

Common conditions leading to cattle carcass and offal condemnations at 3 abattoirs in the Western Province of Zambia and their zoonotic implications to consumers

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ABSTRACT

From a total of 32 717 cattle slaughtered, 183 whole carcass condemnations were attributable to 9 diseases and conditions, namely, tuberculosis (TB), cysticercosis, emaciation, generalised lymphadenitis, jaundice, abscesses, moribund, sarcosporidiosis and odour. Bovine TB was the most important cause of condemnations (152/183, 83.1 %). Bovine cysticercosis and sarcosporidiosis accounted for 5/183 (2.7 %) and 8/183 (4.4 %), respectively, while each of the remaining conditions contributed less. Among the many conditions responsible for offal/organ condemnations were fascioliasis, contagious bovine pleuropneumonia, hydatidosis and TB. In terms of number and weight, *Fasciola gigantica* infections made livers and lungs the most condemned offals (20.1 % and 0.7 %, respectively). Hydatidosis was the cause of 0.9 % lung and 0.1 % liver losses. *Cysticercus bovis* contributed to only 0.05 % of all inspected tongues, hearts, and heads. TB was very rare in heads (0.01 %). The financial impact of whole carcasses and offals condemned during the study period was enormous and deprived livestock farmers of the much needed revenue and consumers of protein sources. Much or all of the condemned material that could have been useful was wasted by not being retrieved for conversion to processed meat, bone meal or pet food. Failure to detect lesions of potential zoonotic diseases at slaughter poses a health risk to consumers especially when meat is eaten undercooked.

Key words: bovine tuberculosis, cattle, condemnations, *Cysticercus bovis*, *Fasciola gigantica*, Zambia.

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and in some instances, meat may be consumed undercooked.

MATERIALS AND METHODS

Study area and animals

Western Province, which lies between the latitudes 14 °S and 17 °S and longitudes 22 °E and 25 °E, is one of the least developed provinces of Zambia, but harbours a large proportion of the country's traditionally owned cattle population. It provides beef and beef products to major urban centres in the country. The main cattle production system is the pastoral/agro-pastoral livestock production system. Other economic activities performed are fishing, cassava growing and to a lesser extent maize production. Most of the cattle are of the Barotse breed that has a dual purpose of providing milk and meat. The oxen are used for transport and draught power in crop cultivation. Most livestock graze the communal lands within the massive Barotse flood plain created by the Zambezi river and its tributaries. This river transects the province in the centre as it meanders from the north to the south creating over the years numerous lagoons, ox-bow lakes and marshy areas, many of them having permanent water. The Barotse flood plain is low lying, generally flat and subjected to seasonal floods from December/January to June/July. This plain provides good pastures to about 75 % of cattle during the dry season from August to December when pastures are generally poor elsewhere in the country.

Data collection and analysis

Data for condemnations were extracted from the annual and monthly reports of meat inspectors in the Senanga District Veterinary Department covering a period of 2 years and 7 months. The annual report for 2003 from Senanga district was obtained from the National Livestock Epidemiology and Information Centre (NALEIC) in Lusaka. Meat inspection at representative abattoirs in Western Province located at Zam-Zam, Kembe Cold Storage and Twikatane is normally car-

INTRODUCTION

Abattoirs and slaughterhouses can be sources of valuable information of the incidence of animal diseases and conditions, some of which may be zoonotic. Livestock processed at these facilities represent, to some extent, a valid cross-section of the livestock population. Therefore, incidence of less acute, chronic and milder diseases with no clinical signs may be detected at slaughter. As a result, if such information is well documented, collection and collating of figures from the same area over a period of time will highlight changes in animal husbandry practices and disease control.

Western Province of Zambia is plagued by many livestock diseases that lead to loss in production, death or condemnations at slaughter of either the whole carcass or offal. These include anthrax, blackleg, haemorrhagic septicaemia,

brucellosis, fascioliasis, the cysticercus of *Taenia saginata* (*Cysticercus bovis*), tuberculosis and contagious bovine pleuropneumonia (CBPP). Apart from having adverse effects on livestock production, anthrax, brucellosis, cysticercosis and tuberculosis have public health significance. Contagious bovine pleuropneumonia is the most devastating disease seen in the province¹. While vaccination against CBPP is undertaken by the government, local farmers rarely practise any other prophylaxis or control helminths in their livestock.

Zoonotic tuberculosis (TB) caused by *Mycobacterium bovis* is present in animals in most developing countries, including Zambia, where surveillance and control activities are often inadequate or unavailable⁶. Little information is available from the affected countries, but risk factors for *M. bovis* in both animals and humans are present, especially in the tropics³. An estimated 90 % of the total milk produced is consumed fresh or soured¹⁹. Although milk is generally boiled, pasteurization is not done in rural communities of Zambia

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Table 1: Cattle condemned at slaughter in the Western Province of Zambia during the period 2000–2003 and some causes for carcass condemnations.

Condition	Number of condemnations per year				Total	% of condemned cases
	2000	2001	2002*	2003		
TB	1	149	1	1	152	83.1
<i>Cysticercus bovis</i>	1	0	2	2	5	2.7
Emaciation	0	0	2	2	4	2.2
Generalized lymphadenitis	0	0	2	1	3	1.6
Odour	0	0	2	2	4	2.2
Abscesses	0	0	1	1	2	1.1
Moribund	0	0	0	4	4	2.2
Jaundice	0	0	1	0	1	0.5
Sarcosporidiosis	0	0	0	8	8	4.4
Total condemned	2	149	11	21	183	100

*Only 7 months were included.

ried out by veterinarians and para-veterinarians using standard procedures described in the Public Health (meat, abattoir and butcheries) regulations under CAP 295 of the Laws of Zambia. Cattle that are slaughtered in these abattoirs are brought by trekking or by road in trucks from most parts of Western Province.

Qualitative data were analysed manually for content and recurrent themes in the text. Carcass condemnations were pooled into year of occurrence while the percentage of a single cause of condemnation throughout the study period was calculated as a ratio of that cause over all causes. Offal condemnations were likewise recorded and analysed except for the percentage throughout the study period of all condemnations of a specific offal, which was calculated as a ratio of that cause over all the inspected items. Unlike many types of offal, lungs and kidneys are paired in each animal. These were counted as individual items and contributed to the denominator. Conditions that led to few offal condemnations were grouped together under the name 'others'.

RESULTS

Carcass condemnations

The total number of carcass condemned for all causes was 183, representing 0.51 % ($n = 37\,717$) of cattle examined during the 3 years and 7 months covering the period 2000–2003. Of the total number of cattle inspected, 4629 were in 2000, 9422 in 2001, 10 147 in 2002 and 11 519 in 2003. Bovine tuberculosis contributed 83.1 % ($n = 183$) of the carcasses condemned with the bulk occurring in 2001 (Table 1).

Cysticercus bovis accounted for only 2.7 % of carcass condemnations. Four cases were moribund (2.2 %), and another 8 condemned due to sarcosporidiosis (4.4 %) were reported only in 2003. A single case of jaundice as a cause of con-

demnation was reported in 2002. Other causes as listed in Table 1 were lower.

Offal or organ condemnations

Livers (46.8 %) and lungs (11.0 %) were by far the most condemned offal over the whole study period while tongues (0.6 %) and hearts (1.2 %) were the least condemned (Table 2). *Fasciola gigantica* infections were the leading cause of condemnations of livers (20.1 %) and lungs (0.7 %). Contagious bovine pleuropneumonia had a fluctuating frequency throughout the study period.

Hydatid cysts were reported in 0.1 % of livers and 0.9 % of the lungs (Table 2). It was the second most common cause of all condemned lungs. *Cysticercus bovis* was observed rarely (0.01–0.02 %) in predilection sites of hearts, tongues and heads (masseter muscles) over the whole study period. A total of 6 suspected TB cases (5 in 2002) were observed in hearts, heads, lungs, tongues and intestines.

No follow-up was intended or undertaken by the veterinary officers to identify the origin and take measures in cases of bovine cysticercosis and tuberculosis. Contagious bovine pleuropneumonia follow-up was, however, planned according to the reports but was never undertaken because of a lack of transport and resources.

In terms of number and weight of condemned offal, fascioliasis caused the largest losses in livers and lungs (Table 3). Enormous losses which may be related to *F. gigantica* were caused by cirrhosis and necrosis. Overall, most losses were recorded for livers, lungs and intestines.

DISCUSSION

Of the 9 disease conditions responsible for carcass condemnations found in this study, bovine TB was the single most important cause accounting for 83.1 % ($n = 183$). Others were moribund (2.2 %), cysticercosis (2.7 %), jaundice (0.5 %),

sarcosporidiosis (4.4 %), odour (2.2 %), abscesses (1.1 %), generalised lymphadenitis (1.6 %) and emaciation (2.2 %). Unlike TB which was predominant in 2001, the other conditions were recorded in the last 2 years of the study. The practice of recording a group of mycobacterium species causing similar lesions to those of tuberculosis as seen in this study for the purpose of meat inspection sometimes has the effect of inflating the real occurrence of the disease¹². A thorough systematic necropsy is more likely to detect infection than routine slaughter inspection of carcasses⁵. Because of the non-specific nature of granulomas, the tubercle-like lesion is used as a surrogate test at abattoirs. Therefore, in order to characterise the real occurrence of *M. bovis*, it is necessary that bacteriological and histopathological diagnostic procedures are carried out to support normal meat inspection which is based on gross examination of miliary abscesses or lesions. Apart from TB, all other causes of carcass condemnations were lower than those reported elsewhere in Zambia and in Zimbabwe^{2,16}. In a review of abattoir records over a 20-year period between 1965 and 1984 in Lusaka, Zambia, most carcass condemnations were due to oedema (22.7 %), *C. bovis* (20.1 %), *M. bovis* (17.4 %), extensive bruising (7.7 %) and the cases being moribund (6.2 %)¹⁶. Tuberculosis and cysticercosis occurred more frequently; *M. bovis* ranked the highest in 1975–1977 and 1979–1981, while *C. bovis* in 1965–1969. Bovine carcass condemnations in Zimbabwe were mostly due to oedema/emaciation (29.6 %), *C. bovis* (15–18.4 %) and to a lesser extent tuberculosis (0.2 %)².

The term 'moribund' literally means 'about to die' and when used as a diagnosis or recordable condition, it always leads to uncertainty. This is because it fails to specify from which condition or disease the animal is about to die. Generally, the recording of low condemnation rates of

Table 2: Causes, number and percentage of offal/organ condemnations at meat inspection in the Western Province of Zambia during the period 2000–2003.

Offal/organ	Condition	2000	2001	2002*	2003	Total	%
		<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	
Liver	Fascioliasis	909	2131	1927	2211	7178	20.1
	Cirrhosis	1259	2335	1789	2090	7473	20.9
	Necrosis	278	391	184	701	1554	4.4
	Abscesses	0	7	25	27	59	0.2
	Hydatidosis	0	10	19	19	48	0.1
	Others	0	194	321	223	738	2.1
Lung	Fascioliasis	517	141	344	91	486	0.7
	CBPP	15	638	239	1490	2589	3.6
	Hydatidosis	296	4	28	318	646	0.9
	Abscesses	0	68	208	0	572	0.8
	Others	735	912 ^a	1376.5 ^a	589.5	3612.5	5.1
Heart	<i>C. bovis</i>	0	2	2	1	5	0.01
	Pericarditis	39	69	84	105	297	0.8
	Others	8	25	42 ^a	41 ^a	116	0.3
Tongue	<i>C. bovis</i>	3	N/A	2	2	7	0.02
	Abscesses	16	N/A	42	14	72	0.2
	Others	5	N/A	75 ^b	63 ^c	143	0.4
Kidney	Hydronephrosis	183	274	388	550	1355	1.9
	Haemorrhages	6	6	9	4	25	0.03
	Others	30	100	128	241	459	0.6
Spleen	Contamination	32	48	95	14	149	0.4
	Splenomegaly	39	20	18	23	100	0.3
	Others	24	57	135	122 ^a	338	0.9
Intestine	Tape worms	301	110	318	175	904	2.5
	Others	61	115	289 ^a	662 ^a	1127	3.2
Head	<i>C. bovis</i>	3	2	1	2	8	0.02
	TB	0	1	2	0	3	0.01
	Abscesses	3	15	20	30	68	0.2
	Others	10	60	95	69	234	0.7

*Only 7 months were included; ^aincludes 1 TB case; ^bincludes 2 TB cases; ^cincludes 3 TB cases; N/A, not available.

cysticercosis and TB in Zambia may be due to several reasons. Cysticerci can easily be missed during meat inspection because they may not be present on the routine cuts or as a result of light infections in the carcasses^{8,9}. Apart from light infections, another reason may be an improvement in human and livestock hygiene in some communities. Similar to missed cysticerci lesions at slaughter, an Australian investigation showed that the abattoir necropsy procedure failed to detect an estimated 47.0 % of cattle with TB⁵. The failure to detect single lesions during abattoir inspection, therefore, poses a health risk to consumers, especially when meat is eaten undercooked, in that most measles- or TB-infected carcasses may be passed untreated.

In cattle, it was discovered that any condition modifying the balance established between the tubercle bacillus (in its latent infection) and the host's immune defences can have an impact on the risk of developing the disease¹³. Natural exposure to *M. bovis* or environmental mycobacteria may assist in the development of specific immunity, but there is no direct evidence for such immunological

priming of tuberculosis resistance in cattle¹⁸. It has been shown that high TB condemnation rates occur during drought years¹³ as was seen in 2001 in the present study. Drought in this case was the environmental factor that increased the risk of cattle developing TB. However, if more animals tendered for slaughter in a given year come from endemic areas, the recording of TB at slaughter is bound to be high. Similarly, when there was a period of drought from 1980–1984 in Zambia, 37.5 % of carcasses were condemned due to TB¹⁶. During such periods, farmers are forced to sell off many of their cattle to offset, among other things, poor crop yields. However, circumstantial evidence suggests that an adequate intake of mineral, vitamin and protein reduces the susceptibility of cattle to TB¹⁸. Although weather patterns have been implicated in the susceptibility of herds to *M. bovis* infection, there is insufficient information to determine the risk factors precisely.

Fascioliasis as caused by *F. gigantica* infection was by far the leading cause of liver and lung condemnations (20.1 % and 0.7 %, respectively). If conditions related to this parasite (*i.e.* cirrhosis,

necrosis and calcification) were considered under it, then the losses would have been even greater. Even though numbers of offal condemned due to hydatidosis, *C. bovis* and TB were few, the zoonotic implications of having human carriers of *Taenia saginata* tapeworms and *M. bovis* on one hand and dogs or wild canids as definitive hosts of *Echinococcus granulosus* in Western Province on the other, should not be ignored or interpreted as insignificant.

Origins of cattle and farming systems have been known to have an influence on the occurrence of *M. bovis* and *C. bovis* especially in the Southern and Western provinces of Zambia where a pastoralist way of life is practised. Humans and animals in these areas share the same micro-environments and water holes, especially during the dry seasons and droughts, thereby increasing the risk of TB being easily spread from an infected herd to an uninfected one¹⁵. Cattle are used as medium of exchange in place of money. Thus, apart from milk and meat products, there is a lot of exchange of cattle between families and villages (M Munyeme, pers. comm., 2004). This

Table 3: Causes and weight of offal/organ condemnations at meat inspection in the Western Province of Zambia during the period 2000–2003.

Offal/organ	Condition	2000	2001	2002*	2003	Total
		Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)
Liver	Fascioliasis	4545	10 655	9540	10 550	25 795
	Cirrhosis	6295	11 695	9045	10 450	33 485
	Necrosis	1390	1955	920	3505	7770
	Abscesses	0	35	89	135	259
	Hydatidosis	0	50	95	95	240
	Others	0	970	1615	1570	4155
Lung	Fascioliasis	1551	423	1017	273	1461
	CBPP	45	1914	720	4470	8552
	Hydatidosis	888	12	647	954	1046
	Abscesses	0	204	84	0	1739
	Others	2205	2882	3876.5	631.5	9595
Heart	<i>C. bovis</i>	0	1.5	1	1	3.5
	Pericarditis	23.5	34.5	52.5	114	214.5
	Others	5	15	25	51	96
Tongue	<i>C. bovis</i>	1.5	N/A	1.5	2	5
	Abscesses	12.5	N/A	31.2	51	93.7
	Others	3	N/A	60	80	143
Kidney	Hydronephrosis	91.5	137	194.5	244.5	667.5
	Haemorrhages	3	3	4.5	5	15.5
	Others	15	48.5	64.5	67.5	195.5
Spleen	Contamination	32	48	90.5	99	269.5
	Splenomegaly	38	20	18	6	82
	Others	22.5	57	122.5	119	311
Intestine	Tape worms	2107	880	2544	6370	11 901
	Others	427	920	2582	1670	5599

implies that cattle are neither kept in closed nor stable populations due to these movements within and between herds and kraals.

Human disease caused by *M. bovis* has been confirmed in African countries including Zambia^{4,7,10,14,17}. Households that reported a TB case within the previous 12 months were approximately 7 times more likely to own herds containing tuberculin-positive cattle (odds ratio = 7.6, $P = 0.004$)⁴. Some risk factors such as animal reservoirs, milk production and animal husbandry, close physical contacts between humans and infected animals and the increasing HIV pandemic have been reviewed⁶. These risk factors are a growing concern, especially in rural settings of Zambia. The determination of the extent of transmission of TB between cattle and humans as well as wildlife and cattle is part of an on-going study in Southern and Central provinces of Zambia¹⁵. This study is also assessing the risk factors and socio-economic implications of TB in rural communities where there is sharing of contaminated water supplies.

Condemnations of carcass and offal have been found to impact negatively on livestock farmers and consumers countrywide in that material and carcasses condemned in Western Province of Zambia represent a considerable loss of

valuable protein and revenue. No attempts were made to retrieve some of the material condemned which did not have zoonotic implications (e.g. as a result of fascioliasis) so that they could have been converted to processed meat and bone meal to be used as pet food.

In conclusion, an effective slaughterhouse monitoring system provides valuable disease information at a global and/or regional level¹¹. If follow-up on cases found in abattoirs is not done, it means that infected cattle and perhaps humans in areas of origin remain undetected. It is important, therefore, to awaken the interest of policy makers, veterinarians, farmers and other organisations in diseases like TB, cysticercosis, sarcosporidiosis and fascioliasis among animals slaughtered for meat in Zambia.

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