ones (60%), as shown in table (5), fig (4).
Table (5) summary of the finding of plasmodium spp, in local breed of chicken in Khartoum State

<table>
<thead>
<tr>
<th>Location</th>
<th>No animal examind</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khartoum</td>
<td>20</td>
<td>7(35%)</td>
<td>13(65%)</td>
</tr>
<tr>
<td>Bahry</td>
<td>20</td>
<td>4(20%)</td>
<td>16(80%)</td>
</tr>
<tr>
<td>Omdurman</td>
<td>20</td>
<td>4(20%)</td>
<td>16(80%)</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>15(25%)</td>
<td>45(75%)</td>
</tr>
</tbody>
</table>
Fig (4) prevalence of the plasmodium spp, in local breed of chicken in Khartoum State
Plate (1) circular scolex of Choanotaenia infundibulum
Plate (2) Oval scolex of Raillietina tetragona
Plate (3) anterior of Asearidia galli (large lips)
Plate (4) Posterior of the bointed end of Asecaridia galli male
Plate(5) anterior view of Subulura brumpti (doulp of sophagus)
Plare (6) Plasmodium spp. As seen in chiken smear (Giemsa stained)
The indigenous breeds of poultry have developed a pattern of resistance to disease that ensures their survival in adverse living conditions which characterize a village farmer’s or shepherd’s living domains. In this environment, the care given towards such chicken has always been poor. The housing system is open without any organized husbandry efforts with regard to rearing chickens in such backyards. Therefore the local breeds tend to find their own way to get access to feed and water through scavenging and look for hidden places as protective shelters such as old broken jars or nearby peripheral bushes to lay their eggs and brood on them until they hatch in comparison with their foreign counterparts, which receive proper hygienic attention and good plentiful food and housing. Imported breeds are bred for high productivity and growth efficiency. Very little research is published regarding local breed productivity potential and growth efficiency. They are, therefore, considered to be very inferior compared with their foreign counterparts. However, the foreign breeds of poultry have weak tolerance to diseases and adverse environmental conditions, a disadvantage compared with local breeds. Therefore local breeds are easier to be reared in the Sudan, under field backyard conditions. Moreover, the local breeds, if they are properly attended to, may provide the golden solution for the problems of
malnutrition facing poor people by providing a cheaper source for proteins that compensate the shortage in protein created by the rise in red meat prices. Besides, any surplus of production can be made available to the local market providing additional economic benefits to the local population. This observation had been made by many authors before (Eisa et al, 1976 and Al., 1994). This study investigated the parasite load of local breeds of chicken reared at the backyard husbandry. This study revealed that chicken load regarding nematodes was (42.6%) in Khartoum State, and cestodes was (67.3%).

Ali (1994) found that the occurrence of nematodes and cestodes was similar (69.39%). The types of nematodes reported in this study were *Ascaridia galli* and *Subulurabrumpti*. This is in agreement with Eisa et al,(1976) and Ali (1994). However, Eisa et al., (1976) found *Tetrameres americana*, *Congylonema ingulvicola*, and *Acuaria spiralis*, which were not found in this survey.

The prevalence of *Ascaridia galli* was 2% in Khartoum State, while ali (1994) reported that it was 4.08%. It was also noted that *Ascaridia galli* was found only in Bahrey area in combination with *Choanotaenia infundibulum* which was in agreement with Eisa et al. (1976) and Ali (1994).

There is scantily information about blood parasites in local chickens in Sudan. This study was carried out to detect blood
parasite in local breeds of chicken in Khartoum State. This survey revealed that *plasmodium spp.* was (35%) in Omdurman, (20%) in Khartoum and Bahrey (20%). This finding seems to point to *P. gallinaceum* although Soulsby (1982) pointed out that this species is not found in Africa. Blood parasites in poultry are rarely associated with clinical symptoms such as Anaemia (Kufinann, 1996). This observation was found to be true in local breeds where no chickens with blood parasites had anaemia. This result agrees with Kaufrnann, (996) who found that the local breeds of chicken which were infected by avian malaria had no apparent clinical signs. The disease was not considered important economically to the local chickens although the disease has its effect on imported poultry production. This study revealed that avian malaria is widely distributed in Khartoum State. The overall prevalence was 25% using blood smear technique. This finding agrees with Fallon et al. (2006) and Sturrock et al. (2007) who found avian malaria in different bird species using blood smear and polymerase chain reaction (PCR). With regard to the different localities, the higher prevalence of the *Plasmodium spp.* was 35% in Omdurman, while the lower was 20% in Khartoum and 20% Bahrey.

This study showed that the local breeds of chicken had high parasite load, however, they have showed sufficient resistance which enabled them to survive and be healthy enough for sale in the local market without costing the producer but a minimum of expense. This is encouraging and is an incentive for more research.
to reveal their potentialities as a cheap source of food for the public.
CONCLUSION AND RECOMMENDATION

The study revealed that cestode worms had a higher prevalence rate among local breeds of chicken in Khartoum State. This maybe due to the high abundance of the intermediate hosts such as ants, beetles and house flies. Particularly Choanotaenia infundibulum and Subulurabrumpti had a higher prevalence in Khartoum locality (Myou Market) followed by Babrey locality (Elhag Yousif market) and Omdurman locality (Omdurman market).

Ascaridia gauli only found in Barey locality in combination with Subulura brumpti. However, trematodes were not recorded all over Khartoum state. This could be attributed due to absence of their intermediate hosts in the study area. Plasmodium spp were found in moderate prevalence in the study area. It is recommended to apply advanced techniques such as serological tests and polymerase chain reaction (PCR) could be used to identify Plasmodium spp recorded in this study. Proper veterinary services are recommended to control parasites and their intermediat hosts of local chickens in Khartoum State for the purpose of increasing their productivity. Thus, this is expected to increase the income of resource-poor families.
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バック

لاخلصة

في الوضع المتداول، الالتهاب الدوائي من الأحياء المثلثية والبشرية في الدراسة هذه العملية الأسدية (الجروح)

(المناطق المحلى، نُمَر) اللاحالي في الدراجات 20، يأخذ أن وهي ت يكن أعمى صاحبية، وتدفع تماينً يوصي في الدراجات الطبية، ويشكل في الدراجات، ويفل thừa الوضعية بالجروح في الوضعية الفوسي وكسوة، ثم إجراء وذالك دورة الحلاية (نعم، بالجروح، أن، وتماين) الوضعية.

المنطقة 35.49 لو الجزء الكاحلي أو التشيع، الدراجات 60 لونة في الوضعية، 68% 37.3 في اثباث المظهر، الدراجات في الوضعية. في الوضعية 22، أعلى (أو نمَر) اللافت، الدراجات تقدم تفاصيل في الوضعية 27، أن،这样做، الدراجات في الوضعية (أو نمَر) الدراجات في الوضعية.

المنطقة: الدراجات 43، الدراجات فوق، الوضعية، في الدراجات في الوضعية. (أو نمَر، الدراجات) 61، الدراجات في، الدراجات، الدراجات، الدراجات في، الدراجات 27، أثيوبيا، الدراجات، الدراجات، الدراجات في، الدراجات 21، الدراجات 30، الدراجات في، الدراجات، الدراجات: الدراجات 30، الدراجات في، الدراجات، الدراجات، الدراجات 20، الدراجات في، الدراجات، الدراجات 6، الدراجات في، الدراجات.
The study included the examination of 101 birds from Egypt. Out of these, 30 were infected with Choanotaenia infundibulum, 23 with A. galli, and 44 with subulura brumpti. These findings support the idea that waterfowl are often hosts for these parasites. The results also emphasize the importance of waterbird populations in the transmission of these intestinal parasites.
The number of patients with malaria was 20, which was 35% of the total number of patients. Among them, 4% of the samples were positive for Plasmodium spp. (Plasmodium spp)