

Sanitary practices and occurrence of zoonotic conditions in cattle at slaughter in Morogoro Municipality, Tanzania: implications for public health

ERICK V.G. KOMBA^{1*}, EWALDO V. KOMBA², ERNATUS M. MKUPASI¹, ALBANO O. MBYUZI³, SHAABANI MSHAMU⁴, DENICE LUWUMBA³, ZABLON BUSAGWE¹ and ALEXANDA MZULA⁵

¹Department of Veterinary Medicine and Public Health, Sokoine University of Agriculture, P. O. Box 3021, Morogoro, Tanzania

²Department of Internal Medicine, Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam, Tanzania

³Veterinary Investigation Centre, Southern Zone, P.O. Box 186, Mtwara, Tanzania

⁴Department of Veterinary Physiology, Biochemistry, Pharmacology & Toxicology, Sokoine University of Agriculture, P. O. Box 3017, Morogoro, Tanzania

⁵Department of Veterinary Microbiology and Parasitology, Sokoine University of Agriculture, P. O. Box 3019, Morogoro, Tanzania

Abstract: As meat consumption is increasing worldwide to cover for protein demands, also raise concerns and challenges regarding meat hygiene and safety. The current one year follow up study aimed at investigating on sanitary practices and occurrence of zoonotic conditions, during post-mortem examination, in cattle at slaughter in Morogoro Municipality abattoir. Sanitary practices were assessed through direct observation where as routine post-mortem inspection procedures were employed to detect zoonotic conditions in cattle at slaughter. During the study period a total of 30,713 cattle were slaughtered and inspected at the abattoir. Results revealed poor hygienic practices at the level of abattoir surrounding, the slaughter operation area, personnel as well as meat vans. Whole carcasses, lungs, livers, hearts and heads were condemned due to zoonotic conditions at rates of 0.026%, 1.96%, 1.61%, 0.02% and 0.21% respectively. Bovine tuberculosis, *Cysticercus bovis* cysts, fasciolosis and hydatidosis were the responsible zoonotic conditions for the condemnations. Bovine tuberculosis was a leading zoonotic cause of condemnations accounting for 95.7% of lungs and 100% of all head and carcass condemnations. *Cysticercus bovis* cysts were ranking the second in serving as causes of condemnations closely followed by fasciolosis and lastly hydatidosis. Occurrence of disease conditions with zoonotic implication in cattle at slaughter, meant for human consumption, may pose significant economic and public health risks to especially disaster-prone marginalized communities. Thus, there is a need to introduce appropriate control measures of livestock diseases to minimize the rate of infection; and eventually reduce economic losses and safeguard public health.

Key words: sanitary practices, zoonoses, abattoir, cattle, public health, Tanzania

Introduction

Most of the slaughter-facilities in Tanzania receive slaughter stocks from the traditional livestock sector which constitutes more than 98% of the total livestock population in the country (MAFS, 2002). The traditional livestock sector is characterized by poor animal genetic make-up, poor management and disease burden. Animal diseases seriously affect the productivity of livestock population in the sector. Control of livestock diseases in

* Correspondence: Dr. Erick V.G. Komba; E-mail: ekomba@suanet.ac.tz/ babagrid@yahoo.com

Tanzania is poorly achieved because of inadequate veterinary services especially in rural areas (Kambarage *et al.*, 1995; Nonga *et al.*, 2009; Mellau *et al.*, 2010, 2011). The inadequate veterinary services in rural areas are mainly due to shortage of veterinary staff, poor infrastructure, and inadequate diagnostic facilities, drugs and biologicals. As a result animals brought for slaughter into urban areas from the rural traditional sector are rarely detected during ante-mortem examination and hence the animals proceed into slaughter.

Diseases and infections that are naturally transmitted between vertebrate animals and humans (zoonoses) account for 60% of all infectious disease pathogens and 75% of all emerging pathogens (WHO, 2010; Woolhouse & Gaunt, 2007). Humans can acquire these infections directly from contact with sick or carrier animals, or through the ingestion of contaminated foodstuffs or from other environmental sources (Lahuerta *et al.*, 2011). It has been suggested that human population density, human population growth, wildlife host species richness and low latitude are predictors for the emergence of zoonotic diseases (Jones *et al.*, 2008). The severity of these diseases in humans can vary from mild symptoms to chronic sequelae or life-threatening conditions (Lahuerta *et al.*, 2011). The effects of zoonoses are accentuated among marginalized groups as the poor tend to have closer interactions with animals and are further isolated from accessible health services. Many endemic zoonoses have been documented in developing countries and elsewhere, most of which disproportionately affect poor and marginal communities. These include diseases like cysticercosis, trichinellosis, toxoplasmosis, hydatidosis, campylobacteriosis, Rift Valley fever and tuberculosis (Gracey *et al.*, 1999).

The monitoring and surveillance of emerging infectious and zoonotic diseases in food animals are important components of food safety systems. The emergence of H5N1 influenza and bovine spongiform encephalopathy (BSE) has increased the concern of emerging zoonotic diseases to both public and animal health (Brown, 2004). Consequently, researchers attention dwells on novel approaches, such as syndromic surveillance, for detecting emerging diseases in food animals at various points along the farm-to-fork continuum (Vourc'h *et al.*, 2006; Van Metre *et al.*, 2009).

Abattoirs have played an important role in the surveillance of various diseases of human and animal health importance (Vilas *et al.*, 2008; Hadorn *et al.*, 2008; Karama *et al.*, 2008). Surveillance at the abattoir allows for all animals passing into the human food chain to be examined for unusual signs, lesions or specific diseases. A study evaluating surveillance systems for bovine tuberculosis in Switzerland found that surveillance during meat inspection at the slaughterhouse had the highest sensitivity for identifying the disease compared to passive clinical surveillance of humans or cattle on farms (Hadorn *et al.*, 2008). Changes in the incidence of lesions at slaughter may provide important information for syndromic surveillance of diseases of animal, public health, and food safety significance. Consequently, the objective of the present study was to assess sanitary practices and identify zoonotic conditions of cattle detected at abattoir during post-mortem meat inspection in Morogoro Municipality in Tanzania.

Materials and methods

Study design and study animals

This study was conducted at Morogoro Municipality abattoir in Tanzania. Morogoro abattoir is government owned and managed by the Morogoro Municipal Council. Morogoro

Municipality (6°49'S - 37°40'E) is located at about 200 km west of Dar es Salaam. The Municipality has a total population of about 228,863 (113,639 males and 115,224 females) (URT 2002).

This was a prospective abattoir survey, undertaken for a period of 1 year from February 2010 to January 2011. In Tanzania, the livestock setup is such that only adult animals are presented for slaughter. All the animals presented for slaughter at the abattoir and subjected to post-mortem inspection during the study period were included in this study.

Data collection

In the present study, assessment of sanitary practices of the abattoir involved the following parameters; location, presence of a fence, source and availability of potable water, slaughter place layout and availability of basic facilities, waste disposal, presence of toilets and bathrooms, protective gears for the personnel, hygiene of workers and the surroundings, hides handling and meat vans hygiene.

Inspection of the slaughtered animals was carried by both the resident meat inspectors involved in routine meat inspection at the abattoir and the researchers. Involvement of the researchers, which was three times every week, was seeking to assess the sanitary practices and also attaining quality control of the post-mortem inspection data. Usually, the meat inspectors carry out this work without daily supervision by qualified veterinarians, who visit the premises only when there are problems.

The procedures adopted for inspection of slaughter cattle employ meat inspection protocols issued by Tanzania Meat Inspection Act of 1993. The procedures involve visual examination, palpation and incision of muscles and intact organs such as the lungs, liver, spleen, heart, kidneys, tongue and various regional lymphnodes. For some diseases like bovine tuberculosis and cysticercosis further thorough examinations of other parts, or body systems are considered whenever lesions are detected in one of examined organs. Findings from meat inspection were recorded on meat inspection disease analysis report format.

Data analysis

Data were analysed using Statistical Package for Social Sciences version 11.5. Descriptive statistics were computed to determine the prevalence of zoonotic infections in examined slaughter cattle. Graphics were produced in Microsoft Excel.

Ethical consideration

The Institutional Review Board of the Sokoine University of Agriculture approved this study. The permission to carry out the study at the abattoir was sought from the Morogoro Municipal Veterinary Officer. Meat inspection was effected by qualified, registered government employed inspectors using standard procedures.

Results

Descriptive

During this period (February 2010-January 2011), a total of 30,713 cattle were slaughtered and inspected. The average number of animals slaughtered per day was 86 ± 14.4 . More than 95% of the animals slaughtered were of indigenous type belonging to Tanzanian Short-horn Zebu (TSZ) and Boran breeds. A few slaughter cattle were of exotic breeds most of them

disposed as culls. The average carcass weight was 97.5 ± 25.4 kg for indigenous breeds and 158.25 ± 82.85 kg for exotic cattle. Indigenous cattle were purchased from cattle auctions around Morogoro Municipality; namely Dumila, Mkata, Melela, Misongeni, Nanenane and Dakawa. Apart from the auction level, it was difficult to precisely trace back the geographical origins of all the animals slaughtered due to lack of reliable animal identification methods. Most of the slaughter animals were sent to the abattoir by trekking means.

Sanitary practices

Morogoro abattoir is located within an area close to a busy road and surrounded with residential houses with no room for expansion. It is not fenced and hence provides room for being accessed by vermin. The abattoir, receiving water from the community supply, suffers scarce availability of potable water during dry seasons. According to the abattoir staff water may flow two or three days a week during this season. Drainage infrastructures at the abattoir were available but open and allow standing of liquid wastes including blood, floor washings and other materials to be conveyed to pits. Washing of animal products involved only the intestines. Similarly, the floor on which all the slaughter operations are carried on was not regularly cleaned with water (every second day) because of water shortage. During the water shortage periods washing of these items were done using water fetched from other sources away from the abattoir.

The abattoir building had crevices on the walls and the floor such that proper cleaning was compromised. It was provided with well-distributed artificial light but of inadequate intensity. There was suitable and sufficient means of ventilation to the external air which was however interfered by animal and human overcrowding. All the processes of carcass dressing i.e. bleeding, skinning, evisceration and portioning were done manually on the floor. The abattoir layout considered both clean and unclean operations as recommended but these were not efficiently separated as they were demarcated by an imaginary line thereby allowing occasional overlaps. Basic sanitary amenities such as detergents, disinfectants and clothes for hand drying were made available but at irregular and/or deficient supplies. Occasional hand washing followed by drying on own worn clothes was observed among some workers. Sterilizing agents such as boiling water or live steam were always lacking during slaughter operations.

The two abattoir toilets though were thorough cleaned weekly, were always in unhygienic manner which further compromised good hygienic practices of a food industry. Slaughter process and eventually meat inspection was always closely witnessed by animal owners whose health status was unknown. The abattoir lacked cold room storage and the meat was distributed to the market on the day of slaughter. The facility was provided with a place for drying hides situated close to slaughter operations area attracting flies due to emission of bad smell as a result of decomposition. The abattoir had a waste disposal facility situated close to slaughter operations area, the situation which attracted cats, flies, crows and stray dogs. The facility was provided with an incinerator which was not operating during the study period. Most meat vans were pickup vehicles each with an open body. They were of poor hygiene and during meat transportation butchers would also get in and sometimes stepped on meat.

Condemnations due to detection of zoonotic conditions

During the 12 month period of the study cattle whole carcasses, lungs, livers, heads and hearts were condemned due to detection of zoonotic conditions during post-mortem examination. The condemnations of the organs/parts were associated with detection of bovine tuberculosis, *Cysticercus bovis* cysts, liver flukes and hydatid cysts. The frequencies of condemnation of each part/organ are shown in Figure 1. Figure 2 summarises the proportion contribution of each detected zoonotic condition to the total condemnations. Whole carcass and head condemnations were solely due to detections of bovine tuberculosis. Condition specific condemnations of lungs, livers and hearts are shown in Table 1.

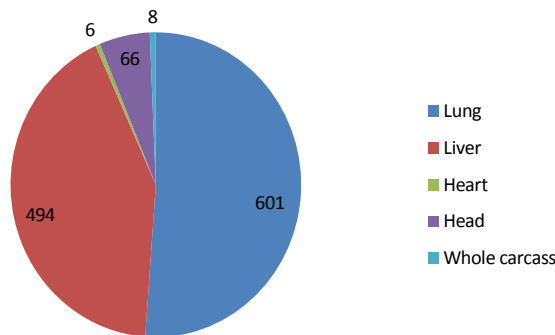


Figure 1: Frequency of abattoir condemnation due to detection of zoonotic conditions at post-mortem examination

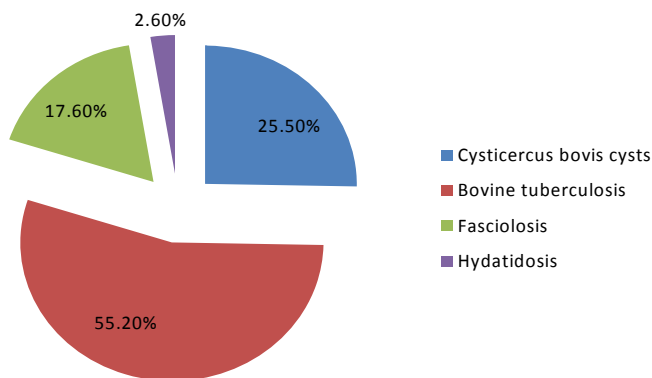


Figure 2: Proportion contributions of different zoonotic conditions to total condemnation of slaughter cattle organs/parts

Table 1: Zoonotic conditions associated with condemnations of cattle organs during post-mortem inspection at Morogoro Municipal abattoir

Organ	Condition	Condemnation rate
Lung	Bovine tuberculosis	575 (1.87%)
	Hydatidosis	14 (0.046%)
	Calcified cysts	12 (0.04%)
Liver	Fasciolosis	207 (0.67%)
	Hydatidosis	17 (0.055%)

	Calcified cysts	270 (0.88%)
Heart	Calcified cysts	6 (0.02%)

Discussion

Being a key element in the production and distribution chain for meat it is essential that a slaughterhouse be as hygienic as possible in order to prevent the spread of both human and animal diseases as well as to reduce economic losses due to premature spoilage of meat caused by contamination. According to Biu *et al.* (2006) many abattoirs and slaughter slabs in developing countries are poorly constructed, have poor slaughter and meat inspection facilities and qualified meat inspectors are always inadequate. The obvious hygiene problem and inadequate meat inspection always causes illness and disease (Hedberg *et al.*, 1992; Joshi *et al.*, 2003). In the present study it was witnessed that the abattoir, surroundings, personnel and also meat vans were in poor hygienic conditions. This has a huge public health implication as it highlights on potential for possibilities of transmitting animal, human and environmental derived pathogens to consumers. More than 100,000 people are affected annually by food borne infections which in some cases are caused by bad food hygiene in slaughter houses or in households ((Tassew *et al.*, 2010).

The present study observed bovine tuberculosis (BTB) occurring at higher levels than any other zoonotic condition during the study period. It is a chronic infectious disease that affects a wide range of mammals, including domestic cattle and humans (Morris *et al.*, 1994). The disease remains an important public health concern worldwide as a result of deficiencies in preventing and/or controlling measures targeting the spread of its causative agent *Mycobacterium bovis* (Etter *et al.*, 2006; Thoen *et al.*, 2006a). Although human TB is mainly caused by *M. tuberculosis*, in regions where bovine TB is prevalent in animals, human TB cases due to *M. bovis* may also occur (O'Reilly & Daborn 1995; Thoen *et al.*, 2009) resulting from ingesting contaminated un-pasteurized milk and raw meat and also by inhaling cough spray from infected livestock (O'Reilly & Daborn 1995; Cosivi *et al.*, 1998; Ayele *et al.*, 2004). The observed correlation between the prevalence of *M. bovis* infection in humans and that of local cattle populations highlights the potential threat of this disease for humans. The threat may be immense in rural communities where people have a very close relationship with the animals and milk pasturalization rarely practiced.

The global prevalence of human tuberculosis due to *M. bovis* has been estimated at 3.1% of all human tuberculosis cases, accounting for 2.1% and 9.4% of pulmonary and extra pulmonary TB cases respectively (Cosivi *et al.*, 1998). Population growth, co infection of TB with HIV/AIDS, and widespread development of drug-resistant strains have complicated the morbidity and mortality of TB cases in humans and significantly increased the cost associated with the use of multiple drug therapy (Daborn and Grange, 1993; O'Reilly & Daborn 1995; Corbett *et al.*, 2003, 2006; WHO, 2009; Thoen *et al.*, 2006b; 2009).

The public health and economic consequences of infection of cattle with metacestodes of the worldwide occurring human tapeworm, *Taenia saginata*, are considerable (Pawlowski & Murrell, 2001). In the present study the metacestodes (cysts) featured as the second common cause of organ condemnations. As previously noted (Geerts *et al.*, 1980; McLauchlan, 1981), compared with viable cysts, degenerating parasites were more commonly found at post-mortem. These are less easily recognizable because of the loss of familiar gross and microscopic architecture (Silverman & Hulland, 1961). The adult stage of *Taenia saginata* is one of the most common pathogenic cestode in humans (Bordon, 1992). Humans are at a risk of infection when raw or undercooked beef harbouring a viable cyst is consumed (Bordon, 1992; Ogunremi *et al.*, 2004). Infected individuals may remain

asymptomatic for years, and the only symptom may be the spontaneous passage of proglottids. However, nonspecific symptoms, such as vague abdominal pain, nausea, vomiting, diarrhoea and weight loss can be present (Karanikas *et al.*, 2007). Although the tapeworm seems to be a benign parasitic disease, it can lead to serious surgical gastrointestinal system complications that are seldom reported in the medical literature (Chirdan *et al.*, 2001; Jongwutiwes *et al.*, 2004; Karanikas *et al.*, 2007).

Fasciolosis was among the zoonotic causes associated with organ condemnations in the present study. The disease was a leading cause of liver condemnations in slaughter cattle. Other studies in the country (Hyera, 1984; Kambarage *et al.*, 1995; Mwabonimana *et al.*, 2009; Nonga *et al.*, 2009; Mellau *et al.*, 2010, 2011) also found the disease to be the commonest cause of cattle liver condemnations. Studies involving live animals have also been conducted in country (Keyyu *et al.*, 2005, 2006; Swai *et al.*, 2006), reporting prevalence as high as 94% in traditional cattle stocks. According to Mas-Coma *et al.* (2005) the disease is an emerging/re-emerging zoonosis in many countries as a consequence of many phenomena related to environmental changes and man made modifications. Together with other trematodiasis the disease is included in a list of important helminthiasis with a great impact on human development. The proportion contributions of fasciolosis to total organ condemnations in the present and other studies does not necessarily reflect the magnitude of the infection in slaughter stock. This is because there are many light infections in which affected parts are trimmed and the remaining portion passed for human consumption; and these are not recorded. Liver fluke infestation rarely causes mortalities in cattle, and much of the economic importance of the disease is due to its effect on production and the losses owing to condemnations of the livers (Kambarage *et al.*, 1995).

Echinococcosis or hydatid disease assumes a cosmopolitan distribution but the disease is endemic in the Mediterranean, Africa, Middle East, South America, Australia, Russia, and China where livestock, mainly sheep and cattle, are raised with dogs who act as the definitive hosts for the adult phase of the echinococcal tapeworm (Eckert & Deplazes 2004; Foster & Hertz, 2010; Dakkak, 2010; Sotiraki & Chaligiannis, 2010). Factors contributing to the increase of prevalence and to the spreading of the disease in endemic areas include the diversity of livestock production systems (predominantly extensive, traditional animal husbandry), small, ill-equipped and unsupervised slaughter-houses, illegal and family slaughtering, low public awareness of hydatid disease, and the high population of stray dogs (Dakkak, 2010). The disease contributed 2.6% of the total condemnations in the present study highlighting its presence in traditional cattle herds. Human infections have been reported in pastoral communities in the country (Ernest *et al.*, 2009). Apart from exerting health effect to both humans and animals, hydatid cysts have important economic consequences (Torgerson, 2003). Human-associated economic losses arise through diagnostic cost, surgical or chemotherapeutic treatment, hospitalization, convalescence, life impairment and fatalities (Torgerson, 2003). In animals economic losses are associated with decreases in carcass weight, milk production and fertility rates, and from increased condemnation of viscera. Previous studies in the country and elsewhere in Africa (Macpherson *et al.*, 2004; Kebede *et al.*, 2008; Nonga & Karimuribo, 2009) also showed evidence of existence of the disease in domestic animals. Poor sanitation and hygiene, and unrestricted disposal of animal viscera post-slaughter may be responsible for the high prevalence of echinococcosis.

In conclusion, zoonoses are prevalent in cattle destined for human consumption in Morogoro Municipality suggesting serious public health implications. Since zoonoses are a result of complex interplay of factors that typically impact poor populations, they are a significant barrier to achieving the Millennium Development Goals in low and middle income countries. We therefore advocate inter-sectoral collaborations and pooling of resources in research, policy and program implementation, as promoted by the “one health” approach to allow financially efficient and more innovative strategies for zoonoses prevention and control both in human and animal populations. Effective control strategies require controlling infections in animal populations, liaising veterinary and medical efforts, active involvement of the populations at risk, and good health systems.

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