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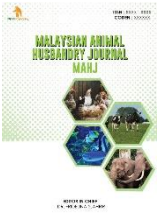

RESEARCH ARTICLE

PREVALENCE OF BABESIOSIS IN LIVESTOCK AND THEIR ASSOCIATED HEMATO-BIOCHEMICAL CHANGES: A CASE STUDY OF BAUCHI CENTRAL ABATTOIR NORTHEASTERN NIGERIA

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ABSTRACT

Babesiosis is a tick-borne parasitic disease that affects a wide range of domestic and wild animals, including sheep, goats, and cattle. This study aims to investigate the prevalence of babesiosis in these livestock species slaughtered at the Bauchi Central abattoir and to assess the associated hemato-biochemical changes. A total of 130 blood samples were collected from Cattle, goat and sheep (n =40) goats (n = 45) and cattle (n=45) Giemsa stained blood smears were prepared and examined under light microscope, to screen for *Babesia* specie. Packed cell volume (PCV) was determined by micro-hematocrit centrifugation technique while haemoglobin (Hb) concentration was determined by Sahli's method. Biochemical test was determined by spectrophotometer-based estimation. The results showed, 49 blood samples belonging to 18 Cattles, 14 sheep and 17 goats were positive for *Babesia* parasite, which gave prevalence of 40.0%, 35.0% and 37.8% respectively. Cattle had the highest prevalence followed by goats and sheep with least prevalence. Also, presence of *Babesia* by sex of animals examined showed that female sheep exhibited significantly higher ($p>0.05$) prevalence of 52.0% than their male (6.67%) counterpart. No significant difference between male and female cattle and goats. Age wise prevalence revealed significantly ($p<0.05$) higher in kids (63.2%) than their adult (19.2%) counterparts whereas young and adult cattle and sheep showed no significant difference. Significant decrease ($p<0.05$) in PCV and haemoglobin concentration in infected animals as compared to the uninfected animals, the mean values of PCV in % (25.78± 4.97, 24.47±5.70) and Hb g/dl (8.63±1.72, 8.13±1.91) of infected cattle and goats fall within normal range while the mean values of PCV %(26.0±6.03) and Hb g/dl (8.62±2.03) of infected sheep was below normal range (27-45) % indicating mild anaemia. Result of biochemical analysis revealed hypoproteinemia, hypoalbuminemia and bilirubinemia.

KEYWORDS

Babesiosis Parasite, Infection Hematological, Biochemical

1. INTRODUCTION

Babesiosis is a protozoan parasitic disease caused by various species of the genus Babesia. It affects many domestic and wild animals, leading to substantial economic losses in the livestock industry. The disease is transmitted primarily by the bite of infected ticks. It is characterized by the destruction of red blood cells, leading to anaemia, jaundice, and a range of clinical signs in affected animals. Globally, the most significant hemoprotozoan diseases affecting animal productivity are Babesiosis, Theleriosis, Anaplasmosis and Trypanosomiasis (Rajput et al., 2006). Bovine babesiosis causes the most serious economic loss to the livestock industry, endangering half a billion cattle across the world (Saad et al., 2015). It is also an economically important disease that causes significant losses in small ruminant production rapidly in tropical and subtropical regions of the world (Muthuramalingam et al., 2014). The livestock sub-sector is an important component that generates income for human livelihood in Africa especially Nigeria (Ahmed, 2002).

In Nigeria, ruminants such as sheep, goats and cattle constitute the largest livestock reared by farmers in the agricultural sector of the country with sheep having a population of 38.5 million 57.4 million goats and 19.2 million cattle (Adebowale et al., 2020). Cattle contribute 10% of Nigeria's livestock and in monetary terms account for about 40% total livestock revenue of Nigeria (Akande et al., 2010). They are very important economically because they are a source of animal protein and income. Sheep and goats contribute significantly to the food security and value chain of the Nigerian economy (Lawal Adewale, 2012). However, their productivity is threatened by ticks and associated hemiparasites diseases especially babesiosis and anaplasmosis (Okaiyeto et al., 2008). The Bauchi region in Nigeria is home to a substantial livestock population, including sheep, goats, and cattle, which play a critical role in the livelihoods of the local population. However, babesiosis remains a persistent threat to the health and productivity of these animals. To address this issue, it is essential to conduct in-depth research on the prevalence of babesiosis and the associated haematological and biochemical changes in animals slaughtered at the Bauchi central abattoir.

This study aims to fill a critical knowledge gap by providing comprehensive insights into the prevalence of babesiosis in the Bauchi region and the impact of the disease on the biochemical and haematological profile of the animals. The data collected through this research will not only contribute to the local understanding of babesiosis but also support the development of targeted interventions and strategies to improve animal health so as to reduce economic losses and enhance livestock productivity in the region. Additionally, the findings may have

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broader implications for disease management and livestock health practices in other areas facing similar challenges.

1.1 The Study Area

The research was conducted between the months of November 2023 to January 2024 at the Bauchi central abattoir. The Bauchi central abattoir is the largest in the state. It is about 6 kilometres away from the state capital and situated along Gombe–Adamawa Road in northeastern Nigeria. The abattoir has an average daily sacrifice of 40–50 cows, 40–60 sheep and 60–80 goats. The state lies between latitude 9.3° and 12.3° north of the equator and longitude 8.5° and 11° east of the Greenwich meridian. The state covers a total land area of 49, 259.01km^2 which is about 5.3% of Nigeria's total land mass. It has a population of 4,676,465 people based on the 2006 population census. Bauchi state is one of the states in the northern part of Nigeria that spans two distinctive vegetation zones namely the Sudan savanna and the Sahel savanna. (See Figure 1)

Figure 1: Map of Bauchi State Arrow Indicating Bauchi Local Government Area (Source: Google Maps, accessed on March 26th, 2028).

2. Materials and Method

2.1 Sample Collection

A total of 130 blood samples were randomly collected from sheep (n=40), goat (n=45) and cattle (n=45). The blood samples were collected for the period of a month from December to March. About 5 ml of blood was collected immediately after slaughter from the severed jugular vein into vacutainer tubes containing 1 mg of ethylenediaminetetraacetic acid (EDTA) for parasitological and haematological examinations, similarly, 5 ml of blood was also collected in plain sample tubes without anticoagulant for biochemical analysis. The age, sex and species of each animal were identified and recorded (sex differentiation was made based on the appearance of external genitalia, that is presence or absence of testes and udder, whereas ages of sampled animals were determined using owners' information and supported by dentition as described (Hassan and Nwannenna, 2009). The blood samples were transported on ice packs to the laboratory for examinations.

2.2 Preparation of Thin and Thick Blood Film

For the preparation of thin blood film; a small drop of blood was placed on one end of a clean grease-free microscopic slide, and another slide (placed at an angle of 45) was used to extend over half the length of the slide and rapidly air-dried. The thin film was fixed in absolute alcohol for a few minutes and dried. Then stained using Giemsa stain for 45 minutes and rinsed with buffered water (pH = 7.2); it was allowed to air dry and viewed under x100 (oil immersion) objective lenses (Cheesbrough, 1999). For the preparation of thick blood film, a drop of blood was placed on a clean–grease free slide, using the corner of another slide blood was spread in a circle of a dime (diameter 1–2 cm). The smear was allowed to dry thoroughly and then stained using Giemsa for 45 minutes. It was rinsed with buffered water and allowed to air dry on a rack, then viewed under a microscope (Cheesbrough, 1999).

2.3 Preparation of Pack Cell Volume (PVC)

Blood with EDTA was drawn into capillary tubes, one end was sealed using a sealant (plasticine). The sample was centrifuged at 1200 rpm for 5 minutes using a micro-haematocrit centrifuge. The PCV was measured as a percentage of micro-haematocrit readers (Reid et al., 2001).

2.4 Preparation of Haemoglobin Concentration

The small acid hematin method was used to determine the haemoglobin count using the haemometer, blood was mixed with n/10 Hcl which resulted in the conversion of haemoglobin to acid haematin which is brown in colour. The solution was diluted till its colour matched the brown-coloured glass of the comparator box. Then, the concentration of haemoglobin was read directly from the graduation in the calibration tube (Brar et al., 2002).

2.5 Biochemical analysis

A blood sample was centrifuged briefly to obtain serum from the top of the tube. The sera were used to determine the concentration of creatinine (kidney function), liver function (albumin and Bilirubin), Lipid profile (Tryglyceride) and total protein in a Spectrophotometer at 259nm absorbance. The purity was evaluated by scanning between wavelengths of 200-300 nm. The concentration of each component/element was calculated using optical density. The unit of 1 optical density was determined by the equivalent to a concentration of 50mg/dl or 50g/dl. They were all measured according to (Lobetti et al., 2000).

2.6 Data analysis

The data obtained were subjected to statistical analysis using the Fisher exact test the odd ratio/or the risk factor was calculated to determine whether or not an association existed between the factors and babesiosis. A 95% confidence interval/CI on or was also calculated for each risk factor to determine if the association between the variable factors and babesiosis was significant.

3. Results

The results obtained from the study have shown that out of 130 blood samples belonging to 45(34.6%) cattle, 40 (30.8%) sheep and 45 (34.6%) goats were examined for Babesiosis, of these, 49 (37.7%) blood samples belonging to 18 (40.0%) cattle, 14(35.0%) sheep, and 17 (37.7%) goats were positive for Babesia parasite. The presence of Babesia by age indicates a prevalence of a higher infection rate of 62.5% and 36.4% in calves and lambs than their adult counterpart with a prevalence of 35.1 and 19.2 % with a p-value of 0.23 and p< 0.001 below (Table 1). In Sheep however, age exhibited no significant association with infection status as both lambs and adult Sheep had comparable infection rates of 36.4% and 34.5% respectively with an odd ratio of 1.08 (95% CI [0.18, 5.6], p=1) (Table 1). Moreover, Sex-based prevalence reveals that female sheep exhibited a significantly higher infection rate of 52.0% than their male counterparts (6.67%), (p=0.005). Male and female cattle show cast infection rates of 30.4% and 50.0% respectively (Table 1). The calculated odds ratio (OR=0.455, 95% CI [0.11, 1.73], p=0.23). Male and female Goats had a prevalence of 28.6% and 45.8% respectively with p=0.23 (Table 2).

Both cattle and Goats did not demonstrate a significant association. The mean values of both pack cell volume and haemoglobin concentration of infected animals decrease as compared to the uninfected (Table 3). The mean values of PCV and haemoglobin concentration of cattle and goats are within normal range but decrease in PCV and Hb of infected sheep. For the biochemical parameters, the result reveals a reduction in total protein and albumen in infected sheep, goats and cattle as compared to both the uninfected animals and the reference range values. There was an elevation in the bilirubin of infected cattle and sheep with a reduction in infected goats as compared to uninfected animals. The mean values of all the species of animals also were elevated when compared to the normal reference value. The mean values of both creatinine and triglycerides were within the normal range (Table 3). There was an elevation in the mean values of creatinine in infected cattle, sheep and goats as compared to the uninfected, but the mean values of triglycerides of infected cattle and sheep decreased while that of goats increased as compared to uninfected.

Table 1: Prevalence of babesiosis in relation to age, and sex, of Cattle, sheep and goats,				
Risk factor	**No. examined**	**No. Infected (%)**	**OR [UL, LL]**	**P**
	Bovine			
Age				
< 2 years	8	5 (62.5)	2.99 [0.49,22.46]	0.23
≥ 2 years	37	13 (35.1)		
Sex				
Male	23	7 (30.4)	0.455 [0.11,1.73]	0.23
Female	22	11 (50.0)		
	Ovine			
Age				
< 1 years	11	4 (36.4)	1.08 [0.18, 5.60]	1
≥ 1 years	29	10 (34.5)		
Sex				
Male	15	1 (6.67)	0.07 [0.01,0.59]	0.005*
Female	25	13 (52.0)		
	Caprine			
Age				
< 1 years	19	12 (63.2)	6.84 [1.58.34.90]	0.00*
≥ 1 years	26	5 (19.2)		
Sex				
Male	21	6 (28.6)	0.48 [0.11,1.91]	0.36
Female	24	11 (45.8)		

Table 2: Prevalence of Babesiosis in relation to animal species			
S/N	**Animal species**	**No. Examined**	**No. Infected (%)**
1	Bovine	45	18 (40.0)
2	Ovine	40	14 (35.0)
3	Caprine	45	17 (37.8)
Total		130	49 (37.7)

Table 3: Mean ± SE Haemato-biochemical parameters of uninfected and infected cattle				
S/N	**Parameters**	**Uninfected**	**Infected**	**Reference value (Merck Veterinary Manual**
1	Pack cell Volume %	33.04±5.28	25.78±4.997	24-46
2	Haemoglobin g/dl	10.97±1.76	8.63±1.72	8-15
3	Creatinine mg/dl	0.89±0.11	1.46±0.45	0.6-1.8
4	Albumin g/dl	3.39±1.86	2.00±0.22	2.8-3.9
5	Bilirubin mg/dl	1.41±0.19	1.84±1.07	0.0-0.8
6	Triglyceride mg/dl	4.34±0.32	2.87±0.56	0-14
7	Total Protein g/dl	5.19±0.62	4.22±0.53	6.2-8.2

Table 4: Mean +_SE Haemato-biochemical Parameters of Sheep			
Parameters	**Uninfected**	**Infected**	**Reference value (Merck Veterinary Manual)**
Pack cell volume %	30.42±4.19	26.0±6.03	27-45
Hemoglobin g/dl	10.11±1.39	8.62±2.03	9-15
Creatinine mg/dl	1.04±0.04	1.12±0.11	0.9-2.0
Albumin g/dl	3.03±0.02	2.51±0.50	2.7-3.7
Bilirubin mg/dl	1.76±0.12	1.90±0.42	0.0-0.5
Triglycleride mg/dl	2.52±0.80	2.17±0.54	0-14
Total Protein g/dl	5.68±0.30	4.35±1.11	5.9-7.8

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Table 5: Mean +_SE Haemato-biochemical Parameters Goat.			
parameters	**Uninfected**	**Infected**	**Reference value (Merck Veterinary Manual)**
Pack cell volume %	29.71±4.31	24.47±5.70	22-38
Hemoglobin g/dl	9.82±1.45	8.13±1.91	8-12
Creatinine mg/dl	0.10±0.01	1.40±1.30	0.7-1.5
Albumin g/dl	2.62±0.53	2.24±0.05	2.3-3.6
Bilirubin mg/dl	1.62±0.39	1.54±0.13	0.1-0.2
Triglycleride mg/dl	1.94±0.46	3.19±0.35	0-14
Total Protein g/dl	4.91±0.55	4.69±0.41	6.1-7.4

4. Discussion

The result above revealed that the prevalence of Babesiosis in cattle, sheep and goats in Bauchi is relatively high. This could be due to several reasons which include; managerial system, these animals are allowed to roam freely within the area during the day and go back to their house in the evening, vectors of this parasite may be found during this period. The high prevalence (37.7%) of babesiosis in this study is similar to a previous study on prevalence and molecular characterization of Babesia ovis infecting sheep in Nigeria with the prevalence of 67.7% and 546.6% using microscopy and 38.4% and 35.4% using PCR technique in Abeokuta and Abuja respectively (Adewumi et al., 2022). However, this report contrasts the previous prevalence of 0.9% in Kano 1% in Bauchi and 1.9% in Ibadan, Oyo state (Jatau et al., 2011; Mudi et al., 2023; Adejinmi et al., 2021).

In this study, young animals have a higher prevalence than adults. This agrees with the report of (Iqbal et al., 2013). This could be attributed to the low sample size, which might also be attributed to the season as reported by who attributed the high prevalence of the infection in calves in winter due low immune status of calves in farms and introduction of a pathogenic strain of B. bovis (El-diasty et al., 2007). Young animals have a higher resistance to hemiparasitic infection which is attributed to the transfer of maternal immunity to these young animals; however, as these animals age, this maternal immunity wears away and at this period, the animal is most susceptible to this parasitic infection. The low prevalence in young animals disagrees with the results found in a studies which show low prevalence of these parasites in lambs and kids below 6 months of age and higher prevalence in adult sheep and goats (Jegede et al., 2015).

On the basis of sex, the result showed a higher prevalence in female than male animals. This could be due to the physiological status of female animals during periods such as pregnancy, parturition, and lactation, the immune status of female animals is significantly compromised This agrees with the report (Khan et al., 2020). On the contrary, Iqbal et al illustrated that males were more infected than females. Reduction in total protein and serum albumin might be linked to a disturbance in liver function. The observed hypoalbuminemia in this study is in agreement with earlier reports which include (Mahmoud et al., 2016; Bhikane et al., 2001). Reduction in total protein could be due to destructed RBCs and its excretion in urine as reported by (Malcovati, 2009). The hyperbilirubinemia is in line with the report of (Rathore, 2018)

5. Conclusion

This study has revealed the presence of babesia parasites in cattle, sheep and goats slaughtered at Bauchi central abattoir Bauchi local government of Bauchi state. This finding revealed a higher prevalence in young and female animals than in their counterparts. The result of the study further revealed a decrease in pack cell volume and haemoglobin of infected sheep which is manifested as mild anaemia. The biochemical parameters, which is manifested as hypoproteinemia, hypoalbuminemia and bilirubinemia. These would be accompanied by negative effects on the economic gains by the peasant farmers due to accompanying morbidity, reduced production and mortality. Consequently, it might further discourage the production of ruminants in the region

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Adebowale, O.O., Ekundayo, O., and Awoseyi, A.A., 2020. Female Cattle Slaughter And Foetal Wastage: A Case Study Of The Lafenwa Abattoir, Ogun State, Nigeria. Cogent Food & Agriculture, 6 (1), Pp. 1809308.

Adejinmi, J.O., Sadiq, N.A., Fashanu, S.O., Lasisi, O.T., and Ekundayo, S., 2004. Studies on The Blood Parasites Of Sheep In Ibadan, Nigeria. African Journal of Biomedical Research, 7 (1).

Adewumi, T.S., Takeet, M.I., Akande, F.A., Sonibare, A.O., and Okpeku, M., 2022. Prevalence And Molecular Characterization Of Babesia Ovis Infecting Sheep In Nigeria. Sustainability, 14 (24), Pp. 16974.

Ahmed, J., 2002. The Role of Cytokines In Immunity And Immunopathogenesis Of Pirolasmoses. Parasitology Research, 88, Pp. S48-S50.

Akande, F.A., Takeet, M.I., and Makanju, O.A., 2010. Haemoparasites Of Cattle in Abeokuta, South West Nigeria. Science World Journal, 5 (4).

Bhikane, A.U., Narladkar, B.W., Anantwar, L.G., and Bhokre, A.P., 2001. Epidemiology, Clinico-Pathology And Treatment Of Babesiosis In Cattle.

Brar, R.S., Sandhu, H.S., and Singh, A., 2002. Veterinary Clinical Diagnosis By Laboratory Methods. Kalyani Publ.

Chesbrough, M., 1999. District Laboratory Practice In Tropical Countries. Part1: Low Price Eds., Cambridge University Press, Pp. 280-291

El-Diasty, M.M., Rasheed, N.M., Kheder, Z.A., and Abd El-Maged, R.R., 2017. Biochemical, Pathological And Molecular Studies On Babesiosis In Calves. Egyptian Journal Of Agricultural Research, 95 (3), Pp. 1269-1283.

Hassan, Z.A., Nwannenna, A.I., 2009. Animal Handling And Restrain: An Instructive Approach 1st ed Ndahi Press. Pp. 61. Isbn:9781-2530-3-3.

Iqbal, F., Khattak, R.M., Ozubek, S., Khan, A.U., Ali, M., Sheikh, R.S., 2013. Application of The Reverse Line Blot Assay For The Molecular Detection Of Theileria And Babesia Sp. In Small Ruminants of Pakistan', Iranian Journal of Parasitology, 8, Pp. 289–295.

Jatau, I.D., Abdulganiyu, A., Lawal, A.I., Okubanjo, O.O., and Yusuf, K., 2011. Gastrointestinal And Haemo Parasitism Of Sheep And Goats At Slaughter In Kano, Northern-Nigeria. Sokoto Journal Of Veterinary Sciences, 9 (1), Pp. 7-11.

Jegede, O.C., Asadu, I.A., Opara, M., Obeta, S.S., and Olayemi, D.O., 2015. Gastrointestinal Parasitism In Local And Exotic Breeds Of Chickens Reared In Gwagwalada Guinea Savannah Zone Of Nigeria. Sokoto Journal Of Veterinary Sciences, 13 (3), Pp. 25-30.

Khan, A., Noushin, R., Attaullah, M., Khan, S.N., Hussain, R., Dawar, F.U., and Ullah, K., 2020. Prevalence Of Tick Born Babesia Infection In Domestic Cattle Of Khyber Pakhtunkhwa, Pakistan. Pak J Zool, 52 (6), Pp. 2401-2403.

Lawal-Adebowale, O.A., 2012. Dynamics of Ruminant Livestock Management In The Context Of The Nigerian Agricultural

System. Livestock Production, 4, Pp. 1-20.

Lobetti, R.G., Möhr, A.J., Dippenaar, T., and Myburgh, E., 2000. A Preliminary Study on The Serum Protein Response In Canine Babesiosis: Research Communication. Journal of The South African Veterinary Association, 71 (1), Pp. 38-42.

Mahmoud, M.S., El-Ezz, N.T.A., Abdel-Shafy, S., Nassar, S.A., El Namaky, A.H., Khalil, W.K., and Suarez, C.E., 2016. Assessment of Theileria Equi And Babesia Caballi Infections In Equine Populations In Egypt By Molecular, Serological And Hematological Approaches. Parasites & Vectors, 9, Pp. 1-10.

Malcovati, L., 2009. Red Bood Cell Transfusion Therapy and Iron Chelation In Patients With Myelodysplastic Syndromes. Clinical Lymphoma And Myeloma, 9, Pp. S305-S311.

Mudi, H., Yerima, I.M., Yuguda, A.U., and Babayo, S.A., 2023. Prevalence And Risk Factors Of Anaplasmosis In Cattle Slaughtered At Central Abattoir Bauchi, Bauchi State, Nigeria. International

Muthuramalingam, T., Pothiappan, P., Gnanaraj, P.T., Sundaram, S.M., Pugazhenthi, T.R., and Parthiban, S., 2014. Report on An Outbreak Of Babesiosis In Tellicherry Goats. Indian J Vet Anim Sci Res, 43, Pp. 58-60.

Okaiyeto, S.O., Tekdek, L.B., Sackey, A.K.B., and Ajanusi, O.J., 2008. Prevalence Of Haemo And Gastrointestinal Parasites In Sheep And Goats Kept By The Normadic Fulanis In Some Northern States Of Nigeria. Research Journal Of Animal Sciences, 2 (2), Pp. 31-33

Rajput, Z.I., Hu, S., Chen, W., Arijo, Ag and Xiao, C., 2006. Review: Important Of Ticks And Their Chemical And Immunological Journal Of Zhejiang University Science B, 7 (11), Pp. 912-921

Rathore, S., 2018. A Randomized Control Clinical Trial To Evaluate The Efficacy Of Amruta Abheervadi Drops In Neonatal Hyperbilirubinemia (Doctoral Dissertation, Rajiv Gandhi University Of Health Sciences (India).

Reid, S.A., Hsein, A., and Copeman, D.B., 2001. Evaluation And Improvement Of Parasitological Tests For T. Evansi Infestation. Veterinary Parasitology, 102 (4), Pp. 291-297.

Saad, F., Khan, K., Ali, S., and Akbar, N., 2015. Zoonotic Significance And Prophylactic Measure Against Babesiosis. International Journal Of Current Microbiology And Applied Sciences, 4, Pp. 938-953.