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## International Journal of Veterinary Science and Medicine

journal homepage: [www.elsevier.com/locate/ijvsm](http://www.elsevier.com/locate/ijvsm)

Full Length Article

## Parasitic conditions of domestic owned rabbits in Osun State, southwestern Nigeria: Retrospective evaluation, risk factors and co-infestations



Shola D. Ola-Fadunsin\*, Karimat Hussain, Musa Rabi, Isau A. Ganiyu

Department of Veterinary Parasitology and Entomology, University of Ilorin, PMB 1515, Ilorin, Kwara State, Nigeria

## ARTICLE INFO

## Keywords:

Coccidiosis  
Co-infestations  
Flea  
Helminthoses  
Mange  
Rabbits

## ABSTRACT

Parasitism is of great concern to the production, reproduction and performance of man and animals. The present study evaluated the parasitic conditions of rabbits brought for medical attention in the major Veterinary hospitals in Osun State, Southwestern Nigeria during ten years (2006–2015). A total of 444 rabbits were brought during the study period, out of which 312 (70.27%) was diagnosed for mange, 126 (28.38%) for helminthoses, 60 (13.51%) for coccidiosis and 6 (1.35%) for flea infestation. There was no defined pattern in the yearly and monthly prevalence of these parasitic diseases. Age, sex and season were the statistically significant ( $P < 0.05$ ) risk factors associated with the prevalence of helminthoses, while age and season were associated with mange at  $P < 0.05$ . There was a significant negative correlation in the co-infection of helminthoses and coccidiosis, helminthoses and mange, coccidiosis and mange, while the co-infection of helminthoses with flea infestation, coccidiosis with flea infestation and mange with flea infestation was not statistically significant. These findings could be useful for surveillance, monitoring and designing of appropriate interventions for diseases control in Osun State and Nigeria at large. The proper management, prevention, control and eradication of these disease conditions will improve the production and reproduction of rabbits for better profitability for farmers and increased availability of protein sources for consumers.

## 1. Introduction

Rabbits are small mammals in the family *Leporidae* of the order *Lagomorpha*, found in several parts of the world [1]. Rabbit has emerged as a growing key livestock that is increasingly being raised by farmers in many parts of Nigeria as the meat is widely acceptable and has low cholesterol content. As at 2008, about a million of fresh, chilled/frozen meat and edible offal of rabbits and hares was exported from Nigeria [2]. Beside been raised for food, they are also used by researchers extensively in the safety evaluation of different therapeutic drugs, foods, chemicals and in a broad variety of biological investigations, for the diagnosis of infectious diseases, in the production of vaccines, sera and other biological substances of public health and veterinary importance [3]. Rabbits are popular pets in many European, American and Asian countries, almost as common as dogs and cats [4]. They are also raised for fibre, whereby with its numerous importance, they are raised to the detriment of the ecosystem [5].

Rabbits are generally infected with a range of parasites varying from helminths, protozoans and ectoparasites. Parasitic infections have caused considerable losses to rabbits in terms of production and its

scientific uses. Numbers of parasites are responsible for illness in rabbits [1]. Infections by helminths causes a greater ramification with significant impact in this animal, when present in sufficient number, they can cause high reduced weight gain, anorexia, diarrhoea, weakness, reduced productivity, morbidity and even mortality [1]. Protozoans such as *Eimeria* infection, are associated with major economic losses in rabbit farming including morbidity and mortality, growth retardation and condemnation of affected livers in cases of hepatic coccidiosis [6]. Ectoparasitism in rabbits is of particular interest because it results in a wide range of pathogenic effects. Feeding of these parasites may cause direct damage to skin and other sub-cutaneous tissues, inflammation and significant blood loss. This activity is usually associated with pruritis, erythema, excoriation, papules, lichenification, scale and crusting and self-trauma [7]. The behavior of ectoparasites may also cause harm indirectly, causing disturbance, increasing levels of behavior such as rubbing and leading to reduced time spent feeding or ruminating and in some cases, it leads to self-wounding [5]. Generally, parasitism is the major reason farmers bring their rabbits to the veterinarian.

Although parasitism is a major problem among rabbits, this study

Peer review under responsibility of Faculty of Veterinary Medicine, Cairo University.

\* Corresponding author.

E-mail address: [olashodam2@yahoo.com](mailto:olashodam2@yahoo.com) (S.D. Ola-Fadunsin).

<https://doi.org/10.1016/j.ijvsm.2018.06.002>

Received 2 April 2018; Received in revised form 5 June 2018; Accepted 6 June 2018

Available online 18 June 2018

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appears to be the first to be conducted in the southwestern part of Nigeria with a very few documented individually in the Northwestern [8], Southeastern [9] and North central [10] parts of Nigeria respectively. This study evaluated ten years medical records of parasitic diseases of rabbits in Osun State, Southwestern Nigeria.

This research will contribute in providing epidemiological data of parasitic diseases of rabbits in Osun State for epidemiological surveillance, baseline for academics and improving veterinary education as well as appending further knowledge to the few research on this subject matter carried out in other parts of the country.

## 2. Materials and methods

### 2.1. Study area

This research was conducted in Osun State. The state was created in 1991. Administratively, the state has 30 local government areas that are grouped into 6 zones. The zones are Osogbo, Ede, Iwo, Ikirun, Ilesha and Ife. The state administrative office is located in Osogbo. The state is located within latitude 7° 59'N and longitude 4° 56'E in the Southwestern part of Nigeria. The state is characterised by a tropical wet (March–November) and dry (December–February and August “August break from rains”) climate with a lowland tropical rain forest vegetation. Osun State is bordered in the north by Kwara State, in the east partly by Ekiti State and partly by Ondo State, in the south by Ogun State and in the west by Oyo State [11]. The state has a mean annual rainfall between 127.77 cm and 159.76 cm and an average annual temperature ranging from 21.1 °C to 31.9 °C. The minimum and maximum annual relative humidity is 58.7% and 79.6% [2].

### 2.2. Study design

A ten year retrospective study from January 2006 to December 2015 was conducted on records for rabbits parasitic diseases collected from the zonal Veterinary hospitals of the state that are located in Osogbo, Ede, Ilesa and Ikirun. The records retrieved from the database included; the date of presenting the rabbits to the hospital, the age, sex and the diagnoses made. The breed was not taken into cognizance as most breeds were crossed; also the management system of the rabbits was not included in the statistics as the information was not for all the rabbits. Diagnosis of each parasitic disease was carried out in the hospital based on case history, physical examination and clinical signs. Where possible, cases were confirmed in the laboratory by faecal floatation and skin scraping (been dissolved in 10% KOH) using a light microscope and with direct identification of ectoparasites using a stereomicroscope. Identification was made as described by Soulsby [12]. Clinical diagnosis and records about the rabbits were carried out by qualified veterinarians and laboratory examinations were conducted by qualified veterinary laboratory scientists.

### 2.3. Determination of prevalence

The prevalence of each parasitic disease of rabbits between the study periods was calculated as the total number of the parasitic disease diagnosed throughout the study period divided by the total number of rabbits presented in the hospitals all through the period of the study. The yearly prevalence rate of each parasitic disease was calculated as the total number of the parasitic disease diagnosed in that year divided by the total number of rabbits presented in the hospitals in that year, while the monthly prevalence rate was calculated as the total number of the parasitic disease diagnosed in that month all through the study period divided by the total number of rabbits presented in the hospitals in the said month throughout the study period.

### 2.4. Data analysis

The retrieved data were statistically analyzed using the “Microsoft Excel 2010 and SPSS-Version 22.0” (SPSS Inc., Chicago). Descriptive statistics was conducted to estimate the prevalence using percentages in tables. The univariate analysis (chi-square) test and odds ratios with 95% confidence interval were used to determine the association between each risk factor and the parasitic diseases with more than 100 cases (helminthoses and mange). The odds ratios were calculated with respect to a reference category as indicated in the tables.  $P < 0.05$  was considered significant for the univariate analysis. Spearman's correlation was used to measure the strength of association for parasitic diseases co-infection and  $P < 0.01$  was considered significant for this. The strength of association between parasitic diseases co-infection was measured as described by Mukaka [13].

## 3. Results

### 3.1. Prevalence of parasitic diseases of rabbits (2006–2015)

A total of 444 rabbits were presented to the four veterinary hospitals visited during the ten-year study (2006–2015). Of the parasitic cases diagnosed, mange was the most prevalent recording a 70.27% (95% CI 65.89–74.39) prevalence, while flea infestation was the least prevalent (6/444 (1.35%); 95% CI 0.55–2.79) (Table 1).

### 3.2. Yearly and monthly distribution and occurrence of parasitic diseases of rabbits

The yearly distribution of parasitic diseases of rabbits in Osun State, Nigeria (2006–2015) is presented in Table 2. Helminthoses had its highest prevalence in 2014 (18/18; 100.0%) and lowest in 2009 (6/36; 16.7%) although there were no cases reported in 2008, 2010, 2012 and 2013. Coccidiosis was recorded between 2012 and 2015 with the highest prevalence observed in 2013 (12/12; 100.0%), no case of coccidiosis was recorded between 2006 and 2011. It was only in 2006 (6/36; 16.7%) that rabbits were detected to be infested with fleas, with no record of the condition in the other years under review. Mange in rabbits was diagnosed in all the studied years with exception of 2013 and 2014, prevalence of above 60.0% was recorded in the other years apart from 2012 with a prevalence of 45.5%.

The occurrence of helminthoses within the months showed an undulating pattern with the peak observed in June, no occurrence of the disease was diagnosed in January, February, May, July, August, November and December. Coccidiosis (*Eimeria* infection) was diagnosed in March, September and November, with the peak reported in September (42/96; 43.8%). Interestingly, flea infestation was only diagnosed in April (6/96; 6.2%) with no diagnosis made in the other months of the year. The diagnosis of mange occurred in every month of the year with exception of June and December where no diagnosis was made (Table 2).

### 3.3. Risk factors for helminthoses in rabbits

Within the study period, there was a significant difference in the

**Table 1**  
Prevalence (%) of parasitic diseases of rabbits between 2006 and 2015 in Osun State, Nigeria.

Parasitic disease	Number infected	Prevalence (%)	95% C.I
Helminthoses	126	28.38	24.33; 32.71
Coccidiosis	60	13.51	10.57; 16.94
Flea infestation	6	1.35	0.55; 2.79
Mange	312	70.27	65.89; 74.39

C.I = confidence interval.

**Table 2**  
Yearly and monthly distribution of parasitic diseases of rabbits in Osun State, Nigeria (2006–2015).

	No of Rabbits	Number of Parasitic Disease Condition (%)			
		Helminthoses	Coccidiosis	Flea infestation	Mange
<b>Years</b>					
2006	36	12 (33.3)	0 (0.0)	6 (16.7)	24 (66.7)
2007	54	18 (33.3)	0 (0.0)	0 (0.0)	54 (100.0)
2008	42	0 (0.0)	0 (0.0)	0 (0.0)	42 (100.0)
2009	36	6 (16.7)	0 (0.0)	0 (0.0)	30 (83.3)
2010	24	0 (0.0)	0 (0.0)	0 (0.0)	24 (100.0)
2011	84	30 (35.7)	0 (0.0)	0 (0.0)	54 (64.3)
2012	66	0 (0.0)	36 (54.5)	0 (0.0)	30 (45.5)
2013	12	0 (0.0)	12 (100.0)	0 (0.0)	0 (0.0)
2014	18	18 (100.0)	6 (33.3)	0 (0.0)	0 (0.0)
2015	72	42 (58.3)	6 (8.3)	0 (0.0)	54 (75.0)
Total	444	126 (28.4)	60 (13.5)	6 (1.4)	312 (70.3)
<b>Months</b>					
January	42	0 (0.0)	0 (0.0)	0 (0.0)	42 (100.0)
February	18	0 (0.0)	0 (0.0)	0 (0.0)	18 (100.0)
March	66	18 (27.3)	6 (9.1)	0 (0.0)	54 (81.8)
April	96	48 (50.0)	0 (0.0)	6 (6.2)	78 (81.2)
May	18	0 (0.0)	0 (0.0)	0 (0.0)	18 (100.0)
June	24	24 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
July	18	0 (0.0)	0 (0.0)	0 (0.0)	18 (100.0)
August	6	0 (0.0)	0 (0.0)	0 (0.0)	6 (100.0)
September	96	30 (31.2)	42 (43.8)	0 (0.0)	30 (31.2)
October	30	6 (20.0)	0 (0.0)	0 (0.0)	30 (100.0)
November	30	0 (0.0)	12 (40.0)	0 (0.0)	18 (60.0)
December	0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	444	126 (28.4)	60 (13.5)	6 (1.4)	312 (70.3)

**Table 3**  
Risk factors associated with rabbit helminthoses in Osun State, Nigeria (2006–2015).

Risk factor	Prevalence (%)	OR (95% CI)	P value
<b>Age</b>			
Young	72/210 (34.29)	1.74 (1.15; 2.64)	0.01*
Adult <sup>a</sup>	54/234 (23.08)	1.00	
<b>Sex</b>			
Female	68/194 (35.05)	1.78 (1.18; 2.71)	0.01*
Male <sup>a</sup>	58/250 (23.20)	1.00	
<b>Season</b>			
Wet	125/348 (35.92)	53.02 (10.31; 108.30)	< 0.01*
Dry <sup>a</sup>	1/96 (1.04)	1.00	

OR = odds ratio, CI = confidence interval.

<sup>a</sup> Reference category.

\* Significant at  $P < 0.05$ .

prevalence of helminthoses in young rabbits (34.29%) than adult rabbits (23.08%), with young rabbits been about two times more likely to be infected with helminthoses than adult. Significantly higher prevalence of helminthoses was recorded in female (35.05%) rabbits compared to their male (23.20%) counterpart as females were 1.78 times more prone to the disease than males. The diagnosis of helminthoses was alarmingly recorded during the wet season as against the dry season, with the likelihood of the disease occurring 53.02 times more in the wet season compared to the dry season and this was significant (Table 3).

### 3.4. Risk factors for mange in rabbits

A significant association was observed between the occurrence of rabbit mange with age and season. The condition was higher in young rabbits compared to adult and in the dry season compared to the wet season respectively. The tendency of rabbit mange occurring in the

**Table 4**  
Risk factors associated with rabbit mange in Osun State, Nigeria (2006–2015).

Risk factor	Prevalence (%)	OR (95% CI)	P value
<b>Age</b>			
Young	162/210 (77.14)	1.89 (1.24; 2.88)	< 0.01*
Adult <sup>a</sup>	150/234 (64.10)	1.00	
<b>Sex</b>			
Male	182/250 (72.80)	1.32 (0.87; 1.99)	0.22
Female <sup>a</sup>	130/194 (67.01)	1.00	
<b>Season</b>			
Wet	228/348 (65.52)	0.27 (0.14; 0.51)	< 0.01*
Dry <sup>a</sup>	84/96 (87.50)	1.00	

OR = odds ratio, CI = confidence interval.

<sup>a</sup> Reference category

\* Significant at  $P < 0.05$ .

young was 1.89 times as against adult, while it was diagnosed about 4 times more during the dry season compared to the wet season. There was no significant difference in the occurrence of mange in relation to sex, although higher prevalence was recorded in males compared to females (Table 4).

### 3.5. Co-infection of rabbit parasitic diseases

There was a moderate negative correlation between coccidiosis and mange and this was statistically significant. A significantly low negative correlation between helminthoses and mange was observed, while the association between helminthoses and coccidiosis was significantly negatively correlated and it was negligible. There was no significant association in the co-infection of helminthoses with flea infestation, coccidiosis with flea infestation and flea infestation with mange respectively (Table 5).

## 4. Discussion

Parasitism is one of the most devastating diseases that affects both man and animals including rabbits. Its effects on livestock (rabbits) cannot be overemphasized as it affects the production and reproduction of animals. Mange was the most prevalent disease of rabbits from our study. Mange has been reported to be a serious parasitic disease condition of rabbits in Egypt [5], India [14], Israel [15] and Pakistan [16]. Mange has been reported to be among the most common reasons that lead owners to bring their rabbits to the veterinarian [5]. The high prevalence recorded in our study maybe associated with the fact that most rabbit owners in the study area also keep dogs as pet, as retrieved from the records on the management system of the rabbits, suggesting sarcoptic mange as the mange condition encountered [16]. Successful transmission of mange from dogs to rabbits and rabbits to dogs is possible experimentally as well as naturally [16]. Helminthoses prevalence of 73.0% has been reported among rabbits in India [1], 56.3% in Turkey [4] and 33.33% in Pakistan [3]. These reported prevalences are higher than what we observed in our study. The difference may be attributed to the long duration of our study as against the short duration of study carried out by the aforementioned researchers. These

**Table 5**  
Spearman’s correlation coefficient for the co-infection of parasitic diseases of rabbits in Osun State, Nigeria (2006–2015).

	Helminthoses	Coccidiosis	Flea infestation	Mange
Helminthoses	1.000			
Coccidiosis	-0.161**	1.000		
Flea infestation	-0.074	-0.046	1.000	
Mange	-0.443**	-0.608**	0.076	1.000

\*\* Correlation is significant at the 0.01 level (2-tailed).

prevalences of helminthoses show that helminth infection is of great concern to the rabbit industry in most parts of the world. The 13.51% prevalence reported for coccidiosis in this study is lower than the 38.0% reported by Musongon and Fakae [9] in their study carried out in Southeastern Nigeria. A 85.1% prevalence for coccidiosis has been reported in Kenya [17], 75.0% in Saudi Arabia [18] and 41.0% in China [19]. The low prevalence we observed may be connected to the frequent use of sulfa drugs by rabbit owners on the onset of any clinical sign shown by their rabbits as this may have reduced the prevalence of the disease. Low doses of sulfa drugs as feed additive and as medication is been used to prevent coccidiosis in animals [20]. The low prevalence of flea infestation may be attributed to the fact that fleas are not always easily spotted on the fur of rabbits and if black or dark, dirt is seen in the fur then this is most probably the faeces of the flea [21].

The yearly distribution of parasitic diseases showed an undulating pattern. This may be associated with changes in government which translates to changes in policies affecting diseases surveillance, treatment programs, control measures and sensitization of the public on the need to report and present their animals and pets to the clinics whenever a disease condition is seen.

Our study records that young rabbits were more prone to helminthoses and mange compared to adult rabbits. In line with our findings Mwangi [22] documented that healthy young rabbits are more susceptible to disease (including helminthoses) than older rabbits. The higher prevalence recorded in young rabbits may be attributed to the naiveness of their immune system to helminthic diseases compared to adult that must have built up resistance (immunity) to the condition due to several repeated infections in the past. Elshahawy et al. [5] documented a higher prevalence of mange among young rabbits than adult rabbits; they proposed that the high prevalence seen in young rabbits may be due to keeping young and adult animals together thus getting infection through direct contact. This finding fits with current immunological trends, as it is well known that younger and sick animals are more pre-disposed to be affected by infectious diseases such as mange [7].

Female rabbits were about twice more likely to be diagnosed with helminthoses than males from our study, this could be attributed to the stress of breeding, milking and cyclical hormonal changes in the females. The closer proximity of female rabbits to young rabbits could have been the link between the higher prevalence seen in young and female rabbits due to cross infections between the groups. There was a higher prevalence of mange in males compared to females, although this difference was not significant. Elshahawy et al. [5] reported a similar finding in their study conducted in Egypt. They debated that the higher contacts of males with other rabbits because they occupy larger home ranges and are in charge of the territory defense and the fact that farmers use one male for many flocks of rabbits which will give males more opportunity to frequent contact with infected rabbits causing the higher prevalence reported among males than females.

The significantly higher prevalence of helminthoses recorded during the wet season as against the dry season may be due to moisture seen during the wet season. Increased moisture level is an important biotic factor that favours the development and survival of the infective stages of helminths especially in the tropics [23]. As it pertains to mange, a higher prevalence was recorded during the dry season as against the wet season. The windy conditions associated with the dry season may have favoured the transmission leading to the higher prevalence recorded.

The statistically significant negative correlation between the different parasitic conditions of rabbits in our study may be associated with the fact that these diseases are not related in terms of their transmission, etiologic agent, lifecycle and pathology.

## 5. Conclusions

Our study showed that helminthoses, coccidiosis, flea infestation

and mange were the parasitic diseases diagnosed in rabbits over the ten year period. Mange and helminthoses are the most diagnosed parasitic diseases. The yearly prevalence revealed that there was no defined pattern during the study period. Age, sex and season were the significant risk factors associated with helminthoses, while age and season were the significant risk factors associated with mange. There was no positive correlation in the co-infection of these parasitic diseases. The data generated could be useful for surveillance, monitoring and designing of appropriate interventions for control of rabbits parasitic diseases in Osun State and Nigeria at large.

## Funding

This study did not receive funding of any kind from funding agencies in the public, commercial, or not-for-profit sectors.

## Competing interests

The authors unanimously confirm that there are no known conflicts of interest associated with this publication.

## Acknowledgement

We would like to express our profound gratitude to the Government of Osun State; Dr. Bukola Aluko, the Director of Veterinary Services and all staff of the Ministry for granting access to the record used for this study.

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