RELATIVE ABUNDANCE OF HARD TICK ON REARED CATTLE (FAMILY: BOVIDAE; *BOS* PP.) IN IDAH LOCAL GOVERNMENT AREA (LGA), KOGI STATE, NIGERIA

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Abstract

A survey was carried out among cattle reared in Idah LGA of Kogi State, for tick infestations for a period of four months (May – August, 2009). A total of 294 cattle were sampled, 181 were infested with three species of hard ticks (Family: Ixodidae), comprising of *Amblyomma variegatum*, *Boophilus decoloratus*, and *Rhipicephalus sanguineus*. An overall tick infestation prevalence of 61.6% was recorded. The overall Geometric Mean Intensity/Arithmetic Mean Intensity: GMI and AMI were 1.13 and 6.73 respectively. Of these species, *A. variegatum* recorded the highest percentage abundance in bulls (30.1%) and cows (30.3%) in the month of July. There was, however, no significant difference in the relative abundance of tick infestation between the bulls and cows ($p>0.05$). Also, there was no significant difference in prevalence of infestation between the two sexes ($p>0.05$). However, the lowest (3.8%) and highest (46.4%) abundance of *A. variegatum* occurred in Idah Metropolis and Fulani villages respectively. W/hereas the species with the least percentage abundance, *R. sanguineus*, recorded its lowest (0.5%) and highest abundance (2.1%) also in Idah and Fulani village respectively. The scrotal and udder regions of the bulls and cows recorded the largest tick infestation respectively. The lowest intensity of tick infestation of bulls (GMI = 1.57) and cows (GMI = 1.32) were recorded in muzzle and arm of the cattle respectively.

Keywords: cattle, ixodid ticks, prevalence and intensity of infestation.

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Introduction

Ticks are found worldwide in distribution and they are opportunistic ectoparasites that can attach to the skin of a variety of vertebrate hosts (CDC, 2007). There are approximately 840 different species of ticks which have been classified into two Families – Ixodidae (hard ticks) and Argasidae (soft ticks) and both Families belong to the Order Acari; Class Arachnida; Phylum Arthropoda of Animal Kingdom. The work of Dipeolu (2005) in south-western Nigeria had documented five species of ticks, namely; *A. variegatum*, *B. decoloratus*, *B. geigyi*, *H. rufipes*, and *H. truncatum*. This worker also observed that in all species of ixodid ticks investigated, success in oviposition was aided by moisture provided by light to moderate rainfall, while excessive moisture in terms of rainfall adversely affected oviposition. In this region where the present work was carried out, meteorological records have shown that rainfall often starts as late as April and peaks between August and September and it is usually light to moderate in nature. Records have also shown that ranges in mean monthly minimum and maximum temperatures during wet and dry seasons in the region were 21.9-26.5 (ºC) and 30.7-36.7 (ºC) respectively (Nigerian Meteorological Agency, NIMET, Lokoja, 2001-2006). Ticks are blood-suckers and some important carriers of diseases such as cattle fever and human tick-bite rickettsiosis (Raoult *et al* 2001; Hunter, 2004; Parola *et al* 2005; Owen *et al* 2006; Portillo *et al* 2007; Hochedez *et al* 2008; Tsai *et al* 2009). Some ticks of cattle and game (wild animals) and the diseases they transmit to humans occur at high prevalent level in Africa and other regions of the world. Raoult *et al* (2001) observed that *Rickettsia africae* was the cause of nearly all cases of tick-bite rickettsiosis in patients who became ill after a trip to sub-Saharan Africa. In the same vein, the work of De Echaide *et al* (1998) revealed that

Anaplasma marginale, rickettsial haemoparasite, transmitted to cattle by ticks was endemic in eastern Oregon of US. *B. decoloratus* is the most widespread and common cattle tick in South Africa (Hunter, 2004). Worldwide, tick parasitism and tick-borne diseases cost the livestock industry more than $7 billion, mostly due to losses to cattle. The most serious losses are due to two tick-borne diseases caused by protozoan parasites of the genera *Babesia* and *Theileria* (Sonenshine, 2002).

Livestock production is a source of employment and livelihood in Nigeria agriculture. A large percentage of rural people of this country satisfy their subsistence needs through livestock production. It involves rearing and marketing of livestock which includes mainly cattle, sheep, goats, pigs, camels and poultry but the cattle are the most prominent of all domestic animals in Nigeria (Tewe, 1997). Pests and diseases are the greatest threats to the realization of the productivity potentials of our cattle herds in Nigeria amongst which ticks constitute 80% of the infections and diseases (Adekunle *et al* 2002). The work of these researchers in three states in Nigeria, viz, Kano, Kogi and Niger revealed percentage prevalence of ticks among cattle of 67.5%.

This study was aimed at determining the prevalence and intensity of tick infestations among cattle reared in Idah Local Government Area (LGA). The findings would, undoubtedly, provide useful baseline information for appropriate intervention and control strategy against this zoonotic infestation.

Materials and methods

Survey work was conducted to determine the prevalence and intensity of tick infestations among cattle reared in Idah LGA between the months of May and August, 2009. The abattoir and cattle herds settlement-based survey was carried out in Okenya and Inachalo (Idah) abattoirs and in Fulani villages around FPI/Idah localities.

Before the collection of the samples, the cattle rearers and dealers in the slaughter houses were consulted and the purpose of the research was explained to them, and their cooperation solicited. This greatly facilitated the collection of the samples, using some of the young Fulani rearers who assisted in immobilizing the cattle and hand-picking of ticks during the research exercise. A structured questionnaire was administered to the cattle rearers/ dealers to collect information on name and sex of rearers; place of residence; any previous knowledge of tick infestation; the effects on animal and humans; what form of control measures applied?

The various parts of the cattle were searched for ticks and collections were recorded on data sheet. The specimens were preserved (10% formalin) in well labelled tight fitted screw- cap specimen bottles and taken to the laboratory for identification. The specimens were identified in accordance with identification keys described by Linguist (1984).

The results were analysed statistically for significant difference in the tick infestation and intensity by sex (bulls and cows), using *chi*-square ($\div^2$).

Results

Monthly prevalence and distribution of ticks

Table 1 shows the monthly prevalence (%), percentage abundance and mean distribution of hard ticks by sex among cattle reared in Idah Local Government Area (LGA). The three species of hard ticks (Family; Ixodidae) encountered among cattle examined include *A. variegatum, B. decoloratus and R. sanguineus* (Plates 1A, B and C). Of the three species of hard ticks encountered during the survey, *Amblyomma* sp. exhibited the highest abundance among the bulls (♂) with the percentage abundance of 7.9, 16.0, 30.1 and 16.5% in the months of May, June, July and August respectively.

Also, the cows surveyed recorded *Amblyomma* sp. as the highest abundant species of tick with percentage abundance of 5.9, 17.0 30.3 and 16.1% recorded in the months of May, June, July and August respectively. There was, however, no significant difference in the level of abundance between bulls and cows ($p>0.05$; $\chi^2_{cal} = 3.996$; $df = 3$). Likewise, in both sexes, there was no significant difference in the prevalence of infection ($p>0.05$; $\chi^2_{cal} = 2.303$; $df = 3$). In both sexes, the highest relative abundance of tick infestations occurred in the month of July compared to other months. The highest (7.6/9.9) and the lowest (5.5/4.0) percentage abundance of *B. decoloratus* were recorded for bulls/cows in the months of August and May respectively. Whereas, the highest abundance of *R. sanguineus* (2.1) in bulls occurred in the month of May while the highest abundance (1.9) of the same species of tick (*R. sanguineus*) was recorded for cows in the month of June. However, the lowest abundance of *R. sanguineus* (0.7/0.9) recorded for both sexes of cattle were in July (Table 1).

Pooled data of monthly hard tick infestation among cattle in Idah LGA

Table 2 shows the overall prevalence (61.6%) and Geometric Mean Intensity (GMI)/Arithmetic Mean Intensity (AMI) of 1.13/6.73 of hard ticks among cattle in Idah. The results showed the monthly percentage abundance of 12.9, 23.4, 40.1 and 23.6 of ticks collected for the months of May, June, July and August respectively. The highest intensity recorded here was in the month of May with GMI of (1.58).

The prevalence of 55.0, 59.2, 62.1 and 63.0 were recorded for the months of May, June, July and August

Table 1: Monthly prevalence (%), Percentage abundance and Mean distribution of hard ticks *(Amblyomma variegatum. Boophilus decoloratus* and *Rhipicephalus sanguineus)* in male (♂) and female (♀) cattle reared in Idah LGA.

Months of collection	Hard Ticks Collected					
	No. of cattle sampled Bulls/Cows	No. +ve Bulls/Cows	Prev. (%) Bulls/Cows	No. of ticks collected Bulls/Cows	Percentage abundance Bulls/Cows	GMI Bulls/Cows
May	10 /10	6/5	60.0/50.0	*Amb.* 33/47 *Booph.* 23/32 *Rhip.* 9/13	7.9/5.9 5.5/4.0 2.1/1.6	4.36/7.21
June	15/27	9/16	60.0/59.3	*Amb.* 67/136 *Booph.* 23/28 *Rhip.* 6/15	16.0/17.0 5.5/4.8 1.4/1.9	2.76/2.02
July	50/82	29/53	58.0/64.6	*Amb.* 126/242 *Booph.* 32/79 *Rhip.* 3/7	30.1/30.3 7.6/9.9 0.7/0.9	1.38/1.25
August	20/80	10/53	50.0/66.3	*Amb.* 69/129 *Booph.* 24/52 *Rhip.* 4/10	16.5/16.1 5.7/6.5 1.0/1.3	2.41/1.23
Total	**95/199**	**54/127**	**56.8/63.8**	**419/800**	**(100.0)**	**1.95/1.41**

No significant difference in abundance of ticks between bulls (♂) and cows (♀) ($p > 05$): $c^2_{cal} = 3.995$; c^2_{tab} 0.05, DF (3) = 7.815.

Key: *Amb. – Amblyomma variegatum.*
Booph. – Boophilus decoloratus.
Rhip. – Rhipicephalus sanguineus.

Table 2: The overall prevalence (%) and Geometric Mean Intensity (GMI)/Arithmetic Mean Intensity (AMI) of hard ticks among cattle reared in Idah LGA.

Species of Ticks and months of collection	*Amblyomma variegatum, Boophilus decoloratus* and *Rhipicephalus Sanguineus*				
	No. of cattle examined	No. +ve	Prev. (%)	No. of ticks (%) collected	GMI/AMI
Months					
May	20	11	55.0	157 (12.9)	1.58/14.3
June	42	25	59.2	285 (23.4)	1.25/11.4
July	132	82	62.1	489 (40.1)	1.08/5.96
August	100	63	63.0	288 (23.6)	1.09/4.6
Total	**294**	**181**	**61.6**	**1219 (100.0)**	**1.13/6.73**

respectively. There was, however, no significant difference in the prevalence level of tick infestation from May to August. There were slightly higher GMI (1.58 and 1.25) recorded for the months of May and June than in July and August (Table 2).

The mean distribution of hard ticks in different body parts of cattle reared in Idah LGA

The mean distribution of hard ticks *(A. variegatum, B. decoloratus* and *R. sanguineus)* in different body parts of the cattle reared in Idah LGA is shown in

Table 3. Of these three species of hard ticks, the results showed that *Amblyomma sp*. exhibited the highest relative abundance all over the nine body parts examined among bulls. The highest percentage abundance of 29.6% was recorded for the testis region, while the lowest 0.95% was recorded at the ear region for *Amblyomma sp*. respectively. *Boophilus sp.* and *Rhipicephalus sp*. exhibited 0.0% percentage abundance at the ear and leg regions respectively. While at the Hooves and Jaw regions, *B. decolaratus* exhibited the highest percentage abundance of 4.5% and 1.4% respectively (Table 3).

The highest relative abundance of *A. variegatum* was recorded among cows (♀) with percentage abundance of 17.9% at the udder region, while the *R. sanguineus* exhibited the least percentage abundance of 0.0% at the muzzle, ear and leg regions respectively. In both sexes of cattle, the highest percentage abundance of ticks occurred in the scrotal region for males (bulls: 29.6%) and udder region for females (cows; 17.9) respectively (Table 3) and Plate 1.

The percentage prevalence and percentage abundance of hard tick species among cattle from different localities in Idah LGA

Of the three species of hard ticks, *Amblyomma sp*. also exhibited the highest percentage abundance of 6.6, 12.8, 3.8 and 46.4% for Okenya Abattoir, Inachalo Abattoir, Idah Town and Fulani villages respectively, with the Fulani villages having the highest percentage abundance (46.4%), followed by Inachalo Abattoir (12.8%) (Table 4).

Table 3a: Prevalence (%) and mean distribution of hard ticks (*Amblyomma variegatum, Boophilus decoloratus* and *Rhipicephalus sanguineus)* from different body parts of **male cattle** sampled in Idah LGA.

Different parts of cattle sampled	**No. of cattle sampled**	**No. +ve**	**Hard Ticks No. of ticks collected**		**Collected Percentage abundance**	**AMI**
Anal region	95	29	*Amb.*	62	(14.8)	3.3
			Booph.	25	(6.1)	
			Rhip.	9	(2.1)	
Tail	95	8	*Amb.*	9	(2.1)	
			Booph	8	(1.91)	2.38
			Rhip	2	(0.5)	
Belly	95	13	*Amb.*	25	(6.1)	
			Booph.	6	(1.4)	2.62
			Rhip.	3	(0.7)	
Scotal region	95	39	*Amb.*	124	(29.6)	
			Booph.	24	(5.7)	3.91
			Rhip.	4	(0.95)	
Hooves	95	9	*Amb.*	6	(1.4)	
			Booph.	19	(4.5)	2.89
			Rhip.	1	(0.2)	
Muzzle	95	7	*Amb.*	5	(1.2)	
			Booph.	6	(1.4)	1.57
			Rhip.	0	(0.0)	
Ear	95	3	*Amb.*	4	(0.95)	
			Booph.	0	(0.00)	1.67
			Rhip.	1	(0.2)	
Leg	95	7	*Amb.*	20	(4.8)	
			Booph.	7	(1.7)	3.86
			Rhip.	0	(0.0)	
Arm	95	14	*Amb.*	40	(9.5)	
			Booph.	7	(1.7)	3.50
			Rhip	2	(0.5)	
Total	**95**	**54**		**419**	**(100.0)**	**7.76**

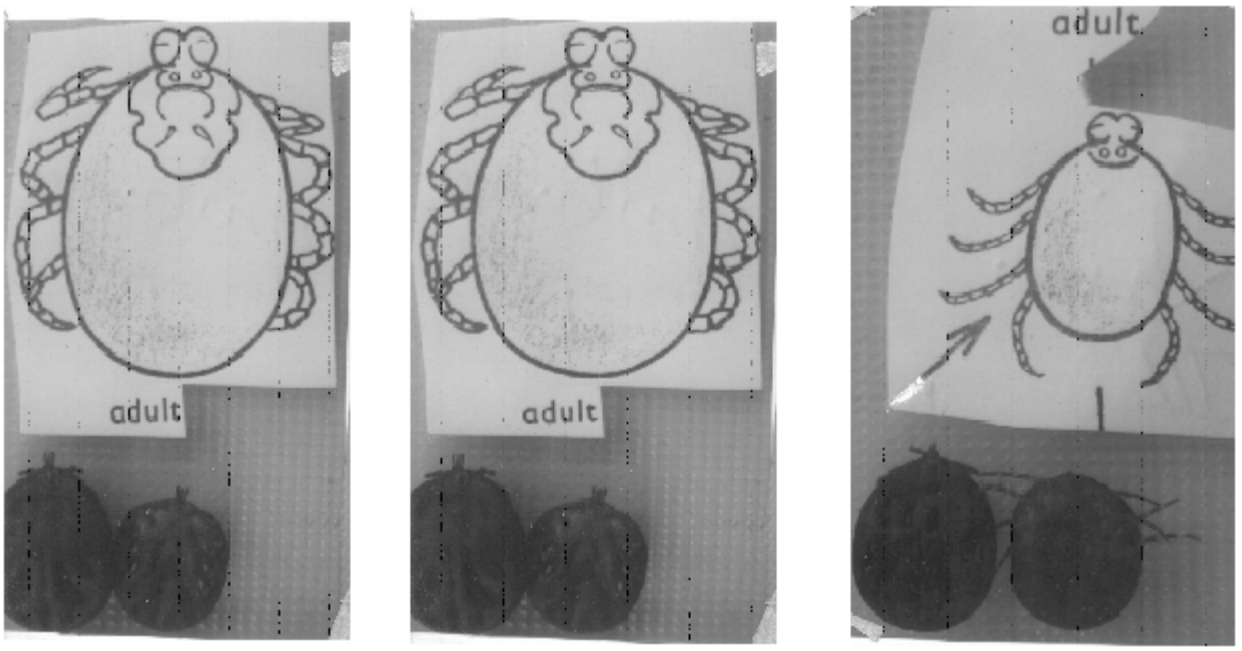
Key: *Amb. – Amblyomma variegatum.*
Booph. – Boophilus decoloratus.
Rhip. – Rhipicephalus sanguineus.

Table 3b: Prevalence (%) and mean distribution of hard ticks (*Amblyomma variegatum, Boophilus decoloratus* and *Rhipicephalus sanguineus)* from different body parts of **female cattle** sampled in Idah LGA.

Different parts of cattle sampled	No. of cattle sampled	No. +ve	No. of ticks collected		Percentage abundance	AMI
Anal region	199	60	*Amb.*	132	(16.5)	3.1
			Booph.	38	(4.8)	
			Rhip.	16	(2.0)	
Tail	199	16	*Amb.*	31	(3.9)	
			Booph	21	(2.6)	3.43
			Rhip	3	(0.4)	
Belly	199	29	*Amb.*	57	(7.1)	
			Booph.	14	(1.8)	2.72
			Rhip.	8	(1.0)	
Udder	199	76	*Amb.*	143	(17.9)	
			Booph.	44	(5.5)	2.64
			Rhip.	14	(1.8)	
Hooves	199	11	*Amb.*	11	(1.4)	
			Booph.	40	(5.0)	4.73
			Rhip.	1	(0.1)	
Muzzle	199	9	*Amb.*	18	(2.3)	
			Booph.	6	(0.8)	2.67
			Rhip.	0	(0.0)	
Ear	199	6	*Amb.*	13	(1.6)	
			Booph.	4	(0.5)	2.83
			Rhip.	0	(0.0)	
Leg	199	39	*Amb.*	72	(9.0)	
			Booph.	13	(1.6)	2.18
			Rhip.	0	(0.0)	
Arm	199	62	*Amb.*	77	(9.6)	
			Booph.	21	(2.6)	1.32
			Rhip	3	(0.4)	
Total	**199**	**127**		**800**	**(100.0)**	**6.31**

Key:
Amb. – *Amblyomma variegatum.*
Booph. – *Boophilus decoloratus.*
Rhip. – *Rhipicephalus sanguineus.*

Plate1 and Table 4 are on the next page.



A
***Amblyomma* sp. (× 2.25)**

B
***Boophilus* sp. (× 2.5)**

C
***Rhipicephalus* sp. (× 2.5)**

Plate 1: Dorsal and ventral views (bottom) of the three live species of ticks collected and diagrammatic illustrations (top) of the species.

Table 4: Percentage Prevalence and percentage abundance of hard tick spp. *(Amblyomma variegatum Boophilus decoloratus* and *Rhipicephalus sanguineus)* among cattle from different localities in Idah LGA.

Locality from Idah LGA	No. of cattle sampled	No. +ve	Percentage prev.	No. of tick abundance		Percentage
Okenya Abattoir (Idah)	20	11	55.0	*Amb.* *Booph.* *Rhip.*	80 55 22	(6.6) (4.5) (1.8)
Inachalo Abbatoir (Idah)	30	18	60.0	*Amb.* *Booph* *Rhip*	156 50 15	(12.8) (4.1) (1.2)
Idah Town (Idah Central Mosque)	12	7	58.3	*Amb.* *Booph.* *Rhip.*	47 11 6	(3.8) (0.9) (0.5)
Fulani Villages (Idah)	232	145	62.5	*Amb.* *Booph.* *Rhip.*	566 187 24	(46.4) (15.3) (2.1)
Total	**294**	**181**	**61.6**		**1,219**	**(100.0)**

Key:
Amb. – *Amblyomma variegatum.*
Booph. – *Boophilus decoloratus.*
Rhip. – *Rhipicephalus sanguineus.*

Discussion

The overall prevalence (61.6%) recorded in this work was relatively high but slightly lower than that of Adekunle *et al* (2002), who recorded 67.5% of tick infestation in Ibadan, western Nigeria. In the present work, *A. variegatum, B. decoloratus* and *R. sanguineus* have been identified to be more prevalent in this Local Government Area. Similar observation was made by Dipeolu, (2005) in Ibadan, who reported the prevalence of hard ticks *(A. variegatum, B. decoloratus, B. geigyi, H. rufipes, H. truncatum and R. sanguineus)*. The study attributed the prevalence of the ixodid ticks to favourable climatic conditions such as moisture provided by light and moderate rainfall. In the same vein, the high prevalence of ticks recorded in this work at Idah could be due to similar favourable climatic condition in Idah LGA (NIMET, 2001-2006). In contrast to the findings of Hunter (2004), *B. decoloratus* was the most widespread and most common cattle tick in S. Africa, *A. variegatum* was the most common in Idah LGA but more comprehensive survey would be required to confirm this observation for this region. The geographical location and climatic conditions of different regions may account for the difference in prevalence of infestations of various species of ticks.

The highest percentage abundance (29.6%) and (14.8%) recorded among bulls ( ) was at the scrotal and anal regions. In the same vein, among cows ( ) the highest percentage abundance (17.9%) and (16.5%) were recorded at the udder and anal regions respectively. This observation was in agreement with that of Robbins (1999) who stated that, once on host, the tick craws to a predilected feeding site where it cuts the skin with its chelicerae and inserts the hypostome causing abscesses and damage to the udder/scrotum and skin. The higher percentage abundance of ticks at anal, scrotal and udder regions compared to other body parts (which are usually covered with thick fur) may be due to more or less bare nature of these regions, thus exposing the skin and making blood readily available for ticks as blood suckers. Conversely, the muzzle and arm of cattle where the lowest intensity of tick infestation was collected are usually skinny and covered with fur. The higher infestation of ticks in Fulani villages than in Idah Metropolis was to be expected because endemic population of ticks is bound to be available in the permanent habitation of the Fulani cattle rearers. Besides, the vegetation and filthy environment where the ticks thrive are more readily available in the village setting than in Idah metropolis.

In this region, meteorological records have shown that rainfall attains the peak in July and there is often a brake of rainfall in the month of August, making the rainfall moderate for ticks to thrive. The observation that the lowest GMI of tick infestation in both sexes of cattle occurred in July and increased again in August (Table 1) was in line with that of Dipeolu (2005), who stated that excessive moisture due to heavy rainfall adversely affects oviposition in ixodid ticks.

The high prevalent rate of tick infestation recorded in this work has serious economic implication as it adversely affects the health of both cattle and humans. It calls for a huge investment into the control measures and treatment of the diseases caused in both animals and humans.

The study has revealed that the hard ticks (Family: Ixodidae), comprising of three species, viz *A. variegatum, B. decoloratus* and *R. sanguineus* were prevalent in Idah LGA. The overall prevalence of infestation (61.6%) and overall intensity GMI/AMI (1.13/6.73) were recorded. The soft ticks (Family: Argasidae) were not encountered in this study.

Having established high rate of infestation caused by ticks among cattle reared in Idah LGA, the following recommendations were made: more comprehensive survey of tick infestation should be carried out in the LGA as a whole to ascertain the level of prevalence and intensity of infestation; the necessary control measures should be put in place by the cattle owners and government; and enlightenment of the Fulani cattle rearers to co-operate with researchers in this type of research work should be instituted so that solutions can be proffered.

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References

Adekunle, O.A., Oladele, O.I. and Olukaiyeja, T. D. 2002. Indigenous control methods for pests and diseases of cattle in Northern Nigeria. *Livestock Research for Rural Development. 14:* 2. Retrieved Apr. 24, 2009 from http:/ www.cipav.org.co/irrd14/2/adek142htm.

Centres for Disease Control (CDC) and Prevention. 2007. Parasitology. In: Microbiology and Immunology: Online, University of South Carolina. Retrieved May 6, 2009, From: http://www.gov/ricidod/EID/vol.4noz/inchinda/htm

De Echaide, S.T., Knowles, D.P., McGuire, T.C., Palmer, G.H., Suarez, C.E. and McElwain, T.F. 1998).Detection of Cattle Naturally Infected with *Anaplasma marginale* in a Region of Endemicity by Nested PCR and a Competitive Enzyme-Linked Immunosorbent Assay Using Recombinant Major Surface Protein 5. *Journal of Clinical Microbiology*, *36 (3)*: 777-782.

Dipeolu, O.O. 2005. Studies on ticks of veterinary importance in Nigeria XII. Ovi position and eclosion in five species of

IXODID ticks in contrasting habitats. *Experimental and Applied Acarology. 1 (1):* 45-62. Retrieved August 3rd, 2009 from http://www.springerlink.com/reference.works/htm

Hochedez P., Canestri, A., Guihot, A., Brichler, S., Bricaire, F. and Caumes, E. 2008. Management of travellers with fever and exanthema, notably Dengue and Chikungunya infections. *Am J Trop Med Hyg 78:* 710-713.

Hunter, P. 2004. Ticks and cattle. In: Veld talk, vol. 3 4pp. Retrieved Nov. 15th, 2008 from: http://www.afrivet.co.zalveld.talk.print.3.htm

Linguist, E. 1984. Ticks as Earlier Ancestors of Terrestrial Arachnids. Online, Old Dominion University. Retrieved April 24 2009, from http://www.parasitology.informa.tick.uni-wuerzburg.de/loginIn/h/2490html

Nigerian Meteorological Agency, NIMET, Lokoja, 2001-2006.

Owen, C.E., Barhami, S., Malone, J.C., Callen, J.P. and Kulp-Shorten, C.L. 2006. African tick bite Fever: a not-so-uncommon illness in international travellers. *Arch. Dermatol. 142:* 1312-1314.

Parola, P., Paddock, C.D., and Raoult, D. 2005. Tick-borne Rickettsioses around the world: Emerging Diseases Challenging Old Concepts. *Clin. Microbiol. Rev. 18:* 719-756.

Portillo, A., Perez-Martinez, L., Santibanez, S., Blanco, J.R., Ibarra, V. and Oteo, J.A. 2007. Detection of *Rickettsia africae* in *Rhipicephalus* (*Boophilus*) *decoloratus* Ticks from the Republic of Botswana, South Africa. *Am. J. Trop. Med. Hyg. 77:* 376-377.

Raoult, D., Fournier, P. E., Fenollar, F., Jensenius, M., Prioe, T., de Pina, J.J., Caruso, G., Jones, N., Laferl, H., Rosenblatt, J.E. and Marrie, T.J. 2001. *Rickettsia africae*, a Tick-borne Pathogen in Travellers to Sub-Saharan Africa. *The New England Journal of Medicine. 344:* 1504-1510.

Robbins, T. 1999. Ixodid *Ticks, Encyclopedia of Animal Management,* 21st Ed. Inc USA, pp. 1003-1004.

Sonenshine, D.E. 2002. Ticks; In: *Encyclopedia of Pest Management,* Inc. USA. 1*0th Ed.* pp. 450-455.

Tewe, O.O. 1997. Sustainability and Development: Paradigms from Nigeria's Livestock Industry. Inaugural Lecture Series. University of Ibadan Press, Ibadan, p. 4.

Tsai, K.H., Lu, H.Y, Huang, J.H., Fournier, P.E., Mediannikov, O., Raoult, D. and Shu, P.Y. 2009. African Tick Bite Fever in a Tawainese Travellers Returning from South Africa: Molecular and Serologic Studies. *Am. J. Trop. Med. Hyg. 81:* 735-739.

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