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Parasitological Screening of Haemo-Parasites of Small Ruminants in Karu Local Government Area of Nasarawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author CNI designed the study and performed the statistical analysis. Author NCJA wrote the protocol, wrote the first draft of the manuscript and managed literature searches. Authors NCJA and LYA managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To determine the prevalence rate and severity of haemoparasitic infections in small ruminants, using age and sex as associating factors.
Study Design: This research study was done using random sampling technique.
Place and Duration of Study: Karu Local Government Area abattoirs, Nasarawa State; Department of Biological Sciences, Bingham University, Karu, between April 2015 and July 2015.
Materials and Methods: Two hundred and sixty five (265) blood samples were examined microscopically at ×100 objective using oil immersion. Thin blood films were prepared using Giemsa's stain, 87 sheep blood samples and 178 goat blood samples were included. Packed cell volume (PCV) was determined using capillary tubes, Hawksley haematocrit centrifuge and reader.
Results: A significantly high prevalence rate of 43.39% was recorded for haemoparasites of small ruminants (P<0.001). The genera of haemoparasites observed were *Anaplasma, Babesia* and *Theileria*, with *A. marginale* having the highest prevalence of 13.96% and *T. hirci* having the least

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prevalence with 1.88%. *Anaplasma* was most prevalent (20.7%) in goats while the most prevalent in sheep was *Babesia* (34.48%). *Theileria* had the least prevalence in both sheep (8.05%) and goats (2.81%). In goats, males had the most prevalence while females were most prevalent for sheep. Blood samples with *A. marginale* had the highest mean PCV of 35.89%, while *B. motasi* had the least mean PCV of 31.82% ($P<0.05$; $P=0.01$). However, the PCV results significantly showed neither anaemic conditions nor dehydration as they fell within 22-38% range.

Conclusion: There was high rate of haemoparasitaemia of small ruminants in both sexes, although the infections were not severe. This could have a negative effect on meat and milk production, as well as their consumers, hence, measures should be taken to prevent and provide control strategies against these haemoparasites and enhance food security to meat consumers.

Keywords: Haemoparasites; ruminants; PCV; meat; anaplasma; babesia and theileria.

1. INTRODUCTION

Animal agriculture is an indispensible prerequisite towards the sustainability of human development because of food provision, employment generation and overall economy of a nation. Apart from the animal protein requirement for human consumption, animal agriculture is also important in providing raw materials for manufacturing other valuable products [1]. Animal diseases constitute a major obstacle to economic development as well as posing health risk to livestock productivity and profitability, inadequate consumption of protein of animal origin, poverty, unemployment, low contribution to the nation's gross domestic product among others. Parasitism is a primary cause of production loss which results in mortality, reduction in weight gain, low fertility, loss in most animal protein – producing countries of the world [2]. Furthermore, the presence of these haemoparasites poses an indirect threat (through consumption of undercooked meat, low-protein meat as well as hazardous chemoprophylactic residues on meat) to the health of consumers.

According to Gates and Wescott [3], gastrointestinal parasites have been noted as major constraint to ruminants' productivity in terms of pathology and economic importance. These parasites are found within the Gastro Intestinal Tract (GIT) of the animal. Haemoparasites on the other hand, are found in the blood stream and tissues of vertebrates throughout the world. In domestic animals, losses encountered due to haemoparasites accounts for about 60% loss of whole population of animals and this is highly noticed in sheep and goats with a range between 30 to 40% losses in the tropics especially in Nigeria [4]. These losses have been best attributed to *Anaplasma*, *Babesia*, *Theileria* and *Cowdria* species, due to the prevalence of the vectors [4]. In Nasarawa State, the economic losses due to tick-borne diseases and tick infestation such as Babesiosis, Anaplasmosis, Trypanosomiasis and Theileriosis are not known because the incidence/prevalence of such diseases has not been described fully. These diseases especially are considered some of the major impediments to the health and productive performance of small ruminants like sheep and goats. Adejinmi et al. [5] reported anaemia as a reliable indicator for the severity of haemoparasitic infections. However, the effect of haemoparasites on the mean PCV is more deleterious in younger animals [6].

Although studies have been carried out with respect to epidemiology of haemo-parasitism in ruminants in Nigeria, most of the studies are confined to cattle, with very few studies focusing on small ruminants. The poor knowledge of local farmers on the incidence of these haemoparasites and their effects on the reproduction performance has a negative impact on the income generation of the farmers and source of protein for increasing the human population. Hence, this study was aimed at studying the prevalence rate and severity of haemoparasites of small ruminants in Karu L.G.A abattoirs with respect to their age and sex, as well as the effect on the packed cell volume of these ruminants.

2. MATERIALS AND METHODS

2.1 Area and Population of Study

Karu is a Local Government Area in Nasarawa State, North-Central geo-political zone in Nigeria. It is close in proximity to the Federal Capital Territory of Nigeria. It has an area of 2,640 km². Karu local government has its headquarters in New Karu town. From west to east, the urban area includes towns like Kurunduma, New

Nyanya, Mararaba, New Karu, Ado, Masaka and newer, fast-growing towns such as One Man Village (which contains over 1 million people) and Gidan Zakara. Apart from the farmers in the LGA, the abattoirs also serve butchers and traders in the some of the satellite towns of the F.C.T such as Kurudu, Jikwoyi and Karu. The ruminants are often bought by butchers from the livestock traders, from where they are transported to the abattoirs for slaughter.

2.2 Sample Collection and Sampling Technique

Whole blood samples from small ruminants were collected using random sampling technique. This is a method of selecting a sample (random sample) from a statistical population in such a way that every possible sample that could be selected has a predetermined probability of being selected. Two hundred and sixty five (265) blood samples were collected, 87 sheep blood samples and 178 goats blood samples from different ages and sexes of the ruminants between April and July, 2015. A total of 265 samples were collected for this study. The sample size was determined using previous prevalence rate of 21.7% [7] as described by Naing et al*.* [8].

About 5ml of whole blood were collected from the severed ovine and caprine jugular veins into properly labelled sterile Ethylene Diamine Tetra Acetic Acid (EDTA) bottles and transported immediately to the Biological Science Laboratory of Bingham University, Karu, for appropriate parasitological (microscopic) and haematological analysis using Giemsa stain blood smear method, microscopy and Packed Cell Volume determination.

2.3 Sample Preparation, Staining Procedure and Microscopy

A drop of free flowing blood was placed toward one end of a clean grease-free microscope slide. A second slide was held at 45° angle to the first slide, allowing the drop of blood to spread into the edge of the spreader slide. Quickly and evenly, the spreader slide was pushed forward, allowing the blood to spread out. The smeared slide was allowed to air dry, then the film was fixed with 70% methanol for two [2] minutes, poured off and allowed to dry before flooding with diluted Giemsa (1 in 10 diluted with buffer distilled water pH 7.2). This was then allowed to stain for 1 hour before washing off with buffered distilled water, and then it was allowed to air dry. The film was then observed microscopically with oil immersion and x100 objectives.

2.4 Determination of Packed Cell Volume (PCV)

Spirit lamp was lit using a match stick and one end of the capillary tube was sealed by placing it in the flame of the fire. The sealed capillary tube was placed in the capillary holder of the micro haematocrit centrifuge, which was then closed properly and spun for 5 minutes, after which the spun capillary tube was placed on the Hawksley haematocrit reader such that the base of the packed cell was placed on the base line of the reader and the top line of the serum was placed on the top line of the reader. Using the adjustable handle, the adjustable line was placed directly on the point of clear buffer separation. The value the adjustable line pointed to was carefully read and recorded.

2.5 Analysis of Results

Pearson's chi-square test was used to analyse the results obtained to determine if the species of haemoparasite identified was linked to the type of ruminant sampled. The test was also used to determine if there was a difference between the species of haemoparasite and sex of the ruminants, as well as their ages. Each test was conducted at 95% confidence interval, $P<0.05$ at the appropriate degrees of freedom (d.f.). A P-value of $P<0.05$ was considered significant. The data were analysed using the programme IBM SPSS Version 22.

3. RESULTS

Table 1 shows the distribution of haemoparasites in sheep, showing the different genera of haemoparasites observed, number of sheep samples examined and the percentage infected. Out of 87 sheep sampled, 49 (56.32%) were infected with haemoparasites. 12 (13.70%) were infected with *Anaplasma*, 30 (34.48%) with *Babesia* and 7 (8.05%) with *Theileria.* Table 2 shows the distribution of haemoparasites in goats showing the different genera of haemoparasites observed, number of goat samples examined and the percentage was infected. Out of 178 sheep sampled, 66 (37.07%) were infected with haemoparasites. 37 (20.7) were infected with *Anaplasma*, 24 (13.40) with *Babesia* and 5 (2.81) with *Theileria.* There was a significant relationship between the

haemoparasites and the infected ruminants (χ2=109.016, df=5, *P*<0.001). The prevalence of haemoparasites was significantly high, with *Anaplasma* having the highest prevalence, and *Theileria* having the lowest prevalence. Table 3 shows the distribution of haemoparasites in the small ruminants according to sex, showing the percentage of each haemoparasite. Male ruminants in this study recorded a significantly higher prevalence of haemoparasitism with 23.77% compared to the 19.62% recorded in females (χ2= 35.842, df=5, *P*<0.001). However, *A. marginale* had the highest prevalence of 9.81% in male while *B. motasi* had the highest prevalence of 8.67% in female ruminants. Fig. 1 shows the overall prevalence of haemoparasites in sheep and goats. The overall prevalence of haemoparasites in small ruminants was 43.39% while the prevalence rates detected were 18.46% and 24.83% in sheep and goats respectively. Fig. 2 shows total percentage of infected animals according to their sex and age (in months). The older ruminants showed a higher level of haemoparasitaemia in this study than the younger ones. However, the prevalence of haemoparasites in adults and young showed no significant difference (P>0.05; *P*= 0.28). Fig. 3 shows the prevalence of haemoparasites according to the species of parasites and mean PCV. Blood samples with *A. marginale* had the highest mean PCV of 35.89%, while *B. motasi* had the least mean PCV of 31.82% ($\chi^{2=}$37.657, df=5, *P*=0.01). Although there was high prevalence of haemoparasites, the mean PCV of the ruminants were significantly within normal range (P<0.05; *P*=0.01).

Table 1. Distribution of haemoparasites in sheep

Haemoparasites	Number of sheep examined	Number of sheep infected (%)
Anaplasma	87	12 (13.70)
Babesia	87	30 (34.48)
Theileria	87	7 (8.05)
Total	87	49 (56.32)

(χ2=109.016; df=5; P<0.001)

Table 2. Distribution of haemoparasites in goats

Haemoparasites	Number of goats examined	Number of goats infected (%)
Anaplasma	178	37 (20.7)
Babesia	178	24 (13.40)
Theileria	178	5 (2.81)
Total	178	66 (37.07)

(χ2=109.016; df=5; P<0.001)

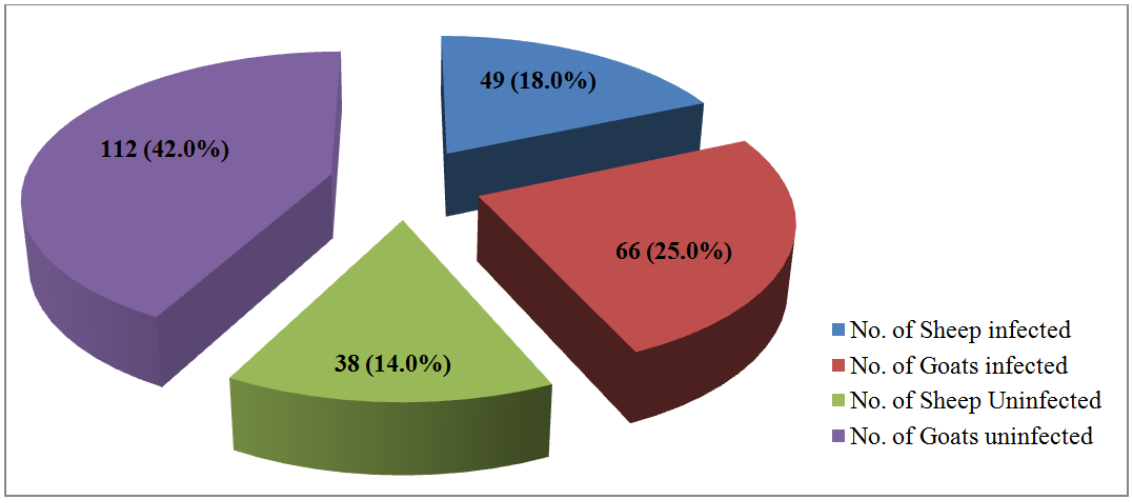

Fig. 1. Overall prevalence of haemoparasites in sheep and goats

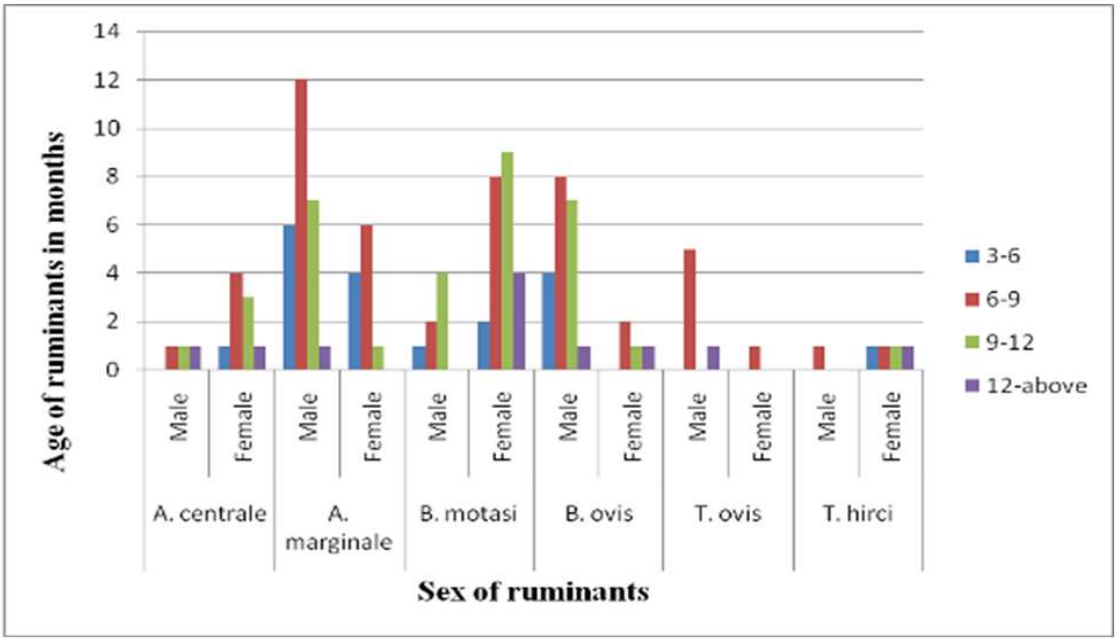

Fig. 2. Total percentage of infected animals according to their sex and age (in months)

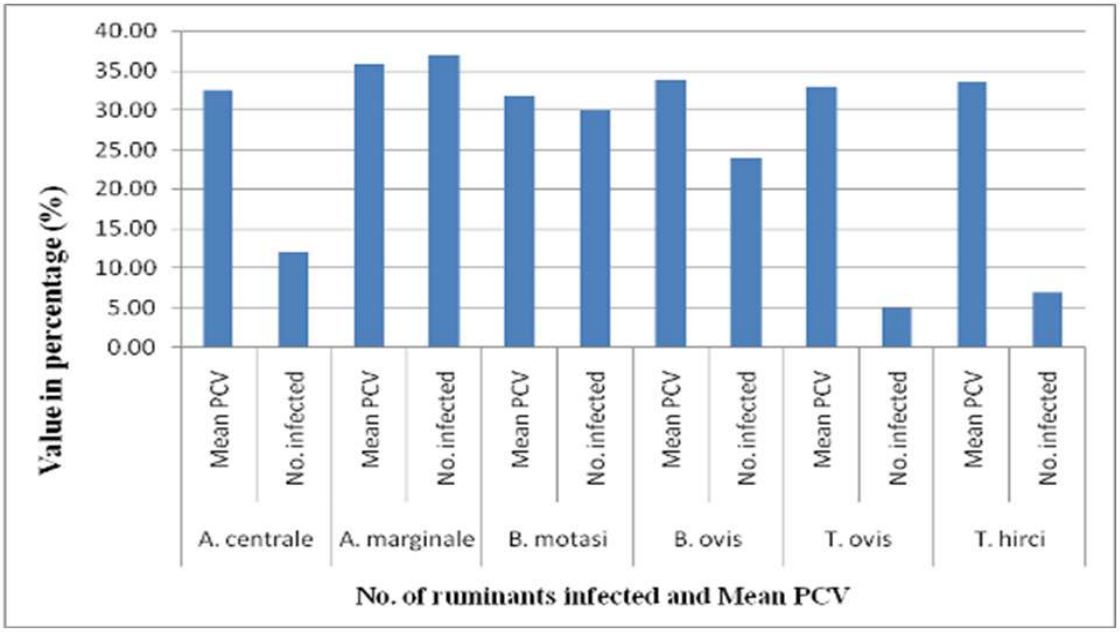

Fig. 3. Prevalence of haemoparasites according to the species of parasites and mean PCV

Table 3. Distribution of haemoparasites according to sex

Sex	No. positive (%)	*A. centrale*	*A. marginale*	*B. motasi*	*B. ovis*	*T. hirci*	*T. ovis*
Female	52 (19.62)	9(3.39)	11(4.15)	23(8.67)	*4*(1.50)	*4* (1.50)	1 (0.37)
Male	63 (23.77)	3 (1.13)	26 (9.81)	7 (2.64)	20 (7.54)	1 (0.37)	6 (2.26)
Total	115 (43.39)	12 (4.52)	37 (13.96)	30 (11.32)	24 (9.05)	5 (1.88)	7 (2.64)

(χ2= 35.842, df=5, P= 0.28)

4. DISCUSSION

This study recorded an overall prevalence rate of 43.39% of haemoparasites of small ruminants. This is significantly very high, compared to the 3.03% reported by Ademola and Onyiche [9], although it is lower than the prevalence of 57.6% reported by Ukwueze and Kalu [10]. This puts the prevalence of haemoparasitic infections in ruminants in Karu L.G.A within the range of 40-45%. The alarmingly high prevalence of haemoparasites in this study should not come as a surprise, as the favourable environmental conditions in the tropics promote the survival and proliferation of the arthropod vectors responsible for the transmission of these parasites [10]. Hence, the high prevalence of haemoparasites could be due to the irregular use of prophylactic measures by small scale farmers who can barely afford them. Most of the small scale farmers in the north notably practice nomadic livestock farming which enables them save cost to a large extent, and also accords them little or no time to attend to the health of their livestock. It should be noted however, that the regular use of chemoprophylaxis might lead to development of drug resistance or presence of drug residue in meat if withdrawal period is not observed before slaughtering, as should be expected from these farmers [9]. The prevalence rates detected were 18.46% and 24.83% in sheep and goats respectively. The haemoparasites had a lower prevalence rate in sheep than goats in this study. This is surprising, as it is naturally believed that goats are better equipped physiologically, to fight and ward off infections and vectors. The higher prevalence in goats could however, be attributed to their grazing environments, as they are known to stray farther than sheep that move in fleets. It should also be noted that constant exposure to predisposing factors of infections could weaken their immune system, no matter how strong initially, hence, making them easy targets to these haemoparasites.

A. marginale had the highest prevalence of 13.96%, followed by *B. motasi* with 11.32%, while *T. Hirci* had the least prevalence with 1.88% animals. The prevalence of *Anaplasma* spp. was highest possibly due to the nomadic livestock grazing system, lack of improvement in the husbandry system (if any), breed of the ruminants, poor veterinary care and climatic change. The high prevalence could also be possibly due to the fact that the disease is transmitted by ticks, dipteral flies, contaminated instruments and equipments. Ticks and dipteral flies are known to be rampant in Northern Nigeria. The prevalence of *Babesia* in this study however, contradicts the findings of Biu and Leeflang [11], who observed *Babesia* to be very rare in northern Nigeria. *Theileria* had the least prevalence rate and it relates to the degree at which ruminants can be infected apart from the fact that the prevalence is generally very low [12-14].

Male ruminants in this study had a significantly higher prevalence of haemoparasitism with 23.77% compared to the 19.62% recorded in females. This is contradictory to previous findings [9,10,15] who noted a higher prevalence in female small ruminants than males. Females are generally believed to be more prone to haemoparasitaemia due to their extended breeding for economic reasons (calving and milk production) [9,10] as well as the stress of breeding, milking and cyclical hormonal changes associated with gestation, parturition and calving processes. The lower prevalence recorded in this study could however be attributed to their acquired immunity resulting from previous exposure to the haemoparasites and their vectors. These female ruminants are also secluded during calving for some period of time; hence, the tendency of being exposed during this period of suppressed or wavering immunity is not high.

Results revealed that there is significant difference in prevalence of haemoparasites in males and females in sheep and goats respectively. In goats, males had the highest prevalence rate of 9.81% while females had 4.15% and in sheep, females had the highest prevalence rate of 8.67% while males had 2.64%. The higher prevalence in female sheep conforms to the findings of [9,10,15]. This could be due to the fact that female sheep are less immunologically equipped due to the hormonal changes associated with gestation and calving.

The older ruminants showed a higher level of haemoparasitaemia in this study than the younger ones. This could be due to the fact that they are allowed to graze on their own while the calves are housed during lactation and fed until they are old enough to be weaned and for grazing. There was no significant relationship between the age of the ruminants and haemoparasitism.

Blood samples with *A. marginale* had the highest mean PCV of 35.89%, followed by *B. motasi* with the least mean PCV of 31.82%. Anaemia is

known to be characterized by low mean PCV values. Anaemia is as a result of haemolysis of red blood cell, and haemoparasites do this by inducing erythrophagocytosis. Ruminants are considered anaemic when their mean PCV value is below 22% and dehydrated when it is above 38% [16]. However, the animals sampled in this study were neither anaemic nor dehydrated as their mean PCV fell within the range of 22-38%. It can hence be deduced that, though the animals sampled in this study were highly infected with haemoparasites, the severity of the parasitaemia was not high. Such subclinical infections may act as nidus for spead of infection to other susceptible aimals and have a negative effect on production [17].

The total infection rate of 43.39% by haemoparasites reported in this study however, suggests a continuous challenge by parasites and the existence of carrier state in most animals. The importance of the study of haemoparasites can be appreciated when one understands how debilitating the infection is to small ruminants. The parasites discovered in this work such as *Babesia, Theileria, Anaplasma* agree with some of the parasites recovered by Ajayi [1]. This goes a long way to prove that the overall veterinary health care system in Nigeria has not improved over the long years.

5. CONCLUSION

The result of this research clearly shows that there was high rate of haemo-parasitaemia of small ruminants of both sexes in Karu Local Government Area, although the infection was not severe. The non-severity of the infection (sub clinical infection) may have led to them being unnoticed by the farmers.

Although not severe, the sub clinical presence of haemo-parasitaemia could have a negative effect on meat and milk production. Hence, government should enforce the parasitological screening of all animals before been slaughtered as control strategy against these haemo-parasites and enhance meat quality and safety for consumers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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