

SURVEY AND MANAGEMENT OF PARASITIC INFECTIONS OF DOGS IN ZARIA

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DECLARATION

The work presented in this Thesis is original and carried out under the supervision of Professor S. U. Abdullahi, Professor R. I. S. Agbede and Prof. J. B. Adeyanju in the Small Animal Clinic of the Veterinary Teaching Hospital and the Laboratory of the Department of Parasitology and Entomology, Ahmadu Bello University, Zaria.

The work of other investigators was referred to and acknowledged. No part of this Thesis has previously been submitted for a degree or diploma.



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December, 1990

DEDICATION

This work is dedicated to my late mother Mrs. Yadu Adawa, Whose dream was to see me become a Veterinarian.

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ABSTRACT

A survey and management of parasites of dogs presented to the Small Animal Clinic of the Ahmadu Bello University Veterinary Teaching Hospital were carried out for a period of one year (March 1988 to February, 1989). Out of the 387 dogs examined, 360 (93.03%) had external parasites. Ticks were the commonest of the external parasites (330 dogs) with *Rhipicephalus sanguineus* being the commonest (291 dogs). The other external parasites included *Haemaphysalis leachi* (31 dogs), *Amblyomma variegatum* (7 dogs), *Rhipicephalus appendiculatus* (1 dog), *Ctenocephalides felis* (23 dogs), *Sarcoptes scabiei* var. *canis* (6 dogs), *Cordylobia anthropophaga* (15 dogs), *Linognathus setosus* (2 dogs) and *Menacanthus stramineus* (1 dog). The back, interdigital spaces, ears, neck and to a lesser extent, the head, chest and abdomen were the predilection sites for ticks. The neck and head were the predilection sites for mites, while fleas and lice were mainly seen on the back. Maggots of *Cordylobia* were mainly observed on the chest, abdomen and interdigital spaces.

Of the 387 dogs surveyed, 205 (53%) had haemoparasites and 221 (57%) had gastrointestinal (GIT) parasites. The haemoparasites included *Hapatozoon canis* (105 dogs), *Babesia canis* (62 dogs), *Ehrlichia canis* (28 dogs) and microfilaria of *Dipetalonema neconditum* (10 dogs). The haemoparasites were more prevalent in local than in exotic and mixed breeds of dogs. The GIT parasites included *Ancylostoma caninum* (135 dogs), *Taenia* spp (32 dogs), *Toxocara canis* (19 dogs), *Toxoascaris leonina* (7 dogs), *Capillaria* spp (5 dogs), *Dipylidium caninum* (7 dogs), *Trichuris* spp (1 dog) and *Isospora* spp (12 dogs). Fewer helminths were recovered from the exotic breeds compared with local or the mixed breeds of dogs. A single subcutaneous ivermectin injection at a dose of 400 µg/kg resulted in 96-100% efficacy against infestation with external parasites, however three treatments were required to eliminate *Demodex canis* infestation. The drug prevented re-infestation with those parasites for 7-28 days. Similar impressive results

were obtained when the same dose of the drug was given to dogs with microfilarie and GIT parasites. However, the drug was only weakly effective against *T. canis* infection and was completely ineffective against *Isospora* and tapeworm infections. It was concluded that external and internal parasites are still highly prevalent in dogs of Zaria area. It was also concluded that ivermectin is safe and broadspectrum in activity against the common external parasites and parasitic nematodes of dogs in Zaria.

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LIST OF ABBREVIATIONS USED

% - Percentage

mcg - Microgramme

kg - Kilogramme

et al - and others

(R) - Trade Mark

MSD Agvet - Merk Sharp and Dohme Incorporated Agriculture and Veterinary Division.

REVIEW OF LITERATURE

1.1 Parasitic Infections of Dogs in Nigeria

1.1.1 Introduction

A parasite is a smaller organism that lives on or in and at the expense of larger organism (host) (Baker, 1970). The prevalence and importance of several external and internal parasites of dogs in Nigeria have been reported. Thus external parasites (e.g. ticks, mites, lice, maggots and fleas), gastrointestinal parasites (e.g. hookworms, roundworms, tapeworms and protozoa) and blood parasites (*Babesia*, *Ehrlichia*, *Hepatozoon* etc.) constitute the main disease problems of Nigerian dogs (Anene and Omamagbe, 1987). The effects of these parasites is aggravated by the poor nutritional status of the dogs.

1.1.2 Prevalence of External Parasites

A number of external parasites (ticks, lice, mites, maggots and fleas) have been reported on Nigerian dogs (Dipeolu, 1975; Agbede, 1981, Idowu and Adetunji, 1981). In a survey of dogs in two small animal clinics and some households in the suburbs of Ibadan, the following ectoparasites were identified; ticks (*Rhipicephalus sanguineus*, *Rhipicephalus simus senegalensis*, *Haemaphysalis leachi leachi* and *Rhipicephalus longus*); maggots (*Cordylobia anthropophaga*); Lice (*Linognathus setosus*, *Trichodectes canis* and *Heterodoxus spiringer*); and fleas (*Ctenocephalides canis*). Of these parasites, ticks accounted for 80% of external parasites seen on dogs surveyed (Dipeolu, 1975). In a similar study in Zaria, the following parasites were encountered; ticks: (*Rhipicephalus sanguineus* and *Haemaphysalis leachi*); fleas (*Ctenocephalides felis*); maggots

(*Cordylobia anthropophaga*); louse (*Linognathus setosus*); and mites (*Otodectes cyanotes* and *Sarcoptes scabiei*) (Agbede, 1981). Ticks were the commonest, accounting for 70% of the parasites seen. Similarly, Tinau (1981) reported a prevalence rate of 81% for ticks in a survey of dogs presented to the Small Animal Clinic of the Ahmadu Bello University Veterinary Teaching Hospital, Zaria. In all surveys (Ibadan and Zaria), *Rhipicephalus sanguineus* were found to be the most common tick found on Nigerian dogs (Dipeolu, 1975; Agbede, 1981; Tinau, 1981). Mites are second only to ticks in terms of abundance and *Demodex canis* is the commonest mite of dogs in Nigeria (Idowu and Adetunji, 1981). Lousiness is a rare skin condition seen on Nigerian dogs (Dipeolu, 1975; Agbede, 1981).

1.1.3 Prevalence of Gastrointestinal Parasites

Several gastrointestinal (GI) parasites have been reported in Nigerian dogs. These include hookworm (*Ancylostoma caninum*), roundworms (*Toxocara canis*, *Toxoascaris leonina*), tapeworms (*Taenia* spp, *Dipylidium caninum* and *Echinococcus granulosus*), protozoa (*Isospora* spp. and *Amoeba* spp) and others (*Trichuris vulpis*, *Spirocerca lupi*, *Strongyloides* spp) (Idowu *et al.*, 1977; Olufemi and Bobade, 1977; Dodo *et al.*, 1979; Saror *et al.*, 1979; Baba *et al.*, 1983; Fabiyi, 1983; Ezeokoli, 1984).

Ancylostoma caninum is the commonest helminth reported in Nigerian dogs (Idowu *et al.*, 1977; Olufemi and Bobade, 1977; Saror *et al.*, 1979; Baba *et al.*, 1983). However surveys involving recovery of helminths during necropsies indicate that *Dipylidium caninum* is the most abundant helminth of Nigerian dogs (Dada *et al.*, 1979; Fabiyi, 1983). The commonest GI protozoa in Nigerian dogs are *Isospora* spp. (Idowu *et al.*, 1977; Ezeokoli, 1984). *Echinococcus granulosus* is the least seen helminth of dogs in Nigeria; only one report of the helminth has been made (Dada *et al.*, 1979).

There appears to be no significant difference in the distribution of GI parasites of dogs in various geographical zones of Nigeria. However, from available reports, it would appear that Jos (North) has an exceptionally high prevalent rate of *Spirocerca lupi* (69%)

infection (Fabiyl, 1983). Its been reported that GI parasites are more prevalence in stray dogs compared to pet dogs (Dada *et al.*, 1979; Fabiyi, 1983; Ezeokoli, 1983). Similarly, Nigerian local dogs have a higher prevalence rate of GI parasites compared to exotic breeds. This difference is attributed to the level of care the dogs received. The local dogs are the least cared for (Ezeokoli, 1984).

1.1.4 Prevalence of Blood Parasites

A number of external parasites serve as vactors of haemoparasites. Ticks and tsetsefly are the most important vactors of haemoparasites of dogs in Nigeria. It has been noted that abundance of these vactors determine the prevalence of haemoparasites in a given geographical location (Anene and Omamagbe, 1987). A number of haemoparasites have been reported in Nigerian dogs. These include *Hepatozoan canis*, *Babesia canis*, *Ehrlichia canis* (Esuruoso, 1972; Saror and Pimentel, 1972; Leeftang *et al.*, 1976; Oduye and Dipeolu, 1976; Adewunmi and Uzoukwu, 1979; Omamagbe, 1980; Omamagbe and Uzoukwu, 1980; Ogunkoya *et al.*, 1981; Ezeokoli *et al.*, 1983; Abdullahi, 1986; Abdullahi and Sannusi, 1986; Abdullahi *et al.*, 1986; Trimmell *et al.*, 1989), *Trypanosoma spp.* (Esuruoso, 1972; Oduye and Dipeolu, 1976; Omamagbe and Uzoukwu, 1980; Adewunmi and Uzoukwu, 1979; Omamagbe *et al.*, 1984), *Haemabatonella canis* (Leeftang *et al.*, 1974; Leeftang *et al.*, 1976; Oduye and Dipeolu, 1976; Adewunmi and Uzoukwu, 1979) and *Microfilaria of Dipetalonema reconditum* (Saror and Pimentel, 1972; Oduye and Dipeolu, 1976).

Hepatozoon canis; is the commonest haemoparasite of dogs in northern Nigeria (Saror and Pimentel, 1972; Leeftang *et al.*, 1976; Ogunkoya *et al.*, 1981; Ezeokoli *et al.*, 1983; Abdullahi, 1986; Trimmell *et al.*, 1989). In southern Nigeria, *Babesia canis* accounts for the majority of the haemoparasites seen in dogs (Esuruoso, 1972; Oduye and Dipeolu, 1976; Adewunmi and Uzoukwu, 1979). *Trypanosoma spp* are encountered more in the east, less in the west and rarely in the north of the country (Anene and

Omamagbe, 1987). There is no sex difference in the prevalence of haemoparasites among Nigerian dogs. The prevalence rate of haemoparasites is usually higher in local compared to exotic breeds of dogs. This phenomenon has been attributed to poor feeding and care, in addition to more exposure to the vectors of these haemoparasites (Trinnell, 1989). *Haemabatonella canis* infection is very rare in Nigerian dogs (Leeflang, 1974; Oduye and Dipeolu, 1976).

1.2 The Use of Ivermectin in Domestic Animals

1.2.1 Introduction

Ivermectin, one of the avermectins, is a chemical derivative of a naturally occurring fermentation product, avermectin B which bears the proprietary name Abamectin. The avermectins are products of an actinomycete, *Streptomyces avermitilis*, first isolated from soil sample at Kitasato Institute in Japan (Koch, 1981; Campbell, 1985). The development of the dosage form of ivermectin was carried out in the United States of America by Merck Sharp and Dohme Inc. which markets it under the following trade names; Ivomec^(R), Eqvalan^(R), Mectizan^(R), Ivomec-p^(R), Heartgard^(R), Cardotek^(R) and Zimectrin^(R).

Ivermectin, though structurally similar to macrolide antibiotics, has no antibacterial activity (Campbell, 1985). However, it has been shown to have a novel mode of action against most of the animal and plant nematodes and arthropods as well as free-living ones. The use of ivermectin in domestic animals is discussed below.

1.2.2 Chemistry and Mode of Action

Ivermectin is a macrocyclic lactone identical in structure to abamectin (avermectin B), its precursor. However, abamectin differs from ivermectin by the possession of an olefin bond while ivermectin, its 22, 23 -, dihydro derivative, has a single bond between carbon 22 and 23. Abamectin B. is converted to ivermectin by hydrogenation in the presence of a catalyst. The sugars seen in the structure of

ivermectin are required for the anthelmintic activity of avermectins. This property is also shared by milbemycin or 13-deoxyaglycone compounds. Abamectin consists of a major and minor components: avermectin B_{1a} with a secbutyl group at carbon 25 (major) and avermectin B_{1b} that has isopropyl group at the same position (the minor). Ivermectin consists of 90% of the major and 20% of the minor homologues. The naturally occurring avermectins have a subset in which the carbon 5 has a methoxy substituent. These are designated avermectin A₁ and A₂. Due to this phenomenon, ivermectin is sometimes called 5-O-dimethyl 22, 23-dihydro-avermectin A. The naturally occurring avermectins, B₂ differs from avermectin B₁ due to the presence of a single bond between carbon 22 and 23 in addition to a hydroxy group rather than a hydrogen atom at carbon 23 (Campbell, 1985).

Ivermectin kills parasite nematodes, arachnids and insects by interfering with gamma-aminobutyric acid (GABA) mediated transmission of nerve signals. It inhibits the transmission of nerve impulses from the ventral cord interneuron to the excitatory motor neurons. This is achieved by stimulating the release of GABA from nerve ending and enhancing the binding of GABA to its receptor on the post-synaptic membrane and neuromuscular junctions in nematodes and arthropods respectively. This action enhances the flow of chloride ions into the cell with consequent hyperpolarization and elimination of nerve signals transmission. The effect of this amplification of GABA action by ivermectin is the paralysis and subsequent death of roundworms and arthropods. This effect can be reversed by picrotoxin or bicuculline (in varying degrees) which are believed to control the closing of chlorine ion channel (Pong *et al.*, 1980; Wright *et al.*, 1984a; Bokisch and Walker, 1986). Ivermectin has been shown to block inhibitory neuromuscular transmission in *Ascaris suum* and the blockage was not reversible by picrotoxin, suggesting that picrotoxin-sensitive blockage of interneuronal stimulation of excitatory motor neuron may not be the only mode of action of ivermectin in *Ascaris*

(Kass *et al.*, 1984).

1.2.3 Spectrum of Activity

Ivermectin is effective against a variety of nematodes and arthropods of domestic animals and wild mammals. It is currently licenced for use in horses, cattle, sheep, goats and camels. No formal approval has yet been obtained for its use in dogs, cats and birds.

The efficacy of ivermectin against various parasites of domestic animals has been determined. Ivermectin given to cattle as oral (Alva-Valdes *et al.*, 1984a) or topical (Hotson *et al.*, 1985; Yazwinski *et al.*, 1986; Barth and Preston, 1988) or parenteral (Wescott *et al.*, 1980; Barry *et al.*, 1983; Bridges, 1985) formulations at a dose of 200mcg/kg has been found to be 90-100% effective against a wide range of bovine ecto-, haemo- and gastro-intestinal parasites. Topical, subcutaneous or oral administration of ivermectin at 200 mcg/kg has 90-100% efficacy against adult and larval stages of *Ostetagia* spp (Armour *et al.*, 1980; Sutherland, 1981; Alva-Valdez *et al.*, 1986b), *Trichostrongylus* spp. (Benz and Ernst, 1981a; Alva-Valdez *et al.*, 1984a; Lescure *et al.*, 1986; Ogunsusi *et al.*, 1986), *Oesophagostomum* spp. (Benz and Ernst, 1981b; Yazwinski *et al.*, 1981a; Barry *et al.*, 1983), *Haemonchus* spp (Wescott *et al.*, 1980; Yazwinski *et al.*, 1981; Sutherland, 1981; Lescure *et al.*, 1986) and *Strongyloides* spp. (Malczawcki, 1982; Yazwinski *et al.*, 1986; Manfredini and Rossi, 1986).

The efficacy against *Nematodirus helvetianus* and *Trichuris* spp. ranges from 50-90% (Akhtar *et al.*, 1981; Campbell and Benz, 1984; Ciordia *et al.*, 1984). Similarly, ivermectin has been found very effective against the following parasites: *Dermatobia homini* (Bavia *et al.*, 1986), *Hypoderma* sp. (Boulard and Thornbery, 1982; Argente and Hillon, 1984; Rioni and Rostrani, 1984), *Psoroptes* sp. (Euzeby *et al.*, 1982; Linklater and Gillespie, 1984; Soll *et al.*, 1985); *Psorogates* sp. (Oberem and Malar, 1984), *Chorioptes bovis* (Soll *et al.*, 1985; Barth and Preston, 1988), *Sarcoptes scabiei* var *bovis* (Lavigne and Smith, 1983; Schroader *et al.*, 1985; Barth and Preston, 1988), *Demodex* sp.

(Casteran and Saloniemi, 1984; Dubrenil *et al.*, 1981; Kofar and Glawisching, 1985). *Haematopinus eurysternus* (Sutherland, 1981; Lavigne and Smith, 1983; Campbell and Benz, 1984), *Linognathus vituli* (Lavigne and Smith, 1983; Titchener, 1985; Barth *et al.*, 1986), *Solenopotes capillatus* (Barth and Sutherland, 1980; Lloyd *et al.*, 1981; Barth and Preston, 1985a), *Damalina bovis* (Shroader *et al.*, 1985; Alva-Valdez *et al.*, 1986b) and *Bovicola bovis* (Lloyd *et al.*, 1981, Malency, 1982).

Ivermectin is also effective against the bovine microflaria, *Parafilaria bovicola* (Wallgren, 1985; Mohammed *et al.*, 1986) and *Onchocerca* sp (Copeman *et al.*, 1986), parasitic otitis caused by *Rhadinia bovis* (Msolla *et al.*, 1985), eye worm, *Thelazia* sp (Carmichael *et al.*, 1985). It has also been reported to be effective against larvae and adults of flies such as *Musca autumnalis* (Mayer *et al.*, 1981; Miller *et al.*, 1981b), *Haematobia irritans* (Miller *et al.*, 1981a), *Stomoxys calcitrans* (Miller *et al.*, 1981b) and the midge *Culicoides brevitarsis* (Standfast *et al.*, 1984).

Reduction in weight, egg production, prolonged engorgement time, paralysis and prevention of moulting are the effect of ivermectin on ticks. These effects have been reported following treatment of cattle infested with *Ornithodoros moubata* (Centurier and Barth, 1980; Soll *et al.*, 1983), *Amblyomma* sp. (Drummond *et al.*, 1983), *Rhipicephalus sanguineus* (Wilkin *et al.*, 1980), *Boophilus* sp. (Nolan and Schnitzerling, 1983; Lombardero *et al.*, 1984; Preegram and Lemche, 1985; De-leon, 1986) and *Dermacentor variabilis* (Conroy *et al.*, 1984; Spellman, 1985).

Ivermectin had been used as chemoprophylactic agent against a number of GIT parasites of cattle (Bremner *et al.*, 1983; Armour *et al.*, 1985). In addition cattle treated with ivermectin were found able to resist re-infection with *Ostertagia* sp. and *Trichostrongylus* sp. (Herd *et al.*, 1986), *Oesophagostomum*, *Trichuris* and *Cooperia* sp. (Egerton *et al.*, 1986; Eysket, 1986), *Dictyocaulus viviparus* (Jacobs *et al.*, 1986; Taylor *et al.*, 1988) and parasitic gastroenteritis (Jacob *et al.*, 1987).

The injectable formulation of ivermectin for horses has been replaced with oral paste due to the association of the former with Clostridia infection at the injection site (Campbell, 1985). However, both formulations have been found effective against a variety of equine parasites. The oral paste given at a dose of 200mcg/kg has 95-100% efficacy against larvae or adults of large and small Strongylid species (Klei and Tobert, 1980; DiPietro, 1983; Swan and Coetzer, 1983; Borgsteede, 1985), including benzimidazole-resistant strains (Wescott *et al.*, 1985; Burger and Bauer, 1987). A 99% efficacy has been shown against *Gastrophilus* sp. (El-abdin *et al.*, 1983; Barth and Preston, 1985b; Frahm, 1986), *Trichostrongylus axei* (Tobert *et al.*, 1982; Lyons *et al.*, 1985), *Strongyloides* sp. (Kivipelto and Asquith, 1985; Ryan and Best, 1985; Kohler and Hiepe, 1986) and *Dictyocaulus arnfieldi* (Barth and Preston, 1985; Lyons *et al.*, 1985).

Oral or intramuscular formulations of ivermectin given to horses at 200 mcg/kg have 97-100% efficacy against *Parascaris equorum* (Bello, 1985; French *et al.*, 1986; Grzywinski *et al.*, 1986; Borasaki, 1987) and migratory larva (Bello, 1983). Similarly the drug has 90-100% efficacy against *Oxyuris equi* (Ludwig *et al.*, 1984; Burrows *et al.*, 1985), *Habronema muscae* (Bridges, 1985; Bordin and Bastos, 1985; Burger and Bauer, 1987), *Onchocerca* sp. (Herd and Donham, 1981; French *et al.*, 1984; Roux *et al.*, 1985), *Drashtia megastoma* (Lycns *et al.*, 1980; DiPietro *et al.*, 1983) and the itch mites *Sarcoptes* sp. (Christenson *et al.*, 1984; Abu-Samaru *et al.*, 1985).

Sheep drenched with ivermectin at a dose of 200mcg/kg were freed of gastrointestinal nematodes, nasal bots and to a lesser extent, itch mites. The injectable formulation is used mainly for the control of itch mites (Campbell, 1985). Ivermectin given to sheep at 200mcg/kg per os had greater than 90% efficacy against adult *Haemonchus contortus* (Wescott and LeaMaster, 1982; Ferrari *et al.*, 1983; Todd *et al.*, 1984) including benzimidazole-resistant strains (Preston *et al.*, 1985; Santiago *et al.*, 1986), the larval stages (Wescott and LeaMaster, 1982; Todd *et al.*, 1985), adult *Cooperia*

sp. (Egerton *et al.*, 1980; Gevrey and Robin, 1984), *Trichostrongylus* sp. (Armour *et al.*, 1982; McKenna, 1985), *Ostertagia* sp. (Swan *et al.*, 1984; Preston *et al.*, 1985), *Chabertia ovina* (Armour *et al.*, 1982), *Nematodirus* sp. (Yazwinski *et al.*, 1983), *Trichuris* sp. (Armour *et al.*, 1982), and *Strongyloides papillosus* (Swan *et al.*, 1984; Preston *et al.*, 1985).

Similarly, sheep treated with ivermectin were rendered free of *Oestrus ovis* (Roncalli, 1984; Evdokimov, 1985), *Linognathus* sp (Molina and Euzeby, 1982; Preston, 1984), *Psoroptes* sp. (Radic *et al.*, 1983; Graunke, 1984; Roncalli and Sutherland, 1986) and more than 97% reduction of the lungworm burden due to *Protostrongylus rufescens* and *Dictyocaulus filaria* (Preston, 1984; Preston *et al.*, 1985).

Oral treatment of goats at a dose range of 100-300mcg/kg resulted in 97% reduction in faecal larvae count of *Muellerus capillaris* (Gregory *et al.*, 1985; Rusev *et al.*, 1985; McGraw and Menzies, 1986). At 200mcg/kg given orally or subcutaneously, ivermectin was 98-100% effective against *Haemonchus contortus* (Hall *et al.*, 1984; Njanja *et al.*, 1985), *Strongyloides papillosus* (Swan and Gross, 1985) and *Trichuris* sp. (Karnia *et al.*, 1983). It is also effective against *Sarcoptes scabiei* var *capri* (Zeybek, 1985; Dakkak and Onhelli, 1986; Manurung *et al.*, 1986; Tekdek *et al.*, 1988), *Psoroptes* sp. (Zeybek, 1985), *Hypoderma* larvae (Tassi *et al.*, 1987) and *Ornithodoros lahorensis* (Zeybek, 1985).

Ivermectin is effective against a variety of camel nematodes and the itch mite *Sarcoptes scabiei* var *cameli*. Camels treated with ivermectin at a dose rate of 200mcg/kg were completely freed of the following nematodes; *Trichostrongylid* spp. (Ibrahim *et al.*, 1981; Boyco *et al.*, 1984), *Camelostrongylus mentutatas* (Adult and larvae), *Haemonchus* spp., *Impalata* sp., *Charbetina ovina* and *Ostertagia* spp (Anon, 1987). At the same dosage, ivermectin rendered treated camels free of *Sarcoptes scabiei* var *cameli* (Higgins, 1984; Opferman, 1985; Hashim and Wasfi, 1986) and camel tick *Hyalomma* (Ibrahim *et al.*, 1981; Higgins, 1985).

In pigs, ivermectin given at a dose of 300mcg/kg subcutaneously has efficacy of between 94-100% against adult and juvenile *Ascaris suum* (Gibson, 1983; Zukovic *et al.*, 1984; Kennedy *et al.*, 1986), *Hyostrongylus rubidus* (Brokken *et al.*, 1984; Biel, 1986), *Metastrongylus* sp. (Stewart *et al.*, 1981; Ferguson, 1984), *Strongyloides ransomi* (Murrel, 1981; Plue *et al.*, 1985), *Stephanurus dentatus* (Stewart *et al.*, 1981; Biehl, 1986); the pig itch mite *Sarcoptes scabiei* var *suis* (Countney *et al.*, 1983; Ziomko *et al.*, 1984; Parent and Belot, 1985) and the louse *Haematopinus suis* (Barth and Brokken, 1980; Ziomko *et al.*, 1984; Ganda *et al.*, 1985).

There are conflicting reports on the efficacy of ivermectin against *Oesophagotomum* sp. and *Trichuris* sp. varying from 0-78% (Stewart *et al.*, 1981; Schillhorn van Veen and Gibson, 1983) to 91-100% (Zukovic *et al.*, 1984; Bankov *et al.*, 1984; Bankov *et al.*, 1985; Bouska and Uyhanlek, 1985). Two pre-farrowing treatments of pregnant sows infected with *Strongyloides ransomi* or *Sarcoptes scabiei* var *suis*; prevented transcolostral transmission of *Strongyloides ransomi* (Barth and Preston, 1984) and postnatal transmission of sarcoptic mange (Coustney *et al.*, 1983) to piglets respectively.

Treatment of dogs at a dose range of 44-100mcg/kg orally or subcutaneously resulted in 96-100% efficacy against adult and migratory stages of *Ancylostoma caninum* (Blair and Campbell, 1979a; Anderson and Robinson, 1982; Camacho *et al.*, 1987; Ramiz, 1984; Egerton *et al.*, 1985; Singh and Gill, 1987). *Uncinaria stenocephala* (Henriquez *et al.*, 1985). At a minimum dose of 100 mcg/kg, 99% of *Trichuris vulpis* were expelled (Blair and Campbell, 1981b; Pugliese *et al.*, 1985) while 200 mcg/kg resulted in 90-100% expulsion of adult and the immature intestinal larvae stages of *Toxocara canis* (Camacho *et al.*, 1983; Ramiz, 1984; Pugliese *et al.*, 1985; Singh and Gill, 1987) and *Strongyloides stercoralis* (Campbell and Benz, 1984). Efficacy of ivermectin against *Toxoascaris leonina* has been inconsistent to poor (Anderson and Robinson, 1982; Campbell *et al.*, 1983; Campbell and Benz, 1984). However, 100% efficacy has been

reported at a dose rate of 400 mcg/kg (Singh and Gill, 1987). Extremely high dosages 1,000-2,000 mcg/kg are required to kill tissue-residing larvae of *Toxocara canis* (Campbell and Benz, 1984).

At 50 mcg/kg orally or subcutaneously, ivermectin is highly effective against microfilaria and pre-cardiac stages of *Dirofilaria immitis* (Blair and Campbell, 1979; Jackson and Seymour, 1980; Anamtaphruti *et al.*, 1982; Boreham and Atwell, 1983; Hayasaki and Oishi, 1984; Loomis and Lee, 1984; Swart, 1985). It is also effective against microfilaria of *Dipetalonema reconditum* (Linderman and McGraw, 1983). Oral administration of ivermectin at 200 mcg/kg resulted in 100 % efficacy against *Capillaria aerophila* (Evinger *et al.*, 1985) and *Capillaria plica* (Kirkpatrick and Nelson, 1987), the causative agents of nasal and urinary capillariasis respectively. Subcutaneous administration of ivermectin to dogs at 200-400 mcg/kg had been found very effective against itch mite *Sarcoptes scabiei* var *canis* (Burgess and Halci, 1984; Schiedt *et al.*, 1984; Gravino, 1985a; Singh and Gill, 1987), *Cheyletiella yasgurti* (Tolosa *et al.*, 1986) and a minimum of three treatments, seven days apart were required to completely clear *Demodex canis* (Ogunkoya and Adeyanju, 1982; Belot *et al.*, 1985; Gravino *et al.*, 1985b; Scott and Walton, 1985). A single subcutaneous treatment has been reported 100 % effective against the ear mites *Otodectes cyanotis* and the dog flea, *Ctenocephalides* spp. (Chauve, 1985; Puliese *et al.*, 1985; Guerraro Malina, 1986).

In cats, ivermectin at a dose rate of 10-30 mcg/kg orally or subcutaneously resulted in 100 % efficacy against *Ancylostoma brazillense* and *A. tuberculose*, while a dose rate of 300 mcg/kg was required to completely expel *Toxocara cati* (Blagburn *et al.*, 1987). It has also been reported effective against *Filaroides* sp. and *Aelustrongylus abstrusus* (Clayton, 1982; Kirkpatrick and Magella, 1987). Ivermectin given subcutaneously at 200 mcg/kg was found 100 % effective against the itch mite *Notoedres cati* (Bigler *et al.*, 1984; Kroetz *et al.*, 1984; Quintaralla *et al.*, 1985; Suarez and Beatero,

1986) and the ear mite *Otodectes cynotis* (Chauve and Reynaud, 1984; Church, 1985; France *et al.*, 1985).

1.2.4 Toxicity

In mammals, toxicity due to ivermectin administration takes days to be apparent. In clinically normal animals, ten times the therapeutic dose is required to produce toxic effects. Most signs associated with ivermectin toxicity indicate central nervous system involvement.

Horses given ivermectin at 2,000 mcg/kg developed ataxia, depression and visual impairment. Adverse reaction due to ivermectin in horses is ventral edema often associated with death of *Onchocerca microfilaria* (Anderson, 1984; Campbell and Benz, 1984). Listlessness, ataxia, recumbency and death in few cases were the toxic signs seen in cattle treated with ivermectin at 2,000 mcg/kg. Ataxia was observed in sheep given ivermectin at 8,000 mcg/kg. A dose of 30,000 mcg/kg was required to produce ataxia in swine (Campbell and Benz, 1984).

In dogs, mydriasis was seen at a dosage of 2,500 mcg/kg, tremors at 5,000 mcg/kg and death occurred at 40,000 mcg/kg (Campbell and Benz, 1984). The collie breed of dogs is exceptionally susceptible to ivermectin at extremely low doses. Toxic signs in collies include: excessive salivation, vomiting, confusion, ataxia, tremors, seizures, recumbency, coma and death (Jerram, 1985; Pulliam *et al.*, 1985; Paul *et al.*, 1986c). The toxic effects may be reversed by picrotoxin (Swine *et al.*, 1985) or physostigmine (Tranqualli *et al.*, 1986) given intravenously.

In mammals generally, GABA-mediated transmission is confined to the CNS and because ivermectin does not readily cross the blood-brain barrier, the host animal is unaffected by the drug at therapeutic levels thus accounting for its high margin of safety.

No teratogenic effects have been reported following the use of ivermectin in pregnant mammals at the recommended dose. Mares given ivermectin at 600 mcg/kg

orally at two-weeks interval during early pregnancy or intramuscularly at two-months interval during the second trimester gave birth to normal foals (Campbell and Benz, 1984). Sows and cows treated repeatedly during pregnancy with ivermectin produced normal offsprings (Campbell, 1983; Campbell and Benz, 1984). Similarly, pregnant rats treated with ivermectin during first trimester had offsprings with no abnormality that could be detected at post-mortem 20 days post-treatment (Gadzhiev, 1984a). Mating of virgin female with hybrid male rats that had been injected with ivermectin at various doses and examined after 17-20 days of pregnancy, no changes in spermatozoa were seen at the therapeutic dose (200 mcg/kg) but at 600 mcg/kg late and early spermatid changes were seen, at ten times the therapeutic dose, dominant lethal mutation at late spermatocyte were recorded (Gadzhiev, 1984b).

SURVEY AND MANAGEMENT OF PARASITIC INFECTIONS OF DOGS IN ZARIA

2.1 Introduction

The prevalence and importance of external and internal parasites of dogs in Nigeria has been reviewed in Chapter one. In Nigeria, the management of external and internal parasites of dogs is mainly chemotherapeutic. Aliu (1983), reported the use of insecticides (organophosphates and Amitraz) in the control of external parasites of dogs and other domestic animals. Oral formulations used for control of internal parasites of dogs in our clinic include pyrantel pamoate, niclosamide, disophenol, morantel, praziquantel while parenteral drugs in use include diaminazine aceturate, oxytetracycline and imidocarb dipropionate and levamisole. Elsewhere, ivermectin (IVOMEC[®] MSD AgVet) in extremely low doses has been used against a wide variety of external and internal parasites of animals, particularly livestock as reviewed in Chapter one.

Internal and external parasitism account for majority of the cases seen at the Ahmadu Bello University Veterinary Teaching Hospital (ABUVTH), Zaria. However, no extensive survey has been done to determine the prevalence and importance of ectoparasites of dogs in Zaria. Similarly, the wide use of ivermectin to control internal and external parasites is currently limited to livestock. The objective of this study therefore was to conduct a survey of ectoparasites and evaluate the clinical use of ivermectin in the control of external and internal parasites of dogs presented to the Small Animal Clinic of ABUVTH, Zaria.

2.2 MATERIALS AND METHODS

2.2.1 Animals

Dogs presented to the Small Animal Clinic of the Ahmadu Bello University Veterinary Teaching Hospital (ABUVTH) between 1st March, 1988 and 28th February, 1989 were screened for internal and external parasites. Those found positive were selected and included in the clinical trial.

2.2.2 Samples collection and Handling

Various locations on each dog (head, ears, neck, interdigital spaces, chest, abdomen, scrotum and tailhead) were systematically examined for the presence of ectoparasites. The number of parasites seen on each location were scored as follows:-

- + - Less than 10 parasites/body location
- ++ - 10-20 parasites/body location
- +++ - More than 20 parasites/body location

Parasites seen were then collected and preserved in clean bottles containing a mixture of 70% Ethanol and 5% glycerol. Skin scrappings and brushing, where appropriate, were taken in clean properly labelled polythene bags.

Identification of ticks, lice and fleas was done by examining individual parasites using a telescopic (bifocal) dissection microscope and details of each parasite were compared with a key for identification of Ixodid ticks (Hoogstraal, 1956; Hoskin and Cupp, 1988), lice (Hopkins and Clay, 1952), fleas (Soulsby, 1982) and also by comparing the various parasites with museum specimen available in the Entomology Laboratory of the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria. Skin scrapping were first boiled in 10 % potassium hydroxide (KOH) for five to ten minutes, then filtered and transferred into a Petri dish and examined using a telescopic (bifocal) dissection microscope. Mites encountered were identified by comparison with a

key for identification of mites (Baker, 1958) and museum specimens.

Internal parasites: blood parasites were identified by obtaining blood from each animal by venopuncture from the cephalic, recurrent tarsal or jugular veins and ethylene diamine-tetraacetic acid (EDTA) was used as anticoagulant. Thick and thin smears were made, stained with Giemsa and examined for haemoparasites. In a few cases, where ehrlichiosis was suspected, 10 ml of whole blood was obtained directly from the animal into a sterile heparin-coated plastic syringe, the needle was discarded and a new one attached. The shaft of the new needle was bent at an acute angle using the sterile needle cover. The blood-filled syringe was taped immediately to the wall in an upright position and left undisturbed for 30 to 60 minutes. After one hour, without disturbing the syringe, 2 ml of plasma was carefully transferred through the bent needle into each of two sterile Leighton tissue culture tubes containing glass coverslips. The tubes were incubated horizontally at 37.C for 48 hours, after which, one of the tubes was removed from the incubator. The cells on the coverslip were washed with 0.9% saline, fixed with methanol and stained with giemsa stain while still in the Leighton tube. The coverslip was then removed from the tube, mounted on a glass slide and examined under the microscope (Price and Sayer, 1983). When a negative result was obtained, the second Leighton tube was examined in the same way after incubation for 96 hours.

For gastrointestinal parasites, fresh faecal samples were obtained from the rectum of each dog using clean polythene bags. A small quantity of each sample was mixed thoroughly with a small amount of floatation fluid (150g of sucrose + 400g of zinc sulphate per litre of tap water) in a centrifuge tube. The suspension was then filtered through layers of gauze into a plastic tube. More fluid was added until a meniscus was formed; a coverslip was then placed on the meniscus and left to stand for five minutes after which it was removed, placed on a glass slide and examined for helminth ova and coccidia and *Giardia canis* oocysts under the microscope (Vajda, 1922; Watson, 1947).

2.2.3 Evaluation of the Efficacy of Ivermectin in the Control of External and Internal Parasites in Dogs

Purposely selected cases of external parasitism were treated with a single dose of ivermectin at 400 mcg/kg subcutaneously; three doses, once weekly, were given to cases of *Demodex canis* infection. The effect of treatment was evaluated weekly for four weeks. Similarly, dogs with internal parasitism were treated with a single dose of ivermectin (400 mcg/kg) and their blood and faecal samples were re-examined 3,7,14,21 and 28 days post-treatment (PT).

2.2 Results

2.3.1 Survey of External Parasites

Out of 387 dogs examined, 360 (93.02%) were found to be infested with external parasites and 43 (11.11%) dogs had multiple parasitism (Table 2.1). Ticks were the most common parasites as they were detected on 85.27% (330 dogs) of the dogs examined. *Rhipicephalus sanguineus* was the most abundant tick as it was seen on 291 dogs (75.20%). Other ticks identified were *Haemaphysalis leachi* seen on 31 dogs (8.01%), *Amblyomma variegatum* seen on 7 dogs (1.8%) and one dog was infested with *Rhipicephalus appendiculatus*.

Thirty-eight dogs (9.82%) were found to be infested with mites. Out of this number, 15 dogs (3.88%) had *Demodex canis*, 7 dogs (1.81%) had *Cheyletiella yasgurti* and 6 dogs (1.55%) were infested with the Itch mite *Sarcoptes scabiei* var. *canis*. Other parasites identified in the survey were fleas, *Ctenocephalides felis*, on 23 dogs (5.94%) while *Cordylobia anthropophaga* larvae caused myiasis in 15 dogs (3.88%). Only 3 dogs (0.18%) were infested with lice, 2 (0.52%) of which had the sucking louse *Linognathus setosus* and 1 (0.26%) was infested with the chicken louse, *Menacanthus stramineus* (Table 2.1).

Table 2.1. Prevalence of extoparasites in 387 dogs in Zaria

Ectoparasite	Number of dogs (Prevalence)
Ticks:	
<i>Rhipicephalus sanguineus</i>	291 (75.19%)
<i>Haemaphysalis leachi</i>	31 (8.01%)
<i>Amblyomma variegatum</i>	7 (1.81%)
<i>Rhipicephalus appendiculatus</i>	1 (0.26%)
Fleas:	
<i>Ctenocephalides felis</i>	23 (5.94%)
Mites:	
<i>Demodex canis</i>	15 (3.88%)
<i>Cheyletiella yasguri</i>	7 (1.81%)
<i>Sarcoptes scabiei</i> var. <i>canis</i>	6 (1.55%)
Maggots:	
<i>Cordylobia anthropophaga</i>	15 (3.88%)
Lice:	
<i>Linognathus setosus</i>	2 (0.52%)
<i>Menacanthus stramineus</i>	1 (0.26%)

* 43 dogs had more than one parasite.

The back, interdigital spaces, ears and neck were the parts of the body mostly parasitised by the ectoparasites encountered in the survey (Table 2). Ticks, the most abundant ectoparasites found in this study, had the back, interdigital spaces, ears and neck as predilection sites while the head, chest and abdomen were moderately parasitized. The scrotum and tail head were only occasionally parasitized. The neck and head were the most important predilection sites for mites while the back and ears were only moderately affected. Fleas and lice were found mainly on the back while the maggots infested the chest, abdomen and interdigital spaces but were occasionally seen on the scrotum and tail head.

Out of 387 dogs examined, 162 (41.86%) had ticks and tick-borne blood parasites. The latter figure consisted of 118 local, 14 exotic and 30 mixed breeds of dogs. One hundred and seventy-five dogs were found to harbour ticks without tick-borne blood parasites while 16 dogs had tick-borne blood parasites only (Table 2.3).

2.3.2 Survey of Internal Parasites

Table 2.4 summarises the internal parasites identified in 387 dogs. Two hundred and five dogs had haemoparasites and 221 gastrointestinal (GIT) parasites. Sixty-three dogs had multiple haemo, or GI or both, parasitism. The haemo-parasites identified were: *Hepatozoon canis* (105 dogs); *Babesia canis* (62 dogs); *Ehrlichia canis* (28 dogs); and microfilaria of *Dipetalonema reconditum* (10 dogs).

Table 2.2 Location of ectoparasites on 360 dogs in Zarla

Location and Number of Dogs									
Ectoparasite	Back	Inter-digital space	Ear	Neck	Head	Chest	Abdomen	Scrotum	Tail head
Ticks	259	232	202	174	87	52	35	8	8
Mites	8	4	6	24	18	1	1	0	0
Fleas	20	0	0	0	0	0	0	0	0
Lice	2	0	0	0	0	0	0	0	0
Maggots	0	7	0	0	0	12	11	1	2
Total	289	243	208	198	105	65	47	9	10

Table 2.3 Prevalence of ticks and tick-borne blood parasites in 387 dogs in Zaria

Findings	Breed and Number of Dogs			
	Local (n - 271)*	Exotic (n - 37)	Mixed (n - 79)	Total (n - 387)
Ticks and tick-borne				
blood parasites	118	14	30	162
Ticks only	121	15	39	175
Tick-borne blood parasites only	12	3	1	16
Total	251	32	70	353

* n - number of dogs examined.

Table 2.4 Prevalence of internal parasites in 387* dogs in Zaria

Parasite	Number of dogs (Prevalence)
Haemoparasite:	
** <i>Microfilaria</i>	10 (5.58%)
<i>Hepatozoon canis</i>	105 (27.13%)
<i>Babesia canis</i>	62 (16.02%)
<i>Ehrlichia canis</i>	28 (7.24%)
Total	205 (52.24%)
Gastro-intestinal parasite:	
<i>Ancylostoma caninum</i>	135 (34.88%)
<i>Toxocara canis</i>	19 (4.91%)
<i>Toxoascaris leonina</i>	7 (1.81%)
<i>Capillaria</i> spp.	5 (1.29%)
<i>Trichuris</i> spp.	4 (1.03%)
<i>Taenia</i> spp.	32 (8.27%)
<i>Dipylidium canium</i>	7 (1.81%)
<i>Isospora</i> spp.	12 (3.10%)
Total	221 (57.11%)

* 63 dogs had multiple haemo - or GIT or both parasites

** Larvae of *Dipetalonema reconditum*

Of the 205 dogs infected with haemoparasites, 147 (17.71%) were local, 19 (9.27%) were exotic breeds and 39 (19.02%) were mixed breeds of dogs (Table 2.5). *Ancylostoma caninum* was the predominant GI-helminth encountered in the study (135 dogs infected). Other helminths identified were *Taenia* sp.(32 dogs), *Toxocara canis* (19 dogs), *Toxoascaris leonina* (17 dogs), *Capillaria* spp. (5 dogs), *Dipylidium caninum* (7 dogs) and *Trichuris* spp. (4 dogs). *Isospora* spp. were the only GIT protozoon encountered in the survey. The infection rate of GIT parasites were 37.98% (147 dogs), 4.91% (19 dogs), 10.08% (39 dogs) for the local, exotic and mixed breeds of dogs respectively (Table 2.6).

One hundred and fifty-eight (58.30%) of the local dogs examined were found to be infected with helminths and/or protozoon parasites while 21 (56.76%) of the exotic and 42 (53.16%) mixed breeds of dogs were similarly infected. Fewer helminths were recovered from the exotic breeds compared with either local or the mixed breeds of dogs (Table 2.6).

2.3.3. Efficacy of Ivermectin Against External Parasites

Of the 114 dogs infested with *Rhipicephalus sanguineus*, 109 (95.61%) were free of ticks 7 days PT, while 88 (77.19%), 47 (41.23%) remained free 14, 21 and 28 days PT respectively after a single treatment with ivermectin.

Table 2.5 Prevalence of blood parasites in 387* dogs in Zaria

Blood Parasite	Breed/Number of Dogs			
	Local (n - 271)	Exotic (n - 37)	Mixed (n - 79)	Total (n - 387)
<i>Hepatozoon</i>	79	9	17	105
<i>canis</i>	44	3	15	62
<i>Babesia canis</i>	17	5	6	28
<i>Ehrlichia canis</i>	7	2	1	10
Microfilaria**				

* 19 dogs had two or more blood parasites

** Larvae of *Dipetalonema reconditum*
n - number of dogs examined.

Table 12.6 Prevalence of gastrointestinal parasites in 387 dogs in Zaria

Blood Parasite	Breed/Number of Dogs			
	Local (n - 271)	Exotic (n - 37)	Mixed (n - 79)	Total (n - 387)
<i>Ancylostoma caninum</i>	93	16	26	135
<i>Toxocara canis</i>	12	2	5	19
<i>Toxoascaris leonina</i>	5	0	2	7
<i>Capillaria</i> spp.	4	0	1	5
<i>Trichuris</i> spp.	2	1	1	4
<i>Taenia</i> spp.	29	1	2	32
<i>Dipylidium caninum</i>	4	1	2	7
<i>Isospora</i> spp.	9	0	3	12

* 27 dogs had mixed parasitism
n - number of dogs examined.

Similarly, 17 (100%) *Haemaphysalis leachi* infested dogs were freed of ticks 7 days PT and 47% of them remained free of ticks up to 28 days (Table 2.7).

Significant re-infestation was noticed in both *Rhipicephalus sanguineus* and *Haemaphysalis leachi* infested dogs 21 and 28 days PT. Twenty dogs treated with ivermectin were freed of fleas 7 days PT and 11 (55%) were never re-infested for the entire study period.

One hundred per cent efficacy was recorded when 6 cases of sarcoptic mange and 7 caused by *Cheyletiella yasguri* were treated with ivermectin. Clinical improvement in the conditions were observed seven days and hair re-growth was recorded by 28 days PT. Fifteen dogs with demodectic mange required three single weekly treatments with ivermectin before they could be freed of the mites. Clinical improvement was observed in all dogs (shown by absence of immature stages and presence of numerous sluggish adult mites in unprocessed skin scrappings) 7 and 14 days PT. Marked improvement was recorded 21 days PT, when only a few dead adult mites were obtained in skin scrappings. No mites were recorded from any of the 15 dogs by day 28 PT.

Fifteen dogs treated against myiasis and 2 against lousiness were free of the parasites 7 days PT. No parasites were observed on the animals, 14, 21 and 28 days PT.

Table 2.7 Efficacy of ivermectin against ectoparasite of dogs

Parasite	No. of dogs	No. of dogs Negative post-treatment			
		7	14	21	28(days)
<i>Rhipicephalus sanguineus</i>	144	109	88	47(15)*	25(42)*
<i>Haemaphysalis leachi</i>	17	17	17	17	8(9)*
<i>Ctenocephalides felis</i>	20	20	20	20	11
<i>Sarcoptes scabiei</i> var. <i>canis</i>	6	6	6	6	6
<i>Cheyletiella yasguri</i>	7	7	7	7	7
<i>Demodex canis</i> **	15	4	4	9	15
<i>Linognathus setosus</i>	2	0	2	2	2
<i>Cordylobia anthropophaga</i>	15	15	15	15	15

* Cases lost due to refusal of clients to report for post-treatment evaluation
 ** Three treatments were given once weekly.

2.3.4 Efficacy of Ivermectin Against Internal Parasites of Dogs

Ten dogs with *Dipetalonema reconditum* microfilariae in their blood were completely freed of the larvae 3 days after a single treatment with ivermectin. Subsequent re-examination of blood samples 7, 14, 21 and 28 days PT revealed no microfilariae (Table 8). Similarly a single dose of ivermectin completely freed 75 dogs of *Ancylostoma caninum*, 7 of *Toxascaris leonina*, 3 of *Capillaria* spp. and 4 of *Trichuris* spp. 3 days PT. It took a minimum of 7 days to free 13 dogs of *Toxocara canis* after a single treatment with ivermectin. Only 8 (61.53%) dogs were negative while 7 dogs had marked reduction of faecal egg count 3 days PT. However, faecal examination 7, 14, 21 and 28 days PT was negative of *Toxocara* eggs.

The drug had no effect on 14 cases of tapeworms and 6 due to *Isospora* spp infections. All animals remained positive for helminth eggs and oocysts of coccidia for the entire study period.

2.4 Discussion

The high prevalence of external parasites recorded in this survey agrees with observations of earlier workers.

The high prevalence rate of ticks and the abundance of *Rhipicephalus sanguineus* observed in this survey are similar to the findings of Dipeolu (1975) in Ibadan. Infestation of dogs by *Amblyomma variegatum* can be considered accidental parasitism since ruminants are considered the natural host of the tick (Mohammed, 1974; George, 1987). However, the damage on the skin caused by the ticks mouth parts often resulted in pyoderma following secondary bacterial infection of the site.

Table 2.8 Efficacy of ivermectin against internal parasite of dogs

Parasite	No. of Dogs Treated	No. of Dogs Negative post-treatment				
		3	7	14	21	28 days
<i>Microflaria*</i>	10	10	10	10	10	10
<i>Ancylostoma caninum</i>	75	75	75	75	75	75
<i>Toxocara canis</i>	13	8	13	13	13	13
<i>Toxoascaris leonina</i>	7	7	7	7	7	7
<i>Capillaria</i> spp.	5	5	5	5	5	5
<i>Trichuris</i> spp.	4	4	4	4	4	4
Tapeworms	14	0	0	0	0	0
<i>Isospora</i> spp.	6	0	0	0	0	0

* *Microflaria*: Larvae of *Dipetalonema reconditum*

** Tapeworms: *Dipylidium caninum* and *Taenia* sp.

Few dogs were found infested with mites because most dogs are kept singly as guard dogs and they congregate mostly during mating season thereby limiting contact between dogs and spread of mites. *Demodex canis* was the most common mite seen in the survey probably because of uncontrolled breeding of dogs in this area and lack of effective medication. However, the prevalence rate of the mite (3.88%) is quite low compared with 17.3% reported in Ibadan (Idowu and Adetunji, 1981). The low prevalence of demodicosis might be due to the presence of *Cheyletiella yasgurti*, which is known to parasitize on *Demodex canis* (Baker, 1970) and this might equally explain the relatively high prevalence of the former mite seen in this study. Compared with other mites, few itch mites (*Sarcoptes scabiei* var. *canis*) were recorded in this survey. Contact with an infected individual or material remains the means of spread of the mite (Muller and Kirk, 1969). The low prevalence of the mites as recorded in this study could be due to the absence of dog colonies and the congregation of dogs only during mating season particularly as the few cases seen were between the months of October and December, corresponding to the mating season of dogs in this area.

The only flea identified on dogs in this survey was *Ctenocephalides felis* while elsewhere in Nigeria only a report of *Ctenocephalides canis* has been made (Dipeolu, 1975). The relative absence of *C. canis* and abundance of *C. felis* on dogs in this area cannot be explained. *Cordylobia anthropophaga* larvae were found to be the only cause of myiasis in this area and was pre-wet season problem. These findings agree with those of Dipeolu (1975) in Ibadan. Lice are rarely seen on dogs in this area and this was confirmed by this study. The lice identified were *Linognathus setosus* and *Menacanthus stramineus* while elsewhere *Linognathus setosus*, *Trichodectes canis* and *Heterodoxus spiniger* have been reported on Nigerian dogs (Dipeolu, 1975). The finding of *Menacanthus stramineus* on a dog in this survey can be considered accidental parasitism because

abundance of the vector of these blood parasites recorded in this study might be responsible for the high rate of infection. The local dogs were the most afflicted with ticks and tick-borne blood parasites compared with exotic and mixed breeds of dogs. The poor care for local dogs as observed by earlier workers (Ezeokoli *et al.*, 1983; Abdullahi *et al.*, 1986; Trimnell *et al.*, 1989) was responsible for this finding. The percentage of dogs with haemoparasites is higher than 32.70% (Læflang *et al.*, 1976), 33.30% (Saror and Pimentel, 1972), 38.10% (Ezeokoli *et al.*, 1983) and 27.60% (Trimnell *et al.*, 1989) reported earlier. This marked increase is due to inclusion into the study mainly dogs with ectoparasitism. Similarly, there was an increase in the prevalence of *Hepatozoon canis* (22.13%), *Babesia canis* (16.02%) and *Ehrlichia canis* (7.24%) compared with 17%, 9.5% and 2.2% (Saror and Pimentel, 1972), 22% 11.0% and 5.1% (Ezeokoli *et al.*, 1983), 17%, 13.3% and 3.5% (Ogunkoya *et al.*, 1981) and 12.8%, 10.4% and 4.4% (Trimnell *et al.*, 1989) respectively, reported by earlier workers. There appears to be a decrease in the prevalence of *microfilariae* compared with an earlier report by Saror and Pimentel (1972).

Local dogs had a higher prevalence of haemoparasites. This is similar to the findings of Trimnell *et al.* (1989). Infection rate were similar in local and exotic but less in the mixed breeds of dogs. This phenomenon has been observed by earlier workers (Trimnell *et al.*, 1989) but there appears to be no satisfactory explanation for this.

The prevalence of gastrointestinal parasites (52.12 %) is similar to 53.30 % reported for pet dogs by Ezeokoli (1984) and much smaller than 100 % reported for stray dogs by Dada *et al.* (1979), in Zaria. The prevalence rate of various GIT parasites recorded in this study are similar to those reported by Baba *et al.* (1983) and Ezeokoli (1984), slightly less than that reported by Saror *et al.* (1979) and very much less than those reported for stray dogs in Zaria and Jos by Dada *et al.* (1979) and Fabiyi (1983) respectively. There appears to be a virtual disappearance of

Spirocerca lupi infection in dogs in Zaria despite earlier reports of its presence (Saror *et al.*, 1979; Baba *et al.*, 1983; Ezeokoli, 1984). *Trichuris* sp. infection once reported only in stray dogs (Dada *et al.*, 1979) is now becoming more prevalent in pet dogs as seen in this study. Only one evidence of *Capillaria plica* infection was earlier reported in the urine of a dog in Nigeria (Abdullahi *et al.*, 1984) and the finding of 1.29 % of dogs surveyed with *Capillariasis* ova in faeces indicates a rise in the prevalence of this parasite.

Infection rate with helminths were similar in all breeds but fewer helminths were obtained from the exotic breeds compared with local and mixed breeds of dogs. These findings are similar to those of Ezeokoli (1984). The recovery of fewer helminths from exotic dogs can be attributed to extra care given to these dogs.

The lethal effect (death) of ivermectin against *Rhipicephalus sanguineus* and *Haemaphysalis leachi* recorded in this study is at variance with reports by earlier workers that prolonged engorgement time, paralysis and prevention of moulting were observed when cattle infested with either; *Ornithodoros moubata*, *Amblyomma* sp., *Rhipicephalus sanguineus*, *Boophilus* sp. and/or *Dermacentor variabilis*, were treated with ivermectin at a dose rate of 200 mcg/kg (Lancaster *et al.*, 1982; Soll *et al.*, 1983; Shroader *et al.*, 1985; Spellman, 1985; De-leon, 1986). From the data, it appears that ivermectin can protect dogs against ticks for a period of up to 14 days.

The 100 % efficacy recorded against fleas that fed on 20 treated dogs is similar to the findings of other workers that reported 100 % efficacy of ivermectin against fleas (Ramiz, 1984; Chauve, 1985; Pugliese *et al.*, 1985; GuerraMalina, 1986). Cases of re-infection seen by day 28 can be attributed to emergence of new adult fleas from dormat/aestivating pupae and a corresponding fall in the plasma level of ivermectin in treated animals.

The efficacy of ivermectin recorded against 6 cases of sarcoptic mange and 7 due to *Cheyletiella yasguri* agree with reports of earlier workers (Scheidt *et al.*, 1984; Gravino, 1985a; Pugliese *et al.*, 1985; Tolosa *et al.*, 1986; Singh and Gill, 1987). Three consecutive weekly treatments were required before 15 dogs could be freed of demodectic mange, this is similar to the findings of Belot *et al.* (1985), Gravino *et al.* (1985b) and Scott and Walton (1985). The efficacies of ivermectin against 15 cases of myiasis and 2 of lousiness are similar to those in cattle treated against *Hypoderma* sp. (Campbell and Benz, 1984; Rioni and Restani, 1991; Yousif and Divivedi, 1984) and lice (Maleney, 1982; Lavigne and Smith, 1983; Barth *et al.*, 1985; Barth and Preston, 1985; Schroader *et al.*, 1985; Titchner, 1985; Alva-Valdes *et al.*, 1986) as well as pigs freed of *Haematopinus suis* (Ziomko *et al.*, 1984; Ganda *et al.*, 1985) after a single treatment with ivermectin.

Complete clearance of microfilariae (larvae of *Dipetalonema reconditum*) from blood of infected dogs after a single treatment with ivermectin agree with the findings of Linderman and McCall (1983) and also similar to the elimination of the microfilariae and pre-cardiac stages of *Dirofilaria immitis* (Anamtaphruti *et al.*, 1982; Boreham and Atwell, 1983; Hayasaki and Oishi, 1984; Loomis and Lee, 1984; Swartz, 1985; Paul *et al.*, 1986a; Paul *et al.*, 1986b; Campbell, 1989) after treatment with ivermectin.

A single dose of ivermectin completely freed all dogs of *Ancylostoma caninum*, *Toxoascaris leonina*, *Capillaria* sp. and *Trichuris* sp. These findings agree with the anthelmintic properties of the drug against a number of canine nematodes reported by earlier workers (Campbell and Benz, 1984; Evinger *et al.*, 1983; Pugliese *et al.*, 1985; Kirkpatrick and Nelson, 1987; Singh and Gill, 1987; Campbell, 1989). The apparent resistance shown by *Toxocara canis* to the drug can be compared with a similar phenomenon where it took several days to weeks to completely eliminate

Dirofilaria immitis and *Strongylus vulgaris* larvae in dogs and horses respectively after a single treatment (McManus and Pullan, 1984; Slocombe and McCraw, 1984). It will require a more intensive investigation to accurately explain this phenomenon.

The drug had no effect on all cases of tapeworms and *Isospora* sp. infections. This is similar to the findings of other workers in which ivermectin was found ineffective against trematodes, cestode and protozoa and it is believed a different neurotransmitter other than GABA is responsible for transmission of nerve impulses in these organisms (Campbell and Benz, 1984; Campbell, 1989). The commercial preparation "IVOMEC-F" (a combination of ivermectin and the flukeicide, clorsulon) has been shown effective against *Fasciola* spp. which are not sensitive to ivermectin (Courtney *et al.*, 1985; Benz, 1986; Robin *et al.*, 1986) but had poor efficacy against paramphistomes (Courtney *et al.*, 1985).

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