RETROSPECTIVE STUDY OF THE RISK FACTORS ASSOCIATED WITH CANINE BABESIOSIS DIAGNOSED AT VETERINARY CLINIC FEDERAL COLLEGE OF ANIMAL HEALTH AND PRODUCTION TECHNOLOGY, VOM, NORTH-CENTRAL NIGERIA, 1999-2006

DANIEL, L.N.,[1*]Kujul N. B.,[1] Kemza, S.Y.,[2] Ibukunoluwa, M. R.[3]
[1]Federal College of Animal Health and Production Technology, P.M.B.1, Vom, Plateau State, Nigeria.[2]Viral Research Division, National Veterinary Research Institute, P.M.B.1, Vom, Plateau State, Nigeria.[3]Department of Biology, Adeyemi College of Education, Ondo, Ondo State.

Abstract
Babesiosis is a parasitic infection due to the multiplication of tick borne parasite, Babesia sp.in erythrocytes of host, which include a wide variety of vertebrates such as ruminants and canine causing decreased livestock output and hence economic losses. People are reported to get infected with a few species of *Babesia* pasites. Babesiosis has been enlisted among nationally notifiable animal diseases and conditions. A retrospective study (excluding laboratory diagnosis of *Babesia* species) of the risk factors associated with canine babesiosis was carried out by going through clinical records in Veterinary Clinic of the Federal College of Animal Health and Production Technology, Vom, North-Central Nigeria, from 1999-2006. The Chi-Square was used to test for the associations between the risk factors looked at and canine babesiosis. The risk factors associated with the disease considered were sex, age, tick infestation, pyrexia, seasonal variation, breed and location. Year by year infection was not considered. The overall result presented 1,767 (18. 59%) out of the 9506 dogs positive of babesiosis as adjudged by the clinicians. Chi-Square ($P<0.05$) analysis significantly associated sex, age, tick infestation, pyrexia, seasonal variation, breed and location of dogs with babesiosis. It was concluded here that sex, age, tick infestation, pyrexia, and breeds of dogs ($P=0.000$) have high risk of infection with babesiosis, hence, implicated as risk factors associated with the disease than seasonal variation and location of dogs ($P=0.44$ and 0.38).
Key words: Retrospective, risk, factors, associated, canine, babesiosis.

Introduction

Babesiosis is a virulent, inoculable, non-contagious tick-borne, haemoprotozoan blood disease that affects a wide range of domestic and wild animals. Babesiosis is caused by a protozoan parasite *Babesia* (Adame, 1996; Hutyra, *et.al*., 1949; Geoffrey, 1985).

People are reported to get infected with a few species of *Babesia* parasites (CDC, 2014 a & b, accessed 4/6/2015)). Although human babesiosis is uncommon, however, Humfeld *et al.* (2008) stated that reported cases of humans have risen recently because of expanded medical awareness. Wormser *et al.,* (2006) reported that human babesiosis develop only in patients who have lived or traveled to an endemic area or received a contaminated blood transfusion within the preceding 9 weeks. Humfeld *et al.,* (2008) stated that severe cases of human babesiosis are most likely to occur in the very young, very old, and persons with immunodeficiency, such as HIV/AIDS patients and also in splenectomized individuals. Same author reported that babesiosis is thought to be the second most common blood parasites of mammals after trypanosomes.

Babesiosis has been enlisted among nationally notifiable animal diseases and conditions (Australian Government Department of Agriculture and Water Resources, 2015; CDC, 2010; OIE, 2015). According to Umoh (2004), babesiosis is enlisted among the disease lists for reporting system of veterinary diseases.

Canine babesiosis is caused by *Babesia canis* and *Babesia gibsoni* and sometimes by other species, with *B. canis* being more prevalent (Taboada, 1998; Herwaldt, 1996; Persings, *et.al*., 2000). The transmission of these pathogens is mainly through tick-bites to dogs at blood meals (Eaton 1934; Hutyra *et. al*. 1949; Rockey and Russel 1961; Urguhart 1987; Adame 1996; Allred, *et.al*., 1997; Radostits *et. al*.1997; Humfeld 2008). However, Birkenbeuer, *et.al,* (1999) reports that direct animal-to-animal transmission may occur when an infected animal with oral abrasions bites a naive dog. Similarly, Merck, (1989) and Hemmer, (2000) stated that the disease can also be transmitted mechanically.

According to Radostits *et. al.* (1997), the epidemiology of babesiosis causing protozoa is governed by the geographical distribution of the insect vectors that transmit them. The ixodid ticks- *Rhipicephalus sanguineus, Haemaphysalis laechi, Dermacentor reticulatus* and *D. venutus*, are vectors of this disease. They are cosmopolitant in distribution, found throughout Asia, Africa, Europe, the Middle East, South ,Central and North America, Puerto Rico, Brazil, and Panama(Eaton, 1934; Hutyra, *et.al.,* 1949; Rockey and Russel, 1961; Merck and Dohme, 1979; Geoffrey, 1985; Normand, 1985; Urguhart, *et.al*., 1987; Taboada, 1998). Of recent some workers (Abdullahi, *et.al*., 1990;

Ramalan, *et.al*., 1998 and Hemmer, 2000) have reported cases of canine babesiosis in Nigeria however, there is no documentation of the epidemiology of the disease in Plateau State.

Babesiosis is characterized by fever and intravascular hemolysis causing a syndrome of anaemia, haemoglobinuria, haemoglobinemia, and splenomegaly which depends on the severity of hemolysis (Radostits, *et.al*., 1997). According to Taboada, (1998) the severity of signs may vary depending on the virulence of the strain of the parasite, the level of infection and immune status of the dog. The acute form of the disease in dogs typically manifests in pyrexia, weakness, mucous membrane pallor, depression, lymphadenopathy, splenomegaly and general malaise (Birkenbeuer, *et.al.,* 1999). If larger numbers of red blood cells rupture at the same time, anaemia, fever (high body temperature up to 40 degrees Celsius), lack of appetite, increased pulse rate, vomiting, diarrhea, jaundice and kidney failures can result (Buller, *et.al*., 1999; Rios, *et.al*., 2003; Humfeld, 2008). Sometimes skin lesions can be present (oedema of the subcutaneous tissue, keratitis and iritis, may also occur (El-Hindaway, 1951; Gilles, 1953).

Although clinical signs of the disease could be a basis for diagnosis of babesiosis, Rockey and Russel (1961) stated that clinical diagnosis of this disease is not enough. According to them clinical signs observed might be confused with other disease symptoms like leptospirosis, hepatitis, and other parasitic diseases. In the same vein, Humfeld *et al.* (2008) stated that babesiosis is a malaria-like parasitic disease having symptoms similar to malaria. Holy *et al.*, (2003) stated that Babesia species can be identified by the demonstration of the organisms in blood smears under the light microscope or by serological examinations.

Dogs are known to accommodate a host of parasitic infectious diseases. In addition, they play important role as source of security, companionship, income and of recent, a source of protein to their consumers. From an article titled 'Effectiveness of dog meat' (2015), dog's fat can be digested several times more easily than beef and the fat contains a lot of unsaturated fatty acid with little cholesterol, which is p reventive for high blood pressure and arteriosclerosis. According to eChinacities.com (2011), dog meat might be just what a man needs to cure his impotence or premature ejaculation.

The disease is of economic and public health importance. The risk factors associated with the infection in dogs can affect social and economic lives of the communities within the tick-infested areas. Affected dogs often die or as Anon,(2001) puts it, are chronically unproductive in terms of performance of those that are kept for breeding purposes, there is broken security and companionship with dog owners. Furthermore, in some parts of Nigeria, dog meat is highly consumed and regarded as the best meat. Hence, in such areas, dogs' cells and tissues destruction due to babesiosis could reduce the quality and palatability of the meat. Similarly, if there is outbreak of the disease resulting in high mortality rate, there will be reduced protein intake by consumers of dog meat, high economic loss due to deaths and cost of treatment of infected dogs and the control of the vectors of the disease. Veterinarians, health workers and dog handlers may also stand at risk of infection.

Hence, this work is aimed at screening for factors likely to be associated with canine babesiosis among dog population brought to Veterinary Clinic Vom for period 1999-2006 by going through clinical records for a planned control/ preventive strategies against the spread of the disease; thereby elevating the standard of living, social, economic and health status of the populace.

MATRIALS AND METHODS

The study was carried out at the Veterinary Clinic, Federal College of Animal Health and Production Technology, Vom, Jos- South Local Government Area of Plateau State. Vom is situated 20Km away from Jos, the capital city of Plateau State. Plateau State is roughly located in the centre of the country, in Nigeria's Middle Belt. Plateau State is ranked in area 12 of 36, and in population 25 of 36 in Nigeria with 17 LGAs. Its bearing are $9^{o}10^{'}$N $9^{o}45^{'}$E. It has an area of about 30,913 square kilometers with an estimated 2006 population census total of around 3.5 million people. It is bounded by Bauchi State- to the northeast, Kaduna State- to the northwest, Nasarawa State- to the southwest and Taraba State- to the southeast (NIPOST, 2009)

A total of 9,506 dogs were presented at the Veterinary Clinic and screened for various diseases. Data collection was by going through clinical records during the period 1999 - 2006.

All the dogs were screened on daily basis against associated risk factors as sex, age, breed, location, tick infestation, pyrexia and seasonal variation.

RESULTS

The results of the study revealed that out of the 9,506 dogs screened, 5,302 (55.78%) were male, 4,204 (44.22%) were female. The general infection rate was 1,767 (18.59%). Of the 5,302 male, 908 (17.13) were infected and female 859 (20.43) were infected (Table 1).

Table 1: Clinical Record of Occurrence of Dog (Canine) Babesiosis Baesd on Sex of Dogs

Sex	Infected (%)	Non-infected (%)	Total (%)
Male	908 (17.13)	4394 (82.87)	5302 (55.78)
Female	859 (20.43)	3345 (79.57)	4204 (44.22)
Total	**1767 (18.59)**	**7739 (81.41)**	**9506 (100)**

(Chi square df(1), 9506=16.945 P=0.000)

Table 2 shows the frequency of occurrence of dog (canine) babesiosis based on the age of dogs. Infection among the age groups shows puppies ≤5 months were 2,843 (29.91%), young growing adults, 5-11 months 4,056 (42.67%), and adults, ≥11 months 2,607 (27.42%) infections respectively. The infection rate within the infected dogs shows that out of the 1,767 infected dogs, puppies ≤5 months, 637 (22.48%), young growing adults 5-11 months 574 (14.15%) and adults, ≥11months 556(21.33%) were infected respectively.

Table 2: Clinical Record of Occurrence dog (Canine) Babesiosis Based on Age of Dogs.

Age (Months)	Infected (%)	Non-infected (%)	Total (%)
≤5	637 (22.48)	2206 (77.84)	2834 (29.91)
5-11	574 (14.15)	3482 (85.85)	4056 (42.67)
≥11	556 (21.33)	2051(78.67)	2607 (27.42)
Total	**1767 (18.59)**	**7739 (81.41)**	**9506 (100)**

(Chi square df(2), 7640=1203.067 P=0.000)

Three thousand one hundred and sixty five out of 9,506 dogs (33.29%) were infested with ticks, while 6,341 (66.71%) were not infested with ticks. The infection rates revealed that 1,315 (41.55%) dogs that presented tick infestation were infected whereas the non-infested but infected were 452 (7.13%) (Table3).

Table 3: Clinical Record of Occurrence of Canine Babesiosis Based on Tick Infestation

Infestation	Infected (%)	Non-infected (%)	Total (%)
Present	1,315 (41.55)	1,850 (58.45)	3,165 (33.29)
Absent	452 (7.13)	5,889 (92.87)	6,341 (66.71)
Total	**1,767 (18.59)**	**7,739 (81.41)**	**9,506 (100)**

(Chi square df(1), 9506=1652.833 P=0.000)

Table 4 shows the frequency of occurrence of dog (canine) babesiosis based on pyrexia. 3,409 out of the 9,506 (35.86%) had fever, 6,097(64.14%) had not. Out of 1,767 dogs infected, 1,434(42.07%) had fever and 333(5.46%) had no fever but were infected.

Table 4: Clinical Record of Occurrence of Babesiosis Based on Pyrexia

Pyrexia	Infected (%)	Non-infected (%)	Total (%)
Had fever	1,434 (42.07)	1,975 (57.93)	3,409 (35.86)
Normal	333 (5.46)	5,764 (94.54)	6,097 (64.14)
Total	**1,767 (18.59)**	**7,739 (81.41)**	**9,506 (100)**

(Chi square df(1), 9506=1635.811 P=0.000)

Table 5 shows occurrence of infections during the raining and dry season. The raining season presented

5662 (59.56%) out of the 9,506 dogs screened while the dry season presented 3,844 (40.44%). The overall infection rate for both the seasons was 1,767 (18.59%).The infection rate is shown to be slightly high during the raining season 1,090 (19.25%) than during the dry season 677 (17.61%).

Table 5: Clinical Record of occurrence of canine babesiosis based on seasonal variation

Season	Infected (%)	Non-infected (%)	Total (%)
Dry	677 (17.61)	3,167 (82.39)	3,844 (40.44)
Raining	1,090 (19.25)	4,572 (80.75)	5,662 (59.56)
Total	**1,767 (18.59)**	**7,739 (81.41)**	**9,506 (100)**

(Chi square df(1), 9506=4.066 P=0.044)

The frequency of occurrence of dog (canine) babesiosis based on the breeds of dogs revealed 5,550 (58.38%) local, 2,006 (21.10%) Alsatian and 1,950 (20.51%) cross breeds of dogs respectively. The highest prevalence of infection was observed in local breed of dog 883 (15.91%) out of 1,767, followed by the Alsatian breed 470 (23.43%) and cross breed 414 (21.23%)(Table6).

Table 6: Clinical Record of Occurrence of Canine Babesiosis Based on Breeds of Dogs

Breed	Infected (%)	Non-infected (%)	Total (%)
Local	883 (15.91)	4667 (84.09)	5550 (58.38)
Alsatian	470 (23.43)	1536 (76.57)	2006 (21.10)
Cross	414 (21.23)	1536 (78.77)	1950 (20.51)
Total	**1767 (18.59)**	**7739 (81.41)**	**9506 (100)**

(Chi square df(1), 7556=56.680 P=0.000)

Table 7 shows the frequency of occurrence of canine babesiosis based on location of dogs. K- Vom / Vom – Vet presented 4339 (45.64%), Trade Centre/ Kuru 2270 (23.88%), Bukuru 823(8.65%), Vwang 675(7.10%), Jos metropolis777 (8.17%) and outside Jos metropolis 624 (6.56%). The infection rates within the locatios were K-Vom /Vom Vet had 799(18.41%), Trade Centre/ Kuru had 385 (16.96%), Bukuru 164(19.93%), Vwang 123(18.22%), Jos metropolis166 (21.36%) and outside Jos metropolis 132(21.15%) respectively.

Table 7: Clinical Record of Occurrence of Canine Babesiosis Based on Location of Dogs

Location	Infected (%)	Non-infected (%)	Total
K-Vom/Vom Vet	799 (18.41)	3540 (81.59)	4339 (45.64)
Trade-Centre/Kuru	385 (16.96)	1885 (83.04)	2270 (23.88)
Bukuru	164 (19.93)	659 (80.07)	823 (8.65)
Vwang	123 (18.22)	552 (81.78)	675 (7.10)
Jos metropolis	166 (21.36)	611 (78.64)	777 (8.17)
Outside Jos	132 (21.15)	492 (78.85)	624 (6.56)
Total	**1767 (18.59)**	**7739 (81.41)**	**9506 (100)**

(Chi square df(5), 9506=11.757 P=0.038)

In this study, Chi-Square test was used to determine the significance of association between canine babesiosis and the risk factors examined.

Statistically, sex had significant association with the disease. Male and female dogs may not have equal chances of coming down with the disease. This could be due possibly to the much attention given to female dogs which are mostly kept for breeding purposes. The slightly high infection rate among the males could also be that the male dogs were more infested with ticks due possibly to their higher tendency to roam about than their female counterparts which are kept under close watch by their owners for monetary gain from the puppies bred by the females. Hence, sex may be considered as a risk factor. Similarly, age had

significant association with canine babesiosis. Puppies (ages ≤5 months) were mostly affected. This could be attributed to the low immune system of the puppies which sudden exposure to disease condition could trigger infection among this age group. Although this category of dogs should have a reasonable level of maternal immunity, the maternal immunity does seem to protect these young ones from the infection. The fairly low infections among the young growing adults (5-11months) and adults (above ≥11 months) could be due to reduced maternal immunity, high exposure to the environment as a result of careless attitudes of owners given to this group. Adult dogs roam and pick ticks, the vector of transmission of the disease. Hence, high chances of interaction with other dogs outside.

Breeds of local dogs had a high risk of infection as compared with the other breeds but there was no significant association with the disease. This could be because they are not expensive, therefore, not given proper care by their owners by letting them to scavenge for food from the environment. This could enhance their chances of getting infected. The slightly high infection rate in this group of dogs agrees with the report of Hemmer (2000), who stated that *Babesia canis* infections in Nigerian dogs are common with clinical disease. Although not statistically significant, the occurrence of the infection in the Alsatian dogs agrees also with the work of Hemmer (2000) who reported that infection with *Babesia canis* is common among imported dogs. The imported dogs might come from *Babesia*-free area into *Babesia* endemic area thereby having high susceptibility to the infection.

Location in this study was associated with the disease. This concurs with the report of Radostits *et al. (*1997) which stated that occurrence of babesiosis causing protozoa could be governed by the geographical distribution of the insect vectors that transmit them. The significant association between canine babesiosis and location of dogs could be due to variation of number of dogs that came from different locations. It is worth noting that a majority of the dogs that were brought to the clinic came from K-Vom/Vom-Vet. This could be due to the level of awareness among the inhabitants of this locality being at proximity to the National Veterinary Research Institute, Vom.

Tick infestation was significantly associated with the disease. This can be incriminated as a risk factor, the disease being a tick- borne disease. This agrees with the documentation of several workers (Eaton, 1934; Hutyra *et. al.,* 1949; Rockey and Russel, 1961; Adame 1996; Allred *et. al.* 1997; Radostits *et. al*., 1997; Humfeld 2008). Similarly, pyrexia was significantly associated with the disease. This agrees with the works of Birkenheuer (1999); Buller *et. al.* (1999); Rios *et al.* (2003); Humfeld (2008) who observed that canine babesiosis, particularly the acute form typically manifests in pyrexia. However, the manifestation of the infection among those without high temperature could be due to misdiagnosis especially when it is based on clinical signs. This agrees with the findings of Rockey and Russel, (1961) and Humfeld, (2008), who stated that clinical signs observed may be confused with other disease symptoms like leptospirosis, hepatitis and other parasitic diseases. The lack of consideration of some factors such as non - laboratory comfirmation for the presence of *Babesia* species, non- determination of blood bilirubin and haemoglobin levels in sampled blood, lack of adequate medical history and treatment given could pose a limit to the conclusion of whether the result of this research is actually a true picture of the outcome of this work.

Seasonal variation was associated with the disease. Raining season had a significant association with the disease over the dry season. This could be due to good climatic condition for the vectors' activities which tend to be high during this season.

Conclusion

It is concluded here that sex, age, tick infestation, pyrexia, breed, location and seasonal variation are associated with babesiosis and can be incriminated as risk factors of (dog) canine babesiosis.

Recommendations

Recommendation is made for more epidemiological studies on canine babesiosis for planned control strategies to be conducted against the spread of the disease. Recommendation is made also for longer period of data collection, consideration of dog management practices, medical history of dogs and treatments given. Also, parameters such as the presence of clinical itcterus and haemoglobinuria, blood bilirubin level, haemoglobin and laboratory confirmation for the presence of *Babesia* should be considered by subsequent researchers. Also public awareness campaign should be carried out on the need for proper screening of dogs for babesiosis and other infectious parasitic diseases to maintain healthy dogs for companionship, security, revenue generation and consumption for an improved standard of living and health of both dog owners and consumers.

References

Abdullahi SV, Mohammed AA, Triomme LAR, Sanusi A, Alafiatay R (1990): Clinical and Haematological Finding in 70 Naturally Occurring Cases of Canine Babesiosis, *Jour. Small Animal Pract.31(3*), 145-147. Abstract 6298.

Adame L (1996): Canine Tick Diseases, *http://www.k9web.com/dog-faqs/medical/tick-diseases html.*

Allred W, Bonagura JE, Myburgh C (1997): Systemic Inflammatory Response Syndromas Multiple Organ Damage/ Dysfunction in Complicated

Canine Babesiosis, *Jour. S. Afr.Vet. Assoc.,* 158-162.

Anon HS, Makimura S, Harasawa R (2001): Detection of *Babesia* species from Infected Dog Blood by Polymerase Chain Reaction, *Jour. Vet Med Sci 6*:111-113.

Australian Government Department of Agriculture and Water Resources (2015): *National List of Notifiable Animal Diseases* available at http://www.agriculture.gov.au/pests-diseases-weeds/animal/notifiable (Accessed June 4, 2015).

Birkenheuer AJ, Levy MG,Savary KC, *et. al*. (1999): *Babesia gibsoni* Infections in Dogs from North-Carolina, *Jour. Ame. Anim Hosp Assoc. 35*: 125-128.

Buller RS, Arens MM, Hmiel SP, Paddock CD, Rikhisa Y, Manian FA, Liddel AM, SchmulewitsN, Storch GA (1999): "*Ehrlichia ewingii,* A Newly Recognized Agent of Canine Babesiosis'', *N Eng/ Joar. Med., 341(32),*148-159.

CDC (2010): Babesiosis Becomes Notifiable. Available at http://www.cdc.gov/parasites/features/babesia_notify_9-7-10.html (accessed 5/6/2015)

CDC (2014a): Babesiosis FAQs. Available at http://www.cdc.gov/parasites/babesiosis/gen_info/faqs.html (accessed 10/6/2015)

CDC (2014b): Epidemiology & Risk Factors. Available at http://www.cdc.gov/parasites/babesiosis/epi.html (accessed 4/6/2015)

Eaton P (1934): Piroplasmosis canis in Florida, *Jour. Parasitol., 20,* 312-314.

eChinacities.com (2011): Men: Eight Foods for Better Sex (According to Chinese Medicine). Availableat http://www.echinacities.com/expat-corner/Men-Eight-Foods-for-Better-Sex-According-to-Chinese-Medicine (Accessed June 9, 2015)

Effectiveness of dog meat: Available at http://wolf.ok.ac.kr/~annyg/english/e4.htm1 (Accessed 9/6/2015).

El-Hindaway MR (1951): Haematological Finding in *Babesia canis*, *British Vet Jour., 107(7*), 258- 263.

Geoffrey DW (1985): *Veterinary Dictionary, Transmission Immunology Infections of Tropical Disease of Domestic Animals.*Pp564-566.

Gilles HM (1953): The Liver in *Babesia canis* Infection, *Ann Trop. Med. Parasitol., 92(4)*, 489-01 *Medline*.

Hemmer OR, Hardie EM (2000): Therapeutic Management of Sepsis. *Babesia canis* ed*, Current Veterinary Therapy XIII, Small Animal Practice,* Pp272-275.

Holy V, Evers A, Alan K, Mason VR, James HM (2003): Experimental *Babesia gibsoni* Infection in Coyotes *(Cnis latrans),Jour Wildlife Diseases,39(4)*, 904-908.

Humfeld KP, Hilderbrandt A, Gray JS (2008): "Babesiosis: A Recent Insights into an Ancient Disease", *Int.Jour. Parasitol., 38(11),* 1219-37.

Hutyra F, Marek J, Manninger R (1949): *Special Pathology and the Therapeutics of the Disease of Domestic Animals* 5th Ed. Vol.1, Alexander Egerlines Chicago III.

Merck S (1989): *Vet. Manual: A Handbook of Diagnosis, Therapy and Disease Prevention and Control for Veterinarian*, 6th Ed.

Merck S and Dohme L (1979): *The Merck Veterinary Manual,* 5th Ed. Pp426-430.

NIPOST (2009): "Post Offices- with Maps of Local Government Areas", *Retrieved*, Pp 10- 20. Available at https://en.wikipedia.org/wiki/Nasarawa_State

NIPOST (2009): "Post Offices- with Maps of Local Government Areas", *Retrieved*, Pp 10- 20. Available at https://en.wikipedia.org/wiki/Plateau_State

Normand DL (1985): *British Encyclopedia of Parasitology Veterinary Protozoology*, Pp301-302.

OIE (2015): World Organization for Animal Health: Protecting our Animals, Preserving our Future. Available at http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2015/ (accessed 5/6/2015)

Persing DH, Herwaldt BL, Glasor C (2000): Infection with a *Babesia*-like organism in Northern California, *N. Eng Med., 332(5),* 601-4 *Medline.*

Ramalan M, Allison JR, Saidu L, Manasah YS, Pefit F (1998): Tick-borne Diseases of Livestock in Northern Nigeria, *Research Sum*., *13,* 110-128.

Radostits O.M, Blood DC, Gay CC (1997): Veterinary Medicine. A Text Book of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 8th Ed. Sounders Publishers.

Rios L, Alvares G, Blair S (2003): Serological and Parasitological Study and Report of Cases of Canine Babesiosis in Columbia, *Rev.501 Bras Med Trop, 36*, 493-98. *Medline.*

Rockey NW, and Russel R (1961): Canine Babesiosis: A Case Report, *Jour Ame.Vet Med Assoc.,138* (12), 635-638.

Taboada J (1998): *Babesiosis, In: Greene CE (Ed),Infectious Disease of the Dog and Cat*, WB Sounders Pheledelphia, Pp473-481.

Umoh J U, (2004): Epidemiology and Project Design. *A Paper Presented at a Workshop Training, National Veterinary Research Institute, Vom, 24th May- 4th June , 2004.*

Urguhart GM, Armour JL, Duncans AM, Dunn, FWJ (1987): V*eterinary Parasitology,* Pp234-238.

Wormser GP, Dattwyler RJ, Shapio ED*, et al.,*(2006): "The Clinical Assessment, Treatment and Prevention of Lyme Disease, Human Granulocytic, Anaplasmosis, and Babesiosis: Clinical Practice Guidelines by the Infectious Diseases Society of America", *Clin. Infect.Dis., 3 (1)*,45-51