

## Bacterial and parasitic zoonoses encountered at slaughter in Maiduguri abattoir, Northeastern Nigeria

Adamu Nuhu Bala<sup>1</sup>, Ali Emmanuel Garba<sup>1</sup>, Adamu James Yazah<sup>2\*</sup>

1. Department of Veterinary Public Health and Preventive Medicine,
2. Bacteriology Research Unit, Department of Veterinary Microbiology and Parasitology, University of Maiduguri, PMB 1069, Maiduguri, Borno State, Nigeria.

Corresponding author email: adamuyaz@yahoo.com

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### Abstract

An abattoir survey to determine the prevalence of zoonotic diseases encountered at postmortem examination of organs and carcasses was conducted in Maiduguri municipality, Nigeria, between 2000 and 2009. A total of 1,378,066 animals were examined and slaughtered from which 403,560 were cattle, 381,601 goats, 373,567 sheep and 219,308 camels. Out of these numbers, a total of 14,944 bacterial and parasitic zoonotic diseases were diagnosed which included tuberculosis (67.6%), dermatophilosis (15.8%), mange (16.7%), fascioliasis (1.5%) and hydatidosis (4.3%). Occurrence of the diseases based on sex, species of animals and season of the year did not show any significant difference ( $P>0.05$ ). It was not possible to get the exact records on breed and age for each slaughtered animal due to poor recording systems at the abattoir. With regards to the type of animals brought for slaughter, almost all animals come from the traditional sector and it was difficult to precisely trace back the geographical origins of all animals slaughtered due to lack of reliable animal identification method and so relating the finding of the study to a particular locality becomes difficult. Species-specific prevalence of tuberculosis was 1.6%, 0.4%, 0.3%, 0.3% for cattle, sheep, goats and camels respectively with a 0.7% crude prevalence. Analysis of the tuberculosis cases showed a high rate of occurrence in cattle ( $P<0.05$ ) and the most affected organs were the lungs (55.1%) and associated lymph nodes (27.7%) ( $P<0.05$ ). It was concluded that zoonotic diseases such as tuberculosis, dermatophilosis and mange are endemic in the study area. Abattoir records are invaluable in epidemiological surveillance and other aspects of disease control and prevention strategies.

**Keywords:** Zoonoses, Ruminants, Abattoir, Survey, Maiduguri, Tuberculosis, Fascioliasis, Hydatidosis, Postmortem, Dermatophilosis.

### Introduction

Nigeria has the largest number of livestock population in the West African sub-region and about 11.6% of the livestock population are in sub-Saharan Africa (FAO, 2000). The country has a livestock population of about 16.3 million cattle, 40.8 million goats, 27 million sheep, and 151 million poultry (<http://www.africanagricultureblog.com/2007/12/nigeria-has-16-million-cattle.html>). Livestock and poultry production are the main economic activities of about 70% of Nigerians living in rural and urban areas. There is increasing contact between humans and animals worldwide due to rising population density and growth especially in developing countries where livestock offers important socio-economic, cultural and religious pathways out of poverty (WHO, 2004). However, food animal production has become a strategic subsector for diversification of income and

the fight against malnutrition and unemployment in the urban and rural areas of the world (Tanya *et al.*, 2004).

High prevalence of animal diseases affects both health and productivity of livestock population. As a result of devastating outcome of livestock diseases, animal protein output has not been able to keep up with the nation's demands (Njombe and Msanga, 2009). Increasing demand for meat and meat product by human population has made human contact with animals unprecedented, coupled with movement of animals across international frontiers to supplement the local supply and increasing the risk of zoonotic diseases especially from endemic zones (Shcwabe, 1984).

The control of livestock diseases still remains a problem because of inadequacy of veterinary services extended to livestock owners particularly those in the rural areas (Kambarage *et al.*, 1995). This may

contribute to a widespread prevalence of diseases in traditional sector (Mellau *et al.*, 2010). Some livestock owners dispose sick, debilitated and infertile animals in an effort to minimize losses. Such animals sometimes are brought to the abattoir for slaughter while some are slaughtered elsewhere. In developing countries, abattoirs and slaughter slabs have poor meat inspection facilities and shortage of qualified meat inspectors (Edwards *et al.*, 1997; Biu *et al.*, 2006) and may serve as focal points for disease dissemination. The slaughterhouse and its regulations, represents a key control point of livestock production chain (Raji *et al.*, 2010) and any observation and information obtained at slaughterhouse can contribute to the understanding of slaughtered animals' diseases. Slaughterhouses provide an excellent opportunity for detecting diseases of both economic and public health importance (Raji *et al.*, 2010). Therefore, the use of meat inspection records is an easy source of data for evaluation of epidemiological aspects of animal diseases (Edwards *et al.*, 1997; Schweizer *et al.*, 2003). This study is therefore aimed at investigating the prevalence of some zoonotic diseases in Maiduguri during a 10-year period (2000-2009).

#### Materials and methods

**The study area:** The study was carried out in Maiduguri, the capital and largest urban center in Borno State, Nigeria. The state lies between latitude 11°05' N and 11°40' N and longitude 13°05' E and 13°25' E (Mbaya *et al.*, 2008). The state has a total area of 72,609 sq. km and is the largest of 36 states in Nigeria in terms of landmass and has a human population of 4,151,193 based on 2006 census (NBS, 2011). The state has a total Gross Domestic Product (GDP) of about US\$5.18 billion and a per capita income of US\$1,214. The state is bordered by three francophone countries namely Niger, Chad and Cameroon (<https://www.cgidd.com/Geography-Selection.aspx>). Borno State has a relatively short rainy season starting in June and ending in October, and a longer dry season with the harmattan starting in November and ending in February. The average monthly temperature of Maiduguri is 35 °C, however, during the cooler periods (November-February) the average temperature drops to about 20 °C (<http://www.climate-charts.com/Locations/n/NI65082.php>).

**Data retrieval, collation and procedures:** The Maiduguri central abattoir was selected for the study and is under the supervision of Ministry of Animal and Forest Resources of the Borno State Government. Permission was obtained from the relevant authority.

Qualified veterinarians serve as meat inspectors under the supervision of Veterinary Surgeon as officer in charge. Records of total number of cattle, sheep, goats and camels brought for slaughter, antemortem and postmortem examination records of lesions were retrieved from Maiduguri abattoir record books. Such records were used to establish the prevalence of bacterial and parasitic zoonotic diseases and lesions affecting cattle, sheep, goats, and camels. Routinely, meat inspectors carry out antemortem examinations of all animals presented for slaughter a day before or shortly prior to slaughter. This is followed by postmortem meat inspection involving visual examination, palpation and systematic incision of carcasses and visceral organs particularly lung, liver, kidney, heart and spleen according to procedures described by Gracey *et al.* (1999). Diseases and lesions are grossly diagnosed based on pathological changes of organ colour, size, morphology, consistency, presence of lesions and parasites (Mellau *et al.*, 2010).

**Definition of some conditions encountered in this study:** *Tuberculosis* is a contagious and usually a chronic debilitating disease in animals and man caused by a bacterium in the genus *Mycobacterium* spp. which pathologically is characterized by tubercle formation in the lungs and associated lymph nodes. The disease can be spread hematogenously to other organs of the body.

*Dermatophilosis* (Streptothricosis) is a skin disease caused by a bacterium called *Dermatophilus congolensis*. The condition is sometimes referred to as "rain scald" as it often looks like raindrops have just fallen on the skin. The condition is initially seen as pustules that are often over-looked. However, the pustules quickly come to together to form large oval crusts as the longer hairs become stuck together in the scab. These large crusty scabs are easily seen. Thick, creamy pus can be found under active crusts. When the scabs or crusts are removed, the underlying skin is usually hollowed out and often bleeds. Most animals do not appear to have itching sensation, however, the lesions are painful when the scab is manipulated. The most common locations of the lesions in cattle are rump, topline, udder and teats as well as the belly.

*Mange* is a persistent contagious skin disease of mammals caused by a tissue-burrowing arthropod, the mange mite causing a lot of skin irritation and itching.

*Hydatidosis* or echinococcosis is a parasitic infection caused by the larvae of a microscopic tapeworm of genus *Echinococcus*. The term hydatid refers to the characteristic multicystic lesion a large, roughly spherical, hollow cyst filled with fluid that

Table-1. Annual distribution of bacterial and parasitic zoonotic diseases among slaughtered animals in Maiduguri abattoir from 2000-2009.

Diseases	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percentage
Tuberculosis	395	364	400	455	1299	1308	1578	849	1550	1311	9509	63.63 <sup>a</sup>
Dermatophilosis	265	279	232	280	190	164	208	176	169	254	2217	14.84 <sup>b</sup>
Mange	111	143	472	408	341	302	261	0	171	136	2345	15.69 <sup>b</sup>
Fascioliasis	20	16	16	25	21	26	30	23	29	23	229	1.53 <sup>c</sup>
Hydatidosis	29	60	110	88	57	63	51	61	57	68	644	4.31 <sup>c</sup>
Total	820	862	1230	1256	1908	1863	2128	1109	1976	1792	14944	
Percentage	5.48	5.76	8.23	8.40	12.76	12.46	14.23	7.42	13.22	11.99	100	

Values with different superscript along the column differ significantly ( $P < 0.05$ )

occurs after infection. It affects both humans and other mammals, such as sheep, dogs, rodents and horses. There are three different forms of echinococcosis, each of which is caused by the larval stages of different species of the tapeworm of genus *Echinococcus*. These are the cystic echinococcosis also known as unilocular echinococcosis, which is caused by *Echinococcus granulosus*. The second is alveolar echinococcosis (also known as alveolar colloid of the liver, alveolar hydatid disease, alveolococcosis, multilocular echinococcosis, "small fox tapeworm"), which is caused by *Echinococcus multilocularis* and the third is polycystic echinococcosis (also known as human polycystic hydatid disease), which is caused by *Echinococcus vogeli*.

*Fascioliasis* is an infectious disease caused by *Fasciola* parasites, which are flat worms referred to as liver flukes. The adult (mature) flukes are found in the bile ducts and liver of infected people and animals, such as sheep and cattle. In general, fascioliasis is more common in livestock and other animals than in people.

Data analysis: The data for this study were analyzed using simple descriptive statistics in excel spreadsheet. Categorized variables were computed and further compared using Chi-square test at critical probability of  $P < 0.05$ . The strength of associations between dependent and independent variables was determined using 2 x 2 contingency tables. The variables compared included prevalence of the diseases based on years, species of animal, sex and season. Organ-specific prevalences of tuberculosis lesions were also compared.

## Result

A total of 1,378,066 animals comprising of 403,560 (29.3%) cattle, 381,601 (27.7%) goats, 373,567 (27.1%) sheep and 219,308 (16.0%) camels were examined, slaughtered and inspected between January 2000 and December 2009. Annual distribution of the bacterial and parasitic zoonotic diseases is shown in Table 1. The result showed that a

total of 14,944 bacterial and parasitic zoonotic diseases were encountered which comprised of 9,509 cases of tuberculosis (67.6%), 2,217 dermatophilosis (15.8%), 2,345 cases of mange (16.7%), 644 cases of hydatidosis (4.3%) and 229 cases of fascioliasis (1.5%) with tuberculosis occurring more significantly than others ( $P < 0.05$ ). Fascioliasis was encountered mainly in cattles while hydatidosis was encountered majorly in the other animal species under consideration. The sex-specific prevalence of the zoonotic diseases encountered is shown in Table 2.

Table-2. Occurrence of the diseases based on sex

Diseases	Males	Females	Total
Tuberculosis	5389	4120	9509
Dermatophilosis	1287	930	2217
Mange	1090	1255	2345
Fascioliasis	101	128	229
Hydatidosis	346	298	644
Total	8213	6731	14944

On the basis of seasonality, more cases were recorded in the raining season than the dry and cold harmattan seasons as seen in Table 3 but not statistically significant ( $P > 0.05$ ). Detailed analysis of the tuberculosis cases are shown in Table 4 with cattle, goats, sheep and camels having prevalences of 1.6%, 0.25%, 0.4%, and 0.33% respectively. Organ-specific prevalence of tuberculosis in the slaughtered animals showed that the lungs and associated lymph nodes were affected more significantly than the other organs as shown in Table 5. Prevalence of tuberculosis between cattle and other species varied significantly but not across the years. The trend of tuberculosis infection in the animals showed a rising and falling pattern across the years.

## Discussion

Slaughter houses provide an excellent opportunity for detecting diseases of both economic and public health importance (Raji *et al.*, 2010). Frequent encounter of bovine, caprine and ovine

Table-3. Seasonal distribution of bacterial and parasitic zoonotic diseases among slaughtered animals in Maiduguri Abattoir (2000-2009).

Seasons	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percentage
Dry season	381	472	512	574	423	388	386	364	384	480	4364	29.20 <sup>a</sup>
Rainy season	459	421	522	610	597	405	579	405	643	556	5197	34.77 <sup>a</sup>
Cold season	600	391	560	566	565	604	501	419	621	556	5383	36.03 <sup>a</sup>
Total	1440	1284	1594	1750	1585	1397	1466	1188	1648	1592	14944	

Values with superscript along the column do not differ significantly ( $P > 0.05$ )

pathological lesions in various organs of the animal has been constant features in the annual reports of various government stations in Nigeria (Babalola, 1975; Ogurinade and Ogunrinade, 1980; Antia and Alonge, 1982). The results of this study showed that about 1,378,066 animals were examined and slaughtered in the Maiduguri abattoir which comprised of 29.3% cattle, 27.6% goats, 27.1% sheep and 16.0% camels. A total of 14,944 bacterial and parasitic zoonotic diseases were encountered which included tuberculosis, dermatophilosis mange, hydatidosis and fascioliasis with prevalence rate of 67.5%, 15.7%, 16.7%, 4.3% and 1.5% respectively, with tuberculosis being encountered more than the other diseases ( $P < 0.05$ ).

The presence of these zoonotic diseases has also been reported previously by Opara (2005), Aliyu *et al.* (2009), Raji *et al.* (2010), and Alawa *et al.* (2011). Analysis of the sex prevalence of the diseases did show that, generally, males were affected more than the females but not statistically significant, likewise in terms of disease specificity, males were affected more but not significantly. Such difference may occur by chance or may be due to difference in genetic makeup in terms of sexual predisposition. Blood *et al.* (2007) has earlier reported higher prevalence of tuberculosis among female cattle than their male counterparts. Seasonality did not have much influence on the outcome of the study even though more cases were

recorded during the raining season. Opara (2005) reported more cases of tuberculosis during the rainy season which contrasted that of Alhaji (1976) who recorded higher prevalence of the disease during the dry season.

Among the diseases of cattle, sheep and goats, infestation by mange mites and ticks, as well as dermatophilosis pose a considerable economic loss particularly to the skin and hide export due to various defects (Woldemeskel, 2000). In Nigeria, the economic significance of dermatophilosis in animals had reached an enormous proportion such that it was declared as second to contagious bovine pleuropneumonia (Llyod and Ojo, 1976). Though mites are active in keratin layer and causes direct damage to skin, they also cause indirect economic loss by decreasing/ceasing reproduction and production performance (Soulsby, 1998). Dermatophilosis has been diagnosed in man in New York, and surveillance is necessary to establish the zoonotic status of the infection in Nigeria. The organism requires existing skin lesions to establish infection, so people with skin lesions are at higher risk especially herdsmen, farmers, veterinarians and butchers who make direct contact with infected animals (Ikpeze, 2004).

Fascioliasis which is caused by the trematode *Fasciola* spp. constitute both economic and public health constrains to profitable ruminant production in tropical Africa (Fabiya and Adeleye, 1982).

Table-4. Prevalence of tuberculosis lesions among animals slaughtered at the Maiduguri abattoir from 2000-2009.

Species	Particulars	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Bovine	No. examined	12458	31906	47483	44350	40372	47331	46781	45761	43977	43141	403560
	No. with TB	329	270	225	249	702	890	878	663	1139	1023	6368
	Prevalence (%)	2.64	0.85	0.47	0.56	1.74	1.88	1.88	1.45	2.59	2.37	1.58 <sup>a</sup>
Caprine	No. examined	36205	39601	40332	38627	41501	40320	37103	31500	40728	35684	381601
	No. with TB lesions	32	31	105	49	273	151	117	23	176	29	986
	Prevalence (%)	0.09	0.08	0.26	0.13	0.66	0.37	0.32	0.07	0.43	0.08	0.28 <sup>b</sup>
Ovine	No. examined	33281	38412	35589	33922	36888	40791	37896	38456	40067	38265	373567
	No. with TB lesions	7	28	50	131	286	247	397	4	105	168	1423
	Prevalence (%)	0.02	0.07	0.14	0.39	0.78	0.61	1.05	0.01	0.26	0.44	0.38 <sup>b</sup>
Camel	No. examined	16682	17893	17892	20182	17761	20578	16725	29435	22081	40076	219308
	No. with TB lesions	27	35	20	26	38	20	186	179	110	91	732
	Prevalence (%)	0.16	0.20	0.11	0.13	0.21	0.10	1.11	0.61	0.50	0.23	0.33 <sup>b</sup>
All	No. examined	98626	127812	141296	137084	136552	149020	138505	145152	146853	157166	1378066
	No. with TB lesions	395	364	400	455	1299	1308	1578	869	1530	1311	9509
	Prevalence (%)	0.40	0.28	0.28	0.33	0.95	0.88	1.14	0.59	1.04	0.83	0.33 <sup>b</sup>

Values with different superscript along the column differ significantly ( $P < 0.05$ )

Table-5. Organ-specific occurrence of tuberculosis among slaughtered animals in Maiduguri abattoir from 2000-2009.

Organs	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percentage
Lungs	650	540	469	515	552	447	503	475	541	548	5240	55.10 <sup>a</sup>
Lymph node	96	192	333	447	319	349	240	102	338	219	2635	27.71 <sup>b</sup>
Liver	28	47	11	62	29	52	120	116	33	31	529	5.55 <sup>c</sup>
Heart	28	52	13	26	44	21	23	34	15	22	278	2.92 <sup>c</sup>
Kidney	31	21	8	16	10	22	11	28	21	8	176	1.85 <sup>c</sup>
Spleen	21	28	6	16	36	31	44	29	37	5	253	2.56 <sup>c</sup>
Intestine	30	30	46	77	40	35	29	40	25	46	398	4.19 <sup>c</sup>
Total	884	910	886	1159	1030	957	970	824	1010	879	9509	100

Values with different superscript along the column differ significantly ( $P < 0.05$ )

Fascioliasis affects the liver leading to liver condemnation in slaughtered animals. The overall prevalence in this study was 1.5% which is lower than those reported by Njoku-Tony and Okoli (2011), Abebe *et al.* (2010), Swai and Ulicky (2009), Kithuka *et al.* (2002), Okoli *et al.* (2000) and Alonge and Fasami (1979). Differences in prevalence of fascioliasis may arise due to poor meat inspection facilities and uncooperative attitudes of butchers because of lack of compensation of condemned organs, seasonality and differences in geographical locations in relation to the bionomics of their snail intermediate host (Anosike *et al.*, 2001). Hydatidosis is a parasitic zoonotic disease caused by the metacestode stage of the dog tapeworm *Echinococcus* spp. A prevalence of 4.3% in this study was higher when compared with the 0.1% reported by Tijjani *et al.* (2010) in small ruminants in the same region. Hydatidosis is associated with livestock morbidity and mortality, organ and meat condemnation at inspection and threat to public health as a result of the close association between dogs, food animals and man.

Detailed analysis of tuberculosis among the slaughtered animals shows that cattle had the overall highest prevalence rate of 1.6% which is significantly different from those of the other animal species in the study. The prevalence across the years was not significant. Prevalence of tuberculosis among animal slaughtered in abattoir has been reported by many authors. The overall prevalence of tuberculosis in this study is 0.7%. Higher prevalence rate of 4.05% was reported by Aliyu *et al.* (2009) from cattle in six northern states of Nigeria; 3.4% by Opara (2005) from cattle in Akwa Ibom state; 9% by Maho *et al.* (1999) from cattle in Chad. Lower prevalence rates of 0.01% and 0.08% were also reported by Alawa *et al.* (2011) and Ojo (1996) respectively in Zaria. Organ specific prevalence of tuberculosis did showed that the lungs were mostly affected ( $P < 0.05$ ) as compared to the other organs followed by the lymph nodes. This further confirms that the primary organ of infection of

tuberculosis is the respiratory system and associated lymph nodes. This is in concordance with the reports of Igbokwe *et al.* (2001) and Liebana *et al.* (2008). Even though not a novel finding per se, the affirmation of such detail is important in the overall context of disease surveillance and monitoring (Cassidy, 2008). Trend of the occurrence of tuberculosis among the different animal species in this study showed a rising and falling pattern which suggests that tuberculosis among animal populations in this part of the world is still endemic. Endemic nature of zoonotic diseases in the area of study could be due to the lack of proper management of animals against important zoonotic diseases, failure to adopt the test and slaughter policy in Nigeria and the influx of infected animals from neighboring countries due to the porosity of our borders (Aliyu *et al.*, 2009).

## Conclusion

The prevalence of zoonotic diseases such as tuberculosis, dermatophilosis, mange, fascioliasis and hydatidosis contribute to organ condemnation associated with economic loss. Results of this study reveals that these diseases are endemic in the study area. Retrospective study of diseases encountered at abattoir will provide useful pathology profiles which could be useful in future risk assessment and planning of control and prevention strategies. It is therefore recommended that retraining of abattoir staff on modern methods of meat inspection practices be done. This suggests a need for a rigorous meat inspection procedure to minimize the chance of consumers acquiring infection through contact with and/or consumption of infected meat. Proper record keeping of abattoir data and if possible computerization of such data is necessary. Public enlightenment campaigns on good livestock husbandry practices at local and national levels should be encouraged.

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