



Factors responsible for the post-slaughter loss of carcass and offal's in abattoirs in South Africa



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ABSTRACT

Global demand for food is surging upward due to the expansion of human population. Hence food production and supply need to double with little or no waste to meet this demand. Food loss at any point in the farm to fork chain inhibits the stability of food security at household and national level. A retrospective (AR) and a post mortem meat inspection (PMMI) study to identify major causes of offal and carcass condemnation was conducted in three abattoirs namely, Adeliade, Queenstown and East London abattoirs represented as AD, QT, and EL respectively. The retrospective study revealed the main causes of tongue condemnation as abscess (0.08%, 0.03% and 0.05%) and actinobacillosis (0.02%, 0% and 0.02%) respectively. The spleen was condemned due to abscess (0.35%, 0.94% and 0.17%) and splenomegaly (0.21%, 0.55% and 0.2%). The heart was condemned due to cyst (0.24%, 0.36% and 0.2%) and inflammation (0.9%, 1.85%, and 0.75%). While the kidney, was condemned due to cyst (0.08%, 0.23% and 0.16%) and nephritis (0.94%, 1.01% and 1.18%). However, a greater percentage of condemnation was recorded during the active abattoir study. During the same period, partial carcass condemnations were mainly due to bruises (63.3%, 50.4% and 41.0%), abscess (7%, 6% and 14%) and improper evisceration (19%, 31% and 27%). The combined monetary loss due to offal's and carcass condemnation during the AR and PMMI study was estimated as ZAR 255194.4 (34191.5 USD) and ZAR 25958.8 (2570.2 USD) respectively. This study identified major causes of offals and carcass condemnation as abscess, bruises, actinobacillosis, cyst, inflammatory conditions and improper evisceration. It can be used as starting point information for early warning on livestock diseases of economic loss in South Africa.

1. Introduction

Livestock is an important source of livelihood and an enabler of food security for many poor resourced communities in South Africa. From 1970 South Africa's cattle population has grown from 6 million to 14 million. Of this number, about 3.2 million are in the Eastern Cape Province. Agricultural census 2011 show that 86% of the populace keep on average 1–10 cattle, while 12.9% keeps about 11–100 cattle. In several other livestock species, the province is also leading regarding ownership and husbandry of livestock (Lehohla, 2013; Tada et al., 2013). Curiously it is the second poorest province in the country with many of its people living below the poverty index, despite several attempts by the provincial government to repopulate the province with cattle using the Nguni cattle project (Museumwa et al., 2008).

Chief among several factors militating against efficient livestock production are diseases which lead to mortality, low growth, and food

wastage through abattoir condemnation. Many studies aimed at identifying the causes of meat loss report the high prevalence of diseases such fasciolosis, cysticercosis, and abscessation. Others are melanosis, parasite infection, hepatitis, fibrosis and much more (Dupuy et al., 2014; Jaja et al., 2016; Mellau et al., 2011; Regassa et al., 2013). In many countries such as Turkey, Tanzania, and Ethiopia, studies have shown variable meat loss of 245483 to over 1 million USD (Regassa et al., 2013; Tembo and Nonga, 2015; Yibar et al., 2015). Globally, one-third of world food production is lost or wasted along the food supply chain, yet around one billion people are malnourished (Chaboud and Daviron, 2017; Kummur et al., 2012). Food wastage contravenes sustainable livestock production system, but the reduction of food losses is essential means to boost food security. Many factors responsible for post slaughter meat loss suggest the failure of primary animal health care (PAHC) at the farm level.

Animal health and growth is important in the perspective of the

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socio-economic impact that animal development has on human health, food security and well-being as well as sustainable livelihoods. Animal healthcare is central to ensuring that livestock is healthy and free from preventable disease, and animal diseases are important constraints because the animals of poor resourced farmers are particularly vulnerable to disease due to the absence, cost or unsuitability of production and animal health input. An animal with little or no veterinary care is susceptible to many infections and hence rejected post slaughter at the abattoir during post mortem meat inspection (PMMI) (Fitzpatrick, 2013; Musemwa et al., 2008; Seimenis, 2012).

The aim of PMMI is to remove from the food chain unhealthy and unwholesome meat to protect consumers and to assist in the detection and eradication of certain livestock diseases (Alton et al., 2010; Phiri, 2006; Yibar et al., 2015). Meat condemnation represents a waste of ideal protein food source capable of abating food insecurity in the province and indeed the country. It is necessary to document the main causes of offal and carcass condemnation at the abattoir. A comprehensive survey aimed at quantifying the amount of food lost to condemnation and factors' contributing to these losses is a first step towards understanding the magnitude of the problem of food losses due to meat condemnation. Hence this study aims to identify the causes of meat condemnation and monetary loss due to condemnation.

2. Materials and method

2.1. Ethical authorization

Research approval was obtained from the University of Fort Hare Ethics Committee before the commencement of the study and an authorization certificate was issued with reference number MUS071SJAJ01, while permission was obtained from the participating abattoir to use their records and facility for data collection on meat condemnation.

2.2. Study area and abattoir description

The study was conducted in the Eastern Cape (EC) Province which is the third largest province in the country covering an area of about 169 580 km², that is, 13.9% of the total land area of South Africa. It is bordered on the northeast by KwaZulu-Natal and in the north by the Free State and Lesotho, the Indian Ocean to its south and southeastern borders, and Western and Northern Cape in the west. The rate of unemployment is highest in the province, and the poverty index is approximately 47% of households are poor. About 63% of the province's population lives in the rural areas (Bradshaw et al., 2003; Carabin et al., 2006). Information of the size and characteristics of the abattoir used in this study can be found in Table 1.

2.3. Study design

A retrospective study of abattoir records (AR) from 2010 to 2012 as

Table 1
Characteristics of study sites.

Characteristics	Abattoir		
Abattoir Code	AD	QT	EL
Location	Adelaide	Queenstown	East London
Type of Abattoir	Low throughput	High throughput	High throughput
Approved slaughter capacity	3–20 animals	21 animals and above	21 animals and above
Average Slaughter per annum	500	4000	20,000
Export	No	Yes	Yes
Coordinates	32°80 S and 26° 90 E	31°54'S and 26°53'E	32.97°S and 27.87°E

well as post mortem meat inspection (PMMI) was conducted from July to December 2013. From the abattoir records, data regarding the slaughter of 51 302 cattle from abattoir records and 1374 cattle from the PMMI was analysed. The PMMI was conducted by International meat quality assurance services with the occasional supervision of a public health veterinarian. Causes of condemnation of meat were recorded on spreadsheets to calculate the frequency and economic implication of such condemnation. The PMMI procedure is outlined in the South African Meat Safety Act (Act No. 40 of 2000). Briefly, it involves the visual examination and palpation of carcasses and visceral organs. Meat inspectors systematically incise various disease focal points to assess the health status of the meat or offal. The diagnosis of infected meat was by gross pathological changes i.e presence of parasite or lesions, colour, morphology, size, and consistency. Organs with lesions were separated, classified and recorded in line with the guidelines for meat inspection (MI) in developing countries (Herenda et al., 1994). Condemned organs were temporarily stored in the condemnation room, treated and disposed of. Information regarding the trimming of carcasses was not captured in the AR; hence only whole carcass condemnation was recorded. Carcass trimmed during the PMMI were collected into a condemnation drum weighed using the Ansutek M1/M2 Portable Crane weighing Scale, (Ansutek Commercial Ltd, New Zealand). The weight of the condemnation drum was subtracted to get the accurate weight (in kilogram) of the condemned carcass or organs.

2.4. Animal sampling and sample size calculation

The method for calculation of sample size was extracted from the formula given by (Thrusfield, 2005). The calculated sample size was 382 for abattoir (QT and EL) and 176 for low throughput abattoir (AD). The sizes were however maximized proportionally to AD (229), QT (458) and EL (687) respectively to increase statistical precision.

The sampling procedure used at AD was a typical case sampling technique; organs with visible pathology were selected during the PMMI. The typical case sampling technique was used because of the small slaughter capacity at the low throughput abattoir. A systematic random sampling was used for QT, and EL (Thrusfield, 2005). Sampling units for AD involved the selection of rejected meat/offal's and recording case as per unit, while sampling units for QT and EL were nominated at equal intervals with the first animal being picked randomly. The total number of animals slaughtered during the preceding year (2012) was obtained from the abattoir records as 26, 401 cattle corresponding to 520 (AD), 4078 (QT), and 21,803 (EL). The PMMI were done for six months in 2013, and the total number of animals slaughtered during this time was 20, 791 cattle, corresponding to 322 (AD), 3788 (QT), and 16, 681 (EL). Sampling interval was thus calculated as the total number of animals slaughtered during the study period divided by the required sample size (Regassa et al., 2013). Therefore, the sampling intervals for the QT were 8 (3785/458) and EL, 24 (16, 681/687). The first animal was chosen randomly from the first 8 and 24 animals, respectively. Subsequently, every 8 and 24 cattle were included in the sample during the slaughter operation.

2.5. Direct monetary loss

Financial losses were calculated based on the prevailing market price of the offals (kg) in the 2010–2012 and 2013. The following average annual exchange rate of one South African Rand was used for the financial estimation: 2010 (7.3 USD), 2011 (7.21 USD), 2012 (8.17 USD) and 2013 (10.1 USD). The average weight of spleen, kidney, heart, tongue was taken and the measurement recorded as 1.9, 3.0, 2.4 and 2.2 kg respectively. The price per kg for each organ was obtained from the three abattoirs, and the calculated average was 35, 30, 40, and 20 Rand, respectively, and for the carcass, the price per kg was 28 Rand. The corresponding price in USD was 3.3, 0.9, 3.7 and 1.9 respectively, while the price for the carcass was 28 Rand. Financial losses

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