SEASONAL DISTRIBUTION AND COMMON MANAGEMENT PRACTICES OF ECTOPARASITES OF DOMESTIC DOGS IN ILORIN, NIGERIA

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ABSTRACT

In spite of their zoonotic potentials, ectoparasites of domestic animals are less studied in many part of Nigeria. This study therefore investigated the seasonal distribution and common management practices of dogs' ectoparasites in Ilorin, North-Central Nigeria. Information on dog's bio-data, activities and control measures adopted by owners were obtained using structured questionnaire. Dogs were examined for ectoparasites using standard parasitological method. Out of the 164(48.9 %) male and 170(51.1 %) female dogs examined, a total of 52.0 % harbored at least one of five species of ectoparasites identified in the study: ticks (Rhipicephalus sanguineus, 70.3 %, Haemaphysalis leachii, 29.4 % and Amblyomma variegatum, 4.5 %), Flea (Ctenocephalides canis, 63.7 %) and lice (Heterodoxus spiniger, 30.0 %). Infestation was higher in males (60.7 %) than females (43.5 %). Multiple infestation particularly combination of tick and flea (34.7 %) were more frequent. Puppies of ≤ 6 months and dogs with short hair (86.5 %) were significantly infested (p<0.05). Analysis of seasonal distribution showed that ectoparasites were more abundant during the rainy season than the dry. The practice of allowing dogs to associate with other dogs; defecate and roam around the premises was significantly associated with increased infestation (p<0.05). Bathing of dogs with locally formulated chemicals significantly reduced infestation; however, they were not recommended acaricides. Some dog owners still employ handpicking, removal by brush or application of kerosene as best practices for controlling ectoparasites; hence, adequate knowledge on safe and reliable methods of control is exigent.

Keywords: Dog, Infestation, Ectoparasites, Seasonal distribution, Management

INTRODUCTION

Canis familiaris (domestic dogs) have long been in close association with humans (Tacon and Pardoe, 2002). In most Nigerian homes, they are primarily kept as guard, children's playmate, walking companion and for hunting or commercial purposes (McConnell *et al.*, 2011); therefore having them as pet animals is undisputable. However, their ability to harbor potentially transmissible ecto- and endo-parasitic diseases is not also in doubt, particularly among children and immunocompromised adults (Irwin, 2002; Ugbomoiko *et al.*, 2008). Ectoparasites are known to present infested dogs with severe skin diseases, life-threatening anaemia and occasionally hypersensitivity disorders of varying degree (Araujo *et al.*, 1998). Parasite intensity, nutritional and immunological status of host are essential virulence factors (Scott *et al.*, 2001). In Africa and other parts of the world, the risk

of zoonotic transmission of *Babesia* spp., *Ehrlichia* spp., *Anaplasma* spp., *Rickettsia* spp., *Borrelia* spp., *Bartonella* spp., *Dipylidium caninum* and *Yersinia pestis* from dogs via some arthropods such as ticks, fleas and lice has been extensively documented (Dantas-Torres, 2008a; Dantas-Torres, 2008b; Little, 2009). In Nigeria, previous studies have reported the prevalence of ectoparasitic infestation in dogs to be between 28 – 98 % (Agbolade *et al.*, 2008; Omudu *et al.*, 2010; Adamu *et al.*, 2012; Konto *et al.*, 2014; Inyang *et al.*, 2017). *Rhipicephalus sanguineus, Boophilus* spp., *Amblyomma* spp., *Haemaphysalis leachii* (ticks); *Ctenocephalides felis*, *C. canis, Pulex irritans* (fleas), *Manecanthus stramineus* (lice) and *Demodex canis* (mite) have been enormously reported except in a few location like our study area; Ilorin, Kwara State, Nigeria where ectoparasitic survey is largely scanty (Natala *et al.*, 2009; Arong *et al.*, 2011; Inyang *et al.*, 2017). The aim of this study was therefore, to investigate the prevalence, seasonal distribution and pet owner's knowledge and management practices with a bid to mitigate increasing ectoparasite infestation among dogs in Ilorin, North Central Nigeria.

MATERIALS AND METHODS

Study Area: The study was conducted in some selected communities surrounding the city of Ilorin (North-Central, Nigeria). Ilorin, the capital of Kwara State, lies on longitude $4^0$35'E and latitude 8^0 35'N with a total landmass of 150 Km^2 and an estimated human population of 777,667. The region enjoys 2 distinct seasons viz.; rainy and dry season. The former spans from April to October, while the latter lasts from October to March (Wikipedia, 2019).

Study Design: This is a cross sectional study involving random screening of dogs in randomly selected communities in Ilorin metropolis. Consent of dog owners was sought after detailed briefing of the study protocols. Only domiciled dogs were screened, while stray dogs were excluded from the study. Information regarding age of dog, gender, defecation sites and management practices of dog owners were obtained using structured, pre-tested questionnaire.

Recovery of Ectoparasites: Each dog was placed on a white cardboard paper and carefully examined for the presence of ectoparasites. Special attention was given to the head, pinnae and external ear canal, followed by the neck, chest region, armpits, legs and interdigital spaces. Thereafter, the dog's entire hair from head to tail was checked by gently applying sufficient pressure to detect small lumps. All attached ticks were removed using forceps. Fleas and lice were recovered by combing the dog's hair along the length of the body using a fine-toothed plastic comb. All ectoparasites recovered from each dog was preserved in pre-labelled sample bottles containing 70 % ethanol and transported to the parasitology laboratory of the Department of Zoology, University of Ilorin, for further processing and identification.

Processing of Ectoparasites: Fleas, ticks and lice were cleared in 10 % potassium hydroxide (KOH) solution for 24 hours and subsequently dehydrated in ascending concentration of alcohol before mounting in Canada balsam. Prepared slides were examined at x40 magnification under a dissecting microscope; identification up to the species level was carried out by matching morphological features of each parasite with standard taxonomic keys described by Hopla *et al*. (1994), Troyo *et al*. (2012) and Mathison and Pritt (2014).

Statistical Analysis: Statistical analysis was performed with IBM Version 20 (SPSS Incorporated, Chicago, USA). Data were analysed using descriptive statistics and intensity of infestation were expressed as percentages, while the student's t-test and Chi square analysis were used for risk analysis of infestation. Proportional test was performed by R console version 3.0.1. The level of significance was set at $p<0.05$.

RESULTS

Out of the 163 males and 170 females domestic dogs screened, 173(52.0 %) were found to habour one or more groups of ectoparasitic arthropods (tick, fleas and lice). Among the infested dogs, 77(28.5 %), 101(37.4 %) and 93(34.2 %) had single, double and multiple pattern of infestation (Table 1).

Table 1: Prevalence and pattern of infestations of dogs (n = 333) in Ilorin, Nigeria

Ectoparasites	Number infected	Percentage (%)
Single Infestation		
Ticks	56	20.7
Fleas	21	7.8
Double infestation		
Ticks + Flea	94	34.7
Ticks + Lice	3	1.2
Flea + Lice	4	1.5
Multiple infestation		
Ticks+ Fleas +Lice	93	34.2

The most frequently observed single infestation was with tick; 20.7 %, followed by fleas which accounted for 7.8 %. The combination of ticks and fleas was the most common double infestation pattern (34.7 %), while ticks and lice was the least encountered (1.2 %).

Five (5) species of ectoparasites consisting of three tick species; *Rhipicephalus sanguineus* (70.3 %), *Haemaphysalis leachii* (29.4 %), *Amblyomma variegatum* (4.5 %), one species of lice; *Heterodoxus spiniger* (30.0 %), and one flea species; *Ctenocephalides canis* (63.7 %) were recorded (Figure 1). The pattern of ectoparasite infestation with respect to sex and age showed that infestation was gender but not age-specific, males (60.7 %) harbored more parasites than females (43.5 %) (Table 2). Single and double infestation patterns were frequently observed in males (23.9 % and 36.8 % respectively), as opposed to females in which multiple infestation was predominant (35.6 %). Dogs in the age range 0 – 6 months were more infested (85.4 %) when compared to those of 7 – 11 months (77.5 %) and ≥12 months (80.9 %).

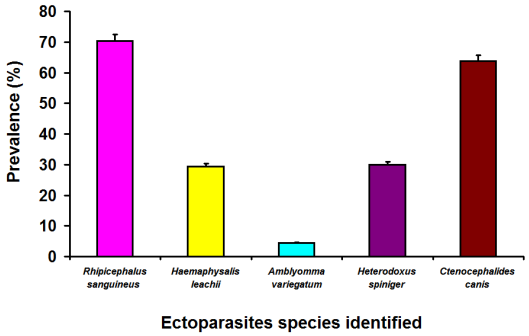

Figure 1: Species of ectoparasites identified in the screened dogs in Ilorin, Nigeria

Single infestation pattern was common in dogs of 0 – 6 months of age; double pattern among dogs ≥12 months and multiple in dogs aged 7 – 11 months (Table 2).

Comparison of parasite prevalence based on coat colour and hair length showed that brown coat dogs were more infested (91.1 %), followed by black (81.8 %), mixed colour (78.4 %), and white (54.4 %). Dogs with shorter hair length had significantly higher ($p<0.05$) degree of infestation (86.5 %) than those with long hair (68.3 %) (Table 3).

The distribution of ectoparasites across seasons indicated that the peak period for the occurrence of ticks was in the month of September (21.2 %) (rainy season), whereas for fleas and lice, highest prevalence of 15.7 % and 21.6 % respectively was recorded in August (rainy season) (Figure 2). The abundance of all ectoparasitic groups greatly diminished in March (dry season), however, the least ectoparasite recovered for all groups was in April (dry season) with tick having a prevalence of 1.8 %, fleas 0.7 % and lice 2.7 %.

Prevalence with respect to dog's activities showed that infestation was significantly higher ($p<0.05$) in dogs with no restricted movement within and outside the compound (95.2 %) when compared with those that roam within the compound (37.7 %). Furthermore, dog's defaecation site and their association with neighbouring dogs were significantly associated with infestation. Also, higher infestation (89.0 %) was recorded in dogs that play with other dogs compared to dogs that were not allowed to associate with others dogs (46.7 %) (Table 4).

Table 2: Ectoparasite infestation patterns with respect to sex and age of dogs in Ilorin, Nigeria

Ectoparasites	Sex		Age		
	Male (N = 163)	Female (N = 170)	0-6 months (N = 89)	7-11 months (N = 71)	≥12 months (N = 173)
Simple Infestation					
Ticks	24(14.7)	32(18.8)	19(21.3)	5(7.0)	32(18.5)
Fleas	15(9.2)	6(3.5)	10(11.2)	4(5.6)	7(4.0)
Double infestation					
Ticks + Flea	53(35.6)	36(21.2)	20(22.5)	21(29.6)	53(30.6)
Ticks + Lice	3(1.8)	0(0.0)	0(0.0)	1(1.4)	2(1.2)
Flea + Lice	4(2.5)	0(0.0)	1(1.1)	0(0.0)	3(1.7)
Multiple infestation					
Ticks + Fleas + Lice	16(9.8)	77(45.3)	26(29.2)	24(33.8)	43(24.9)

Table 3: Prevalence of ectoparasites with respect to coat colour and hair length of dogs in Ilorin, Nigeria

Variables	Number of dogs examined	Number of dogs infected	Percentage (%)	P-value
Coat Colour of dog				
Black	22	18	81.8	
Brown	113	103	91.1	
White	22	12	54.5	
Mixed	176	138	78.4	0.119
Hair length				
Long	82	56	68.3	
Short	251	217	86.5	<0.001

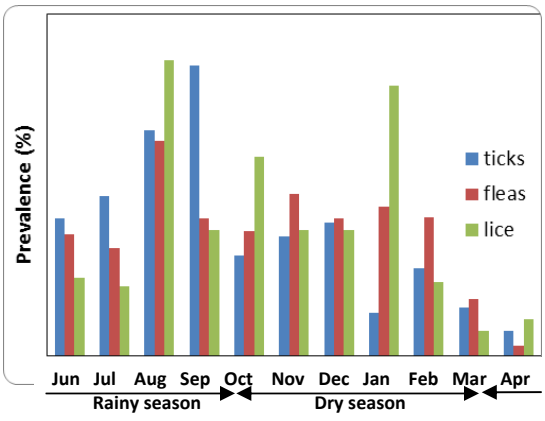

Figure 2: Seasonal prevalence of ectoparasites of dogs in Ilorin, Nigeria

Stratification of infestation with common management practices is presented in Table 5. Infestation was significantly higher ($p<0.05$) among dogs (97.5%) whose owners had never fumigated the compound. A hundred and one (74.3 %) dogs from owners who occasionally fumigate their compound were infested. All dogs belonging to owners who adopted handpicking of ectoparasites as control measure were infested. High prevalence was also reported in dogs whose owners chose bathing of dogs with kerosene (88.9 %), bathing with soap and detergents (70.6 %) and removal by brushing (66.7 %). However, a significantly lower ($p<0.05$) prevalence (50.0 %) was observed among dogs whose owners significantly preferred ($p<0.05$) the use of chemicals.

DISCUSSION

Ectoparasites pose a major threat to the well-being of dogs and humans resulting in devastating consequences if not properly managed. In this study, the domestic dog population screened showed evidence of high exposure with an overall prevalence of 52.0 %. This was similar to earlier reports of Natala *et al.* (2009) and Arong *et al.* (2011) in Zaria and Plateau respectively. However, higher prevalence of 99 % had been documented in Ogun, 96 % in Maiduguri and 86 % in Kwara (Agbolade *et al.*,

Table 4: Prevalence ectoparasites of dogs in Ilorin, Nigeria with respect to dog activities

Variables	Number of dog examined	Number infected (%)	P-value
Where do dogs usually roam?			
Confined to dog house in the compound	49	31 (63.3%)	
Inside the house	0	0 (0.0%)	
Within the compound	53	20 (37.7%)	
Anywhere within and outside the compound	231	220 (95.2%)	<0.001
How do dogs leave house premises?			
Always accompanied	96	52 (51.2%)	
Occasionally accompanied	169	164 (97.0%)	
Never accompanied	68	55 (80.9%)	0.041
Does your dog play with other dogs?			
Yes	273	243 (89.0%)	
No	60	28 (46.7%)	<0.001
Usual place of defecation			
Within the house premises	33	12 (36.4%)	
Outside of house premises	47	31 (66.0%)	
Within and outside the house premises	253	228 (90.1%)	<0.001
Preferred type of floor where dogs defecate			
Cemented/tiles	19	13 (68.4%)	
Grass, soil, etc.	314	258 (82.2%)	0.136

T**able 5: Ectoparasites infestation with respect to common management practices**

Variables	Number of dog examined	Number infected (%)	P-value
How often is the compound fumigated?			
Always	35	12 (34.3%)	
Never	162	158 (97.5%)	
Occasionally	136	101 (74.3%)	<0.001
What methods are employed by dog owners in the control of ectoparasites on their dogs?			
Use of chemical	28	14 (50.0%)	
Bath dog with soap and detergents	68	48 (70.6%)	
Bath dog with kerosene	27	24 (88.9%)	
Removal by brushing	3	2 (66.7%)	
Hand picking	104	104 (100.0%)	
Others	103	79 (76.7%)	<0.001

2008; Ugbomoiko *et al.*, 2008; Konto *et al.*, 2014) all in Nigeria. Out of the three tick species belonging to the family Ixodidae identified, *Rhipicephalus sanguineus* was the most abundant. This may be due to its unique ability to complete up to four generations in a year (Dantas-Torres, 2010). The finding of this study corresponds with findings from many endemic settings both within Nigeria (Ekanem *et al.*, 2010; Shitta *et al.*, 2011) and other parts of the world (González *et al.*, 2004; Nuchjangreed and Somprasong, 2007; Troyo *et al.*, 2012). *Ctenocephalides canis*, the only flea species recovered ranked second in abundance. Its presence among the ectoparasites recovered suggests iron deficiency anemia especially in puppies due to its prolific blood-feeding habit as documented in some studies (Dryden and Gaafar, 1991; Kramer and Mencke, 2001).

Though, several authors had reported high susceptibility of female dogs to ectoparasitic infestations (Ugbomoiko *et al.*, 2008; Adamu *et al.*, 2012; Konto *et al.*, 2014), this contradicts the findings of this study as

male dogs were more infested. This has also been documented previously (Nayak *et al.*, 1997; Rodriguez-Vivas *et al.*, 2003); probably because male dogs roam about widely and thus gain access to vegetation which serve as cover for small mammals. A higher occurrence of double and mixed pattern of infestation observed in this study could be ascribed to favourable environmental conditions that support the development and transmission of diverse ectoparasitic species. This observation is consistent with that of Agbolade *et al*. (2008). Present findings showed a higher degree of infestation in younger animals that corroborates the assertion of other workers (Chee *et al.*, 2008; Konto *et al.*, 2014). This may bother on low or partial immunity development. This study also observed that the coat colour of dogs had no significant impact ($p<0.05$) on prevalence of ectoparasites infestation despite the fact that dogs with brown colour were more infested.

Another important finding is the preference of ectoparasites for dogs with shorter hair, as evidenced by a significantly higher ($p<0.05$) prevalence in dogs with shorter hair length (86.5 %) compared to those with longer hair length (68.3 %). A plausible reason for this is that shorter hair length will enhance easy attachment to the epidermis of host, likewise facilitate drop-off. As regards dog's activities, allowing dogs to associate with other dogs; defeacate within and outside the premises and roam within and outside the compound significantly predisposed dogs to being infested.

Meanwhile, investigation on the seasonal distribution of ectoparasites revealed that all species were present all year round. A steady increase in number was observed from June – August; which coincided with period of intensive rainfall. However, a gradual decline in parasite abundance was noticed from February – April, a period characterized by high temperature. Similar findings were reported in North-eastern Nigeria (Konto *et al.*, 2014), North-central Nigeria (Arong *et al.*, 2011), as well as Iran (Shoorijeh *et al.*, 2008). It has been established that the availability of vegetation during the rains provide a favourable environment for ectoparasites, especially ticks which drop off their host to moult after which they position themselves on leaf blades to infest other potential host that they come in contact with during movement or grazing (Shitta *et al.*, 2011). *Heterodoxus spiniger* showed a distinct ability to thrive both in the rainy and dry seasons as exemplified by the two peak periods observed in August and January. This suggests its resilience during harsh environmental condition and also warrants the need for dog owners to be extra vigilant and apply measures to prevent infestation of their dogs.

Effective management of ectoparasite is exigent in order to keep animals as healthy as possible and eliminate any threat to humans. We noted that of all the preventive measures employed by dog owners, hand picking was a common but ineffective practice as 100 % prevalence was recorded in such dogs. Although fumigation of compound significantly reduced infestation, this measure may be rendered ineffective if dog's activities are not closely monitored by restricting their movement. In southwestern Nigeria, Agbolade *et al*. (2008) had previously established that routine bathing with washing soap and chemical-treated water such as kerosene did not confer protection. However, in our study, we observed a lower prevalence in dogs who received a similar treatment. None of the dog owners used recommended acaricides, hence the need for proper enlightenment on topical or orally administered products. A rise in ectoparasite resistance to some acaricides such as diazinon and coumaphos, as stated in previous studies (Hassall, 1990; Li *et al.*, 2003) makes the development of new and effective potent acaricides products imminent.

Conclusion: In this study, we have been able to establish that dogs in Ilorin, North Central Nigeria habour an array of ectoparasitic species which thrive all year round in varying abundance. This should inform the development of appropriate control strategies to minimize infestation of dogs. Preventive measures adopted by dog owners are unsatisfactory and does not confer long lasting protection for dogs. Therefore, dog owners should be equipped with adequate knowledge of acaricides which are not only environmentally safe, but guarantee the

safety of their dogs as well. Good sanitation of the environment and close monitoring of dogs to prevent access to areas of dense vegetation will go a long way in reducing the risk of infestation.

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