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Risk factors of haemoparasites and some haematological parameters of slaughtered trade cattle in Maiduguri, Nigeria

Paul B. T.[1], Bello A. M.[2], Ngari O.[2], Mana H. P.[1], Gadzama M. A.[1], Abba A.[1], Malgwi K. D.[1], Balami S. Y.[1], Dauda J.[3] and Abdullahi A. M.[1]

[1]Veterinary Teaching Hospital, University of Maiduguri, Nigeria.
[2]Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria.
[3]Department of Veterinary Public Health and Preventive Medicine, University of Maiduguri, Nigeria.

This study was conducted to determine the prevalence of haemoparasites and some haematological parameters of slaughtered trade cattle in Maiduguri abattoir. A total of 120 blood samples were randomly collected from cattle between January and July, 2014. The samples were screened for haemoparasites by examining Giemsa stained thin blood films. Microhaematocrit centrifugation technique was used for determination of packed cell volume (PCV) while total red blood cell (RBC) counts and total white blood cell (WBC) counts were determined by cyanmethaemoglobin and hemocytometer methods. An overall prevalence of 10.8% (CI=0.064, 0.017) was recorded for Anaplasma (5.8%), Babesia (4.2%) and Trypanosoma species (0.8%). Young cattle had significantly (p<0.05) higher prevalence of 9.2% (CI= 0.052, 0.157) compared to adults with 1.7% (CI= 0.005, 0.059). Among different sexes, females had a significantly (p<0.05) higher prevalence of 7.5% (CI: 0.040-0.136) than males with 3.3% (CI= 0.130, 0.083). Rahaji breed had a significantly higher (p<0.05) prevalence of 7.5% (CI= 0.040, 0.136) compared to Ambala with 1.7% (CI= 0.005, 0.059), Kuri and Adamawa gudali each with a prevalence of 0.8% (CI= 0.002, 0.046). Cattle with moderate body condition scores had significantly (p<0.05) higher prevalence of 6.7% (CI= 0.034, 0.126) compared with those that have good body condition scores with 4.2% (CI= 0.018, 0.094) while thin and fat cattle were not infected with haemoparasites. Even though all the haematological parameters were within range of normal values, there was a significant difference (p<0.05) in mean packed cell volume (PCV) and total white blood cell (WBC) counts between infected and un-infected slaughtered cattle. It was concluded from this study that haemoparasites are endemic in cattle populations in Maiduguri and the prevalence of haemoparasites may be associated with changes in PCV and WBC count.

Key words: Haematological parameters, haemoparasites, Maiduguri, Prevalence, risk factors, trade cattle.

INTRODUCTION

The Nigerian livestock resources was conservatively estimated to the tone of USD 6 billion (Anon, 2006; Akande et al., 2010) and contributes significantly to the Agricultural component of the Gross Domestic Product (GDP) of which cattle production contributes up to 40% (McIntyre et al., 1992). Cattle production provides

essential source of protein through meat and milk, generates employment, income, farm power and organic manure for arable Agriculture in the Sudano-Sahelian ecological zones of the country (Ikhatua and Asaka, 2000). Among nomadic Fulani and Shuwa-Arab pastoralists, the ownership of cattle also serve as an index of social prestige (Lamorde, 1998). Furthermore, their products such as hide and skins, bones and blood serve as raw materials for industries (Ikhatua and Asaka, 2000).

Among parasitic diseases of cattle, haemoparasitism constitute a disease entity of great economic importance (Jongejan and Uilenberg, 2004; Salih et al., 2015) and has been recognised as a serious threat to food security of Nigeria. The impact of haemoparasites on cattle productivity is also difficult to quantify (Singla et al., 2007; Samdi et al., 2010) but losses in traction power, milk and meat production and costs of control programs have been ascribed to haemoparasites (ILIR, 1997). Haemoparasites and their vectors have a global distribution, and are especially important in Sub-Saharan Africa (Okorafor and Nzeako, 2014). The prevalence of haemoparasites of cattle in Nigeria is generally considered to be very high due to the preponderance of their arthropod vectors (Biu and Kabono, 2005; Kamani et al., 2010; Okorafor and Nzeakor, 2010; Musa et al., 2014). Moreover, 90% of the cattle population in Nigeria are raised under the pastoral husbandry system of Fulani herders (Lorusso et al., 2013). Under this system cattle are extensively grazed on pastures and forests and may be exposed to various arthropod vectors of haemoparasites (Obadiah and Shekaro, 2012). The prevalence of various genera of haemoparasites of cattle (*Trypanosomes*, *Babesia*, *Anaplasma*, and *Theileria*) was previously reported in different parts of the country (Akande et al., 2010; Kamani et al., 2010; Samdi et al., 2010; Enwezor et al., 2012; Ademola and Onyiche, 2013; Okorafor and Nzeako, 2014; Qadeer et al., 2015) and elsewhere in the world (Alim et al., 2012; Velusamy et al., 2014). Trypanosoma, Babesia and Anaplasma species are listed among the most economically important genera of haemoparasites in Nigeria (Biu and Kabono 2005; Akande et al., 2010; Kamani et al., 2010), and their impact on cattle production and productivity accounts for heavy economic losses to livestock producers in the tropics and subtropics (Soulsby, 1982; FAO, 1984). They are responsible for destruction of erythrocytes leading to anaemia, jaundice, anorexia, weight loss and infertility in livestock (Akande et al., 2010).

There is paucity of information on the prevalence and importance of haemoparasites in trade cattle in Maiduguri. Therefore, this study was conducted to determine the prevalence of haemoparasites of cattle and their associated haematological changes.

METHODOLOGY

Study area

This study was conducted in Maiduguri which is the capital and largest city of Borno State, and has an estimated total population of 521,492 (NPC, 2006). Maiduguri has one of the largest cattle markets in north-eastern Nigeria with a high volume of trade in livestock and livestock products through neighbouring Chad, Cameroun and Niger republics. Maiduguri lies between Latitude 11°N and Longitude 13°E and it is characterized by a long period of dry season which lasts between October and May, with a short period of rainfall between June and September (LCRI, 2007).

Study population and sampling method

A total of 120 trade cattle presented for slaughter at the Maiduguri central abattoir were randomly selected for this study which lasted between January and July, 2014. Characteristics of population such as age, sex, breed and body condition scores were observed and recorded for each sample throughout the study. Sex differentiation was based on the appearance of external genitals while breed identification was based on morphology as described by Yunusa et al. (2013). Ageing was based on rostral dentition as described by Lasisi et al. (2002). Cattle aged less than 3 years old were categorised as young while older ones were considered as adults. The body condition score (BCS) of cattle was evaluated on a 5 point scale based on modification of method described by (DEFRA, 2001).

Collection and preservation of blood samples

5 ml of blood was collected from the jugular vein at the point of slaughter into EDTA containing bottles which were labelled appropriately and placed on ice packs for onward delivery to the side laboratory, Veterinary Teaching Hospital, University of Maiduguri where they were further processed.

Determination of haematological parameters

Packed cell volume (PCV) was determined using microhaematocrit centrifugation technique (MHCT) as described by Brar et al. (2011). Blood was introduced into microhaematocrit tubes by capillary action and one end of each capillary tube was sealed with plasticin. The tubes were spun in a microhaematocrit centrifuge (Hawksley, England) at 13000 g for 5 min. PCV was measured with a hematocrit reader (Hawksley, England), and recorded appropriately (Kamani et al., 2010). Total red blood cell counts (RBC) and total white blood cell counts (WBC) were determined by cyanmethaemoglobin and hemocytometer methods described by Coles (1974).

Preparation of blood film for identification of haemoparasites

A thin blood smear was prepared on a standard microscope glass

*Corresponding author. E-mail: bpaulgadzama@unimaid.edu.ng.

Table 1. Prevalence of Haemoparasites in Slaughtered trade Cattle based on Sex, Age, Breed and Body Condition Sores.

Risk factors	No. examined	No. (%) Infected	95% CI L	95% CI U
Sex				
Male	32	4(3.3)	0.013	0.083
Female	88	9(7.5)	0.040	0.136
Age				
Adult	18	2(1.7)	0.005	0.059
Young	102	11(9.2)	0.052	0.157
Breed				
Adamawa Gudali	2	1(0.8)	0.002	0.046
Ambala	21	2(1.7)	0.005	0.059
Kuri	6	1(0.8)	0.002	0.046
Rahaji	91	9(7.5)	0.040	0.136
BCS				
Thin	9	0(0.0)	0.000	0.031
Moderate	48	8(6.7)	0.034	0.126
Good	60	5(4.2)	0.018	0.094
Fat	3	0(0.0)	0.000	0.031
Total	120	13(10.8)	0.064	0.177

BCS= Body condition score. CI = 95% confidence interval on prevalence.

slide (75 mm by 25 mm), air dried, fixed in methyl alcohol for 3-5 min, stained in 5% Giemsa stain for 30-45 min in a staining jar and rinsed in buffered distilled water (Kamani et al., 2010). Haemoparasites were identified by direct microscopic examination based on morphologic keys as described by Soulsby (1982), using a compound microscope (Olympus, USA)..

Data analysis

Data generated were summarized and presented in tables using descriptive statistics. Prevalence of haemoparasites was estimated as p =d/n (%). Where p= prevalence, d = number of individuals having disease at a particular point in time and n = number of individuals in the population at risk at that point in time (Thrusfield, 2005). The two sided 95% confidence interval (Newcombe, 1998) for various sexes, age groups, breeds and body condition scores of slaughtered cattle were computed on VassarStats.® (Website for statistical computation), and $p < 0.05$ was considered significant.

RESULTS

The distribution of haemoparasites in slaughtered trade cattle by sex, age, breed and body condition scores is presented in Table 1. Out of 120 blood smears examined, 13 representing 10.8% (95% CI= 0.064, 0.177) were positive for various genera of haemoparasites. Sex-wise, the prevalence of haemoparasites was significantly higher ($p < 0.05$) in females (7.5%: 95% CI= 0.04, 0.136) than males (3.33%: 95% CI= 0.013, 0.083). Age-wise, the

prevalence of haemoparasites was significantly higher ($p < 0.05$) in young representing 9.2% (95% CI= 0.052, 0.157) compared with older cattle which represent 1.7% (95% CI: 0.005-0.059). Among the different breed of cattle examined in this study, the prevalence of haemoparasites was significantly higher ($p < 0.05$) in Rahaji which represents 7.5% (95% CI= 0.040-0.136) while the lowest prevalence was recorded in Adamawa gudali and Kuri breeds which both had a prevalence of 0.83% (95% CI= 0.002, 0.046). Similarly, a significantly higher ($p < 0.05$) prevalence was recoded in cattle with moderate and good body condition scores which represent 6.7% (95% CI= 0.034, 0.126) and 4.2% (95% CI= 0.018, 0.094), respectively. Both thin and fat cattle examined in this study were not infected with haemoparasites.

Some haematological parameters of infected and uninfected slaughtered trade cattle is shown in Table 2. Mean values of packed cell volume (PCV), total white blood cell counts (WBC) and red blood cell count (RBC) of infected and uninfected cattle examined in this study were within normal range. However, there was a significant difference ($p < 0.05$) in mean packed cell volume (PCV) and total white blood cell counts (WBC) between infected and uninfected slaughtered trade cattle. On the other hand, no significant difference ($p > 0.05$) was observed in mean RBC between infected and uninfected cattle.

Table 2. Some haematological parameters of infected and uninfected slaughtered trade Cattle in Maiduguri.

Haematological parameter	Mean±SE (Range)	
	Positive (n=13)	Negative (n=107)
PCV (%)	28.5 ± 2.40 (11-40)[a]	32.6 ± 0.49 (20-41)[b]
WBC x 10^3/ µL	7.2 ± 0.41 (4.0-10)[a]	5.5 ± 0.15 (2.2-11)[b]
RBC x 10^6/µL	5.2 ± 0.37 (3.1-8.1)[a]	5.6 ± 0.08 (3.2-8.8)[a]

PCV = packed cell volume, WBC = white blood cell, RBC= red blood cell, All values Mean±SE, Row means with unmatched superscripts ([a, b]) differ significantly at p<0.05.

Table 3. Prevalence of various genera of haemoparasites of slaughtered trade cattle in Maiduguri.

Species of Haemoparasites	n =120	
	No. Infected	Prevalence (%)
Anaplasma species	7	5.8
Babesia species	5	4.2
Trypanosoma species	1	0.8
Total	13	10.8

The prevalence of various genera of haemoparasites in slaughtered trade cattle in Maiduguri is presented in Table 3. The three genera identified in this study were *Anaplasma* (5.8%), *Babesia* (4.2%) and *Trypanosoma* (0.8%).

DISCUSSION

The results obtained in this study indicates that haemoparasites are endemic in cattle populations within Maiduguri and its environs, even though the overall prevalence is not comparable with previous reports. The preponderance of infection with haemoparasites may be attributed to a high prevalence of cattle ticks in Maiduguri (Musa et al., 2014). Biu and Kabono (2005) reported a higher prevalence of haemoparasites in cattle from the same study area. This difference could be attributed to changes in farm management practices, including more aggressive measures of vector control in the last decade. Our result is also at variance with Okorafor and Nzeako (2014) who reported a prevalence of 6.7% for various species of haemoparasites of cattle and Ademola and Onyiche (2013) who reported a prevalence of 5% in Oyo state, Nigeria. Also, our overall prevalence does not agree with Kamani et al. (2010) who reported a higher prevalence of 25.7% for haemoparasites in North-central, Nigeria. These discrepancies could be attributed to local differences in prevalence of haemoparasites due to variations in geographical location (Velusamy et al., 2014) which determines the distribution of the arthropod vectors of the parasites (Shah-Fischer and Say, 1989; Agbede, 2013). However, our result is comparable to

Onoja et al. (2013) who reported an overall prevalence of 9.5% for bovine Babesiosis in slaughtered cattle from Zaria, Nigeria and Kumar et al. (2015) who reported an overall prevalence of 9.3% from cattle in Punjab, India.

The effects of risk factors such as age, sex and breed on prevalence of haemoparasites has been previously reported (Kamani et al., 2010; Alim et al., 2011; Ademola and Onyiche, 2013; Okorafor and Nzeako, 2014). The higher prevalence in females (7.5%) than males (3.3%) agrees with Kamani et al. (2010) who observed a similar trend and attributed their finding to the fact that female animals were generally herded much longer for the purpose of breeding and milk production, thereby prolonging their exposure to challenges of disease. Also, younger cattle less than 3 years old had a higher prevalence compared to their adult counterparts. This finding agrees with Ademola and Onyiche (2013) and could be due to development of immunity in adult cattle with previous infection. The higher prevalence of haemoparasites recorded in Rahaji breed could be attributed to the fact that it is the most numerous breed in Borno State because of their adaptation to arid and semi-arid conditions (Blench, 1999). Moreover, they are usually herded by pastoralists under transhumant conditions which exposes them to the vectors of haemoparasites thereby increasing the risk of infection.

This study has also revealed that haemoparasites were prevalent only in cattle with moderate and good body condition scores but thin and fat cattle were not affected. This finding may be due to the fact that fewer numbers of thin and fat cattle were encountered in the study. Additionally, fat animals usually come from feed lots where they are probably treated against various parasites

and other diseases, thereby minimizing the chances of detecting haemoparasites among them. By contrast, thin cattle may originate from extensively managed herds with poor nutritional background, which increases risk of haemoparasites among them. Moreover, poor nutrition and management are significant risk factors for acquiring other debilitating diseases by extensively managed cattle under transhumant conditions, and could be responsible for loss of body condition.

The mean PCV and total white blood cell counts of infected and uninfected slaughtered trade cattle examined in this study were within normal range (Merck Manual, 2012). However, there was a significant difference (p<0.05) in PCV between infected and uninfected cattle, and this could be attributed to the effects of haemoparasites on blood cells. This finding agrees with Kamani et al. (2010) who reported that infection with *Babesia, Anaplasma, Theileria* and *Trypanosoma* species, either singly or in combination caused a significant reduction in mean PCV of cattle. It also is known that infection with most haemoparasites leads to destruction of erythrocytes and anemia (Soulsby, 1982; Ademola and Onyiche, 2013). The higher mean total white blood cell counts recorded in infected cattle could be explained on the basis of immune response to presence of haemoparasites. Eosinophilia was previously reported in haemoparasitic infections of ruminants (Ademola and Onyiche, 2013) which may contribute to the observed differences in WBC count between infected and uninfected cattle in the present study.

The three genera of haemoparasites identified in this study (*Anaplasma*, *Babesia* and *Trypanosoma*) were previously reported in domestic animals in Nigeria (Abenga et al., 2004; Biu and Kabono 2005; Kamani et al., 2010; Ademola and Onyiche, 2013; Okorafor and Nzeako, 2014; Qadeer et al., 2015) and elsewhere in the world (Soulsby, 1982; Alonso et al., 1992; Bock et al., 2004; Alim et al., 2011; Sitotaw et al., 2014). The higher prevalence of *Anaplasma* (5.8%) and *Babesia* (4.2%) in this study could be attributed to the availability of suitable environmental conditions which favour multiplication and survival of their tick vectors (Soulsby, 1982; Shah-Fischer and Say, 1989). However, the low prevalence of Trypanosomes in the present study is not unusual because Maiduguri is located in the Northern limit of tsetse distribution (Abenga et al., 2004). Previously, cases of trypanosomosis have been reported in the Sahel around Maiduguri (Maxie et al., 1979). These unusual occurrences have been linked to movement of cattle from tsetse infested to tsetse free zones (Anene et al., 1991). Moreover, mechanical vectors such as biting flies have been incriminated in transmission of trypanosomosis in tsetse free zones (Soulsby, 1982).

A number of antiparasitic drugs have been used for the treatment and control of Bovine haematozoa (Soulsby, 1982) but only diminazene aceturate and imidocarb dipropionate are still in common use (Merck, 2013). These drugs have shown up to 100% efficacy against Babesia, Anaplasma and Trypanosoma species and could be used to effectively reduce the prevalence of these haemoprotozoa in cattle populations within Maiduguri and environs.

Conclusion

Even though we recorded a lower prevalence of haemoparasites in this study compared to the previous report in the last decade, it may be concluded that haemoparasites are endemic in cattle populations within Maiduguri, and their occurrence may be associated with changes in some haematological parameters.

RECOMMENDATION

It is therefore recommended that a stringent measure of controlling haemoparasites in food animals should be instituted in Maiduguri and its environs where these animals are sourced. Such measures should include more aggressive chemotherapy, chemoprophylaxis and control of arthropod vectors through the use of effective insecticides, acaricides and environmental management.

Conflict of Interests

The authors have not declared any conflict of interests.

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