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Causes of Organ Condemnation and Estimated Financial Loss in Dromedary Camels Slaughtered at Akaki Abattoir, Ethiopia

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Abstract
An investigation was conducted to identify major camel organs condemned and its causes at Akaki slaughterhouse together with estimated direct financial losses associated with the condemnation from October 2013 to April 2014. A total of 305 camels were thoroughly investigated by conducting both *ante mortem* and *post mortem* examinations following a standard inspection procedure. Different factors and/or conditions contributed towards the condemnation of the camel organs. The major factors observed during *ante mortem* examination of the camels for slaughter include emaciation (7.2%), branding (4.9%), lameness (1.6%) and localized wound (1.6%). However, all camels with these abnormalities were passed for slaughter under special precaution. Two major organs that showed gross abnormalities during *Post mortem* examination and rejected were liver (24.3%, 95% confidence interval [CI]: 19.4 - 29.1%) and heart (2%; 95% CI: 0.4 - 3.5%). However, no other organ and carcass was rejected due to any other reasons. Liver condemnation was significantly associated with sex and age of the camels ($p<0.05$). The direct financial loss due to the two organs condemnation in the abattoir was estimated to be 399,060 Ethiopian birr (ETB) (US$20,485.63; 1US$ = 19.48 ETB) per annum. The liver and the heart condemnation rates of slaughtered camels lead to substantial financial losses but lower than that reported in other ruminants. Therefore, further detailed investigation needs to be conducted to understand specific etiological agents causing organ condemnation, estimate avoidable costs, and to create awareness among the producers, traders and policy makers so that proper control measures can be instituted to optimise the benefit obtained from the camel sector.
Keywords: Camel, Organ condemnation, financial loss, Ethiopia

1. INTRODUCTION

Pastoralism accounts for the livelihood of 50 to 100 million people in developing countries; 60% of this population lives in more than 21 African countries confined to the most arid regions of the countries (Sheik-Mohamed and Velema, 1999; UNDP, 2007). Pastoralists' livelihood largely depend on livestock rearing. Among the east Africa countries, Ethiopia has the largest pastoralist population accounting for 10 to 12% of the total Ethiopian population (USAID, 2005). Ethiopian pastoralists virtually depend on livestock for their livelihood, moving seasonally from place to place in search of water and pasture for their animals (Nori, 2005). In Ethiopia, different reports indicate that more than 10 million people live in pastoral areas (CSA, 2014; Tezera *et al.,* 2010; Bekele *et al.,* 2002).

The increasing human population pressure and declining per capital production of food in Africa precipitated the need to develop previously marginal resources, such as the semi-arid and arid rangelands for agricultural activities. Optimal utilization of these marginal areas were achieved through appropriate livestock production, of which camel production is certainly the most suitable (Mehari *et al*., 2007; Wardeh, 2004; Getahun and Kassa, 2002; Schwartz and Dioli, 1992). The camels have been reared in these rangeland areas owing to the extraordinary power to withstand the harsh environmental conditions for long durations (Al-Dahash and Sassi, 2009).

Ethiopia possesses an estimated number of 1.4 million camels (Central Statistics Authority [CSA], 2014) that are mainly distributed in the south, east, and northeast parts of the country (Workneh, 2002; Ministry of Communication and Information, 2005EC?). The species of camels found in the country is one-humped dromedary camels (*Camelus dromedarius*). They are used mainly for milk and meat production besides using for packing (including transport of water, cereals, wood, and salt), riding, and traction. The camels also play diverse roles in the livelihood of the pastoralists, including the building of assets, insurance against unexpected events, a source of cash income through selling and spiritual and social values. Furthermore, the revenue generated from the export of live camels and their meat has been contributing to the macro-economy of the country (SOS Sahel-Ethiopia, 2007; Ali *et al*., 2004).

There are many diseases that affect the quality of camel meat and have also public health importance. Camels could be either carrier of, susceptible to or suffering from several livestock diseases (Zeleke and Berkeley, 2000). Carcass and organs are found unfit for human consumption due to different reasons including parasitic diseases like hydatidosis and fasciolosis, and mechanical damage like bruise and branding. In farm animals, hydatidosis causes considerable economic losses due to condemnation of edible organs and decreased meat and milk production (Polydorous, 1981; Romazanvoc, 2001). This has been also evidenced in camels. In

Ethiopia, the prevalence of hydatidosis in camels ranges from 18.6 to 30.5% (Ahmed, 1998; Weldemeskel, 2001; Mulatu, 2013; Muskin *et al.,* 2011) while in other countries higher prevalence rates of 51% in Iran (Nourani and Rohani, 2009), 40% in Pakstan (Zubair *et al*., 2004), 39.65% in Kuwait (Abdul-Selam *et al*., 1988), and 35.9% in Libya (Gusbi *et al.,* 1990) were reported.

Abattoir based estimation of economic losses due to carcass and organ condemnation was found to be important for many domestic livestock species in Ethiopia. However, a similar study that identified causes of organ condemnation and its economic loss in camels is lacking in the country. Thus, this study was designed to investigate the major causes of organ and carcass condemnation and to estimate associated financial losses in camels slaughtered in Akaki slaughter house, Addis Ababa, Ethiopia.

2. MATERIALS AND METHODS

The study was conducted in camels slaughtered at Akaki abattoir, which is located in Addis Ababa, Ethiopia. The camels were purchased from Fantale and Borana areas, Eastern and Southern Oromia Regional State, Ethiopia, respectively and transported to the Akaki abattoir. Both Fantale and Borana areas are found in lowland agro-climatic zones. The camels were slaughtered in the abattoir throughout the year to supply camel meat for consumers. Camel meat is not popular in Addis Ababa but consumed mainly by Somali and other Muslim communities dwelling in the city. The average number of camels slaughtered in the abattoir were seven per day and 2500 per annum. Cattle, sheep and goats destined for local butcheries, hotels and restaurants were also slaughtered in this abattoir. The camels were kept for five to seven days in the leirage before being slaughtered during which they recover from stress of transportation and *ante mortem* inspection was carried out.

Three hundred five male and female apparently healthy camels were inspected pre-and post-slaughtering from December 2013 to March 2014. The inspections were conducted on three randomly selected days per week and all camels slaughtered on the three selected days were examined.

Ante mortem and Post mortem inspections

All camels were identified by identification number written on their body, and age, sex and origin of the animal were recorded. *Ante mortem* examination was conducted and recorded according to Food and Agricultural Organisation (FAO) of United Nations recommendation (FAO, 1994). Carcass, liver, lungs, heart, kidneys and other organs were thoroughly inspected by visualization, palpation and making systemic incisions when necessary in order to detect and record presence of cyst, parasite and any abnormalities. Pathological lesions were differentiated and recorded according to the FAO (1994) guideline on meat inspection for developing countries. The inspected organs were classified into the following categories of judgment: approved (that is fit for human consumption), conditionally approved for consumption, and partially or totally condemned as unfit for human consumption (FAO, 1994).

Data analysis and assessment of economic loss

Data generated from ante mortem and post mortem inspections were recorded on standardized data sheets, and the data analysis was carried out using STATA version 11 (StataCorp, 2009). The rate of organ condemnation was defined as the proportion of condemned organs to the total number of organs examined. Univariate logistic regression was used to study association between the status of organ condemnation and animal identifiers (sex, age, and origin) and *ante mortem* findings.

The estimation of the annual financial losses due to the condemnations were based on the average number of camels slaughtered in the abattoir, current average market price of each organ in Addis Ababa and rejection rate of each organ (Sariozkan and Yalcin, 2009). The average number of camels slaughtered in the abattoir was summarised from the record data of the slaughterhouse. The market prices of respective organs in Addis Ababa were calculated based on the rejection rate and prices obtained from abattoir workers and butchers. The annual financial loss was estimated using the following formula:

X= (AS x CLuRP x PLu) + (AS x LiRP x PLi) + (AS x KiRP x PKi) + (AS x ChRP x PHR)

Where X = estimated annual financial losses due to organ condemnation, AS = estimated mean annual kill; LuRP = Lung retail price; PLu = percent condemnation of lung; CLI = Liver retail price; PLi = percent condemnation of liver; KiRP = local retail price of kidney; PKi = percent condemnation of kidney; CHR = local retail price of heart; PHR = percent condemnation of heart.

3. RESULTS

Findings of *ante mortem* and *post mortem* examination

A total of 305 camels were examined during the study period, of which 84.9% (259/305) were from Borana and 46 (15.1%) animals were from Fentale areas. *Ante mortem* examination revealed that a total of 15.4% of the camels had different abnormalities including emaciation (7.2%; 22/305), branding on different body parts (4.9%; 15/305), lameness (1.6%; 5/305) and the remaining 1.6% (5/305) had localized wounds. All camels with these abnormalities were passed for slaughter under special precaution for detailed post mortem examination.

The *post mortem* examination of slaughtered camels revealed at least one organ of 78 (25.5%) camels

were condemned due to different abnormalities. Among the organs condemned, liver condemnation rate was the highest accounting for 24.3% (74/305; 95% CI: 19.4, 29.1) due to various pathological findings that include calcification, hydatid cyst, congestion and adhesion (Table 1). The second organ that was mostly condemned was heart (2% [6/305]; 95% CI: 0.4, 3.5%]) due mainly to adhesion. However, carcass and other organs were not condemned due to any other reasons during the study period.

Table 1: Causes and estimated annual financial losses of camel organ condemned in Akaki slaughter house in 2013/14.

Organs	Causes of condemnation	Number of condemned organs (%)	Estimated annual financial loss (ETB*)
Liver	Calcification	20(6.6%)	106,920
	Cirrhosis	19(6.2%)	100,440
	Hydatid cyst	15(4.9%)	79,380
	Calcification and hydatid cyst	14(4.6%)	74,520
	Congestion	3(1%)	16,200
	Adhesion	3(1%)	16,200
Heart	Adhesion	6(2%)	5,400
Total		80(26.3%)	399,060

*Ethiopian Birr (1USD = 19.48 ETB during the study time)

The association between condemnation rate and considered risk factors was assessed using univariate logistic regression analysis. The proportion of liver condemnation was 25.1% and 19.6% for camels originated from Borana and Fentale areas, respectively, but no significant difference ($p > 0.05$) between the two areas were observed (Table 2). Interestingly we observed that the liver of female camels were 7.6 times more likely to be condemned than that of males ($p < 0.05$). Among the risk factors considered, age of the camels was significantly associated with frequency of liver condemnation ($p < 0.001$) while *ante mortem* findings did not have any association ($p > 0.05$). The prevalence of heart condemnation was 1.9% and 0.1% in camels originated from Borana and Fentale areas, and all of the camels were above 15 years. Similarly only age of the camels (but not origin and sex) was significantly ($p < 0.05$) associated with frequency of heart condemnation.

Estimation of annual financial losses

The average number of camels slaughtered in Akaki slaughter house was 2,500. The direct annual financial losss due to rejection of both liver and heart was calculated based on the market prices of the respective organs in Addis Ababa city (Table 1) that accounted for an estimated value of 399,060 ETB (US$20,485.63; 1USD=19.48 ETB). The average financial loss per head of slaughtered camel was on average 160 ETB (399,060 ETB per 2500 camels).

Table 2: Univariate logistic regression analysis for liver condemnation in camels slaughtered at Akaki slaughter house.

Risk factors		Examined camels	Positive (%)	Odds Ratio(OR)	95%CI of OR	P-value
Origin	Fentale	46	9(19.6)	1.0		
	Borena	259	65(25.1)	1.38	0.63, 3.01	0.421
Age	≤ 5year	35	4(11.4)	1.0		
	5-10 year	103	7(6.8)	0.57	0.16, 2.06	0.387
	10-15year	97	25(25.8)	2.69	0.86, 8.38	0.088
	15years	70	38(54.3)	9.20	2.93, 28.85	0.000*
Sex	Male	45	5(11.1)	1.0		
	Female	260	69(26.5)	2.89	1.10, 7.62	0.032*
Ante mortem findings	??	258	47(15.4)	1.0		
	Branding	2	3	5.29	0.86, 32.42	0.072
	emaciation	3	3	5.29	0.86, 32.42	0.072
	Localized wound	4	7	3.09	1.07, 8.87	0.037*
	Lameness	5	4	0.78	0.26, 2.41	0.670

4. DISCUSSION

In the present study, the most common abnormalities observed during *ante mortem* inspection were emaciation, localized wound, lameness and branding. Of these factors, only localised wound was significantly different ($p<0.05$) from others. Local wound can be induced due to manmade, by trees or bushes particularly died ones, insects and some diseases that affects the skin.

Investigation of the major camel organs condemned showed 24.3% (74/305) of liver and 2.0% (6/305) of the hearts were condemned due to various causes at Akaki slaughter house. The condemnation rate of liver

was significantly higher ($p<0.05$) than that of heart. Pathological conditions and parasitic diseases were the major causes of the liver condemnations. The specific causes of the liver condemnation were calcification, cirrhosis, hydatid cyst, congestion and adhesion (Table 1). The rejection rates of liver in this study was lower than the 53.5% reported by Boru *et al.* (2013) but comparable to the 25.3% reported by Gizachew *et al.* (2013) from Ethiopia. Recently, Tenaw *et al*. (2015) reported lung was the major organ condemned followed by liver. In our study, there was no lung condemnation observed but it is interesting that the trend of liver condemnation we observed in Ethiopia was always higher than that of heart (Tenaw et al., 2015; Berhanu et al., 2015). It was also lower than the rejection rate in cattle slaughtered at different abattoirs in the country, 66.55% at Kombolcha Elfora abattoir (Nurit *et al*., 2012), 64.4% at Jimma municipal abattoir (Amene *et al.*, 2012) and 51.95% from Mekele municipal abattoir (Shegaw *et al*., 2009). The percent rejection observed in this study is higher than the reports of Ahmed *et al*. (2012) and Assefa and Tesfaye (2013) who reported 17.9% from Ismailia abattoir in Egypt and 17.58% from Adigrat municipal abattoir in Ethiopia, respectively. In case of sheep, the rejection rate of liver was 32.4% from Luna export abattoir, Ethiopia (Regassa *et al*., 2013) which is higher than our findings.

The percentage rejection of heart in this study was lower than the 8% rejection reported by Ahmed *et al.* (2012) from Ismailia abattoir in Egypt and by Shagaw *et al*. (2009) who reported 3.71% from Mekelle municipal abattoirs, Ethiopia; but it is higher than the reports of Assefa and Tesfaye (2013) and Amene *et al.* (2012) who reported 0.27% and 1.22% from Adigrat and Jimma municipal abattoirs in Ethiopia, respectively. In case of sheep the rejection rate of heart was 7.4% reported by Regassa *et al.* (2013) from one of the export abattoirs in Bishoftu, Ethiopia which is higher than this study.

The observed variations in the rejection rate of liver and heart is probably due to differences in agro-ecological conditions that could favour survival of the parasites, livestock management systems and prevalence of diseases at the different study sites. This study showed that calcification (6.6%) was the main cause of liver condemnation. This finding was lower than previous studies conducted by Boru *et al.* 2013), Gizachew *et al.* (2013) and Nurit *et al*. (2012) who reported 21.1%, 20.62% (both at Akaki camel slaughter house) and 8.18% (at Kombolcha Elfora abattoir in cattle), respectively. But it was higher than the 0.13% and 3.3% reports in cattle slaughtered at Adigrat (Assefa and Tesfaye (2013) and at Jimma (Amene *et al*. (2012) municipal abattoirs in Ethiopia, respectively. The 6.2% liver condemnation due to cirrhosis observed in the present study was lower than the report of Nurit *et al*. (2012) who reported 16.5% from Kombolcha Elfora abattoir in Ethiopia. But it was higher than the rejection reported in cattle slaughtered in three different abattoirs in Ethiopia (range 1.56% - 3.4%) (Shegaw *et al.*, 2009; Assefa and Tesfaye, 2013 and Amene *et al.*, 2012) and 5.4% by Ahmed *et al.* (2012) in camels at Ismailia abattoir in Egypt.

Hydatid cyst contributed to 4.9% rejection of liver in this study which is slightly higher than reports of Assefa and Tesfay (2013) who reported 3.62% rate of rejection in cattle at Adigrat municipal abattoir, Ethiopia but almost the same as Shegaw *et al*. (2009) who reported 4.69% in cattle at Mekelle municipal abattoir, Ethiopia. Our finding in liver condemnation rate was lower than the 53.5% reported by Boru *et al.* (2013) and 25.3% by Gizachew *et al.* (2013) (both from Akaki camel slaughter house) and 14.3% by Nurit *et al*. (2012) at Kombolcha Elfora abattoir. The liver rejection rate by adhesion in this study was 1% which is lower than the 3.95% reported by Regassa *et al.* (2013) in sheep and goat slaughtered at Luna export abattoir, Ethiopia. Very recently, Eldoma and Omar (2015) also reported that liver was the most organ condemned due to aerobic bacteria (particularly *Staphylococcus aureus*) and hydatid cyst. This has public health concern in areas were raw camel liver is eaten as reported from Sudan (Aljameel *et al.,* 2014).

On the other hand, the main cause of heart rejection observed in this study was adhesion (2.0%) which is lower than 9.9% reported by Ahmed *et al.* (2012) at Ismailia abattoir in Egypt. The differences in the rejection rate of organs was related to different causes that could be due to the differences in the prevalence of camel disease and variation in animal management systems at different study sites. These differences in the heart rejection rate results could be due to the variations in the temperature, environmental conditions, livestock disease control practices, the nature of the pastoral grazing and overall livestock management in the study areas.

In the present study, majority of the slaughtered camels were females (85.2%) and more than 50% of them were found to be positive for different lesions. Comparable findings was reported in Kuwait (Abdul-Salam and Farah, 1988). This might be related to the practices in the management of male and the female camels in that the males are usually moved too far for grazing and watering, whereas females are usually managed around homesteads and at the backyard for milk purpose that commonly expose the females to come in contact with infected dogs (Parija, 2004). In many camel breeding areas, offals' are not consumed by the community; rather it is usually given to dogs. Such practice can increase the chance of environmental contamination because dogs can easily acquire infection and then continuously discharge eggs of the parasite, for example, in the case of hydatid cyst. Consequently, as females remain longer time around home than males for reproductive purposes, the probability of getting more infection will be higher than male ones. Moreover, the situation becomes more exacerbated as dogs are not kept in-door for religious and traditional reasons resulting in presence of increased number of stray dogs' that favours further dissemination of the disease.

The result showed that the rejection prevalence was higher in the older age classes (>15 years) ($p < 0.05$). The age-dependent increase in rejection rate among examined animals is in accordance with the findings of Azlaf and Dakkak (2006). The age variation can also be associated with differences in exposure to infection because older livestock may have been exposed to infection several times in their life (Ibrahim *et al.,* 2011). It is also possible to relate the fact that most of the camels were slaughtered in their old age when their milk and/or calf production and working capacity get reduced.

The 399,060 ETB (US$20,485.63; 1USD = 19.48 ETB) financial loss per annum as a result of organ condemnation observed in this study is lower than the 1,089,758.8 ETB (2175.2 ETB per head) reported by Gizachew *et al.* (2013) in cattle from the same slaughter house. Another report in cattle slaughtered at Jimma municipal abattoir (Amene *et al*., 2012) revealed an estimated annual economic loss of 1, 72,664.09 ETB (191.85 ETB per head). Both reports showed at least 2.5 times higher than the current estimated annual loss in slaughtered camels due mainly to the number of cattle slaughtered is usually significantly higher than that of camels. According to Regassa *et al.* (2012) losses due to small ruminant organ condemnation was estimated to be ~23 million ETB (32 ETB per head) annually in Luna export abattoir. Similarly the annual economic loss of cattle/sheep in Kombolcha Elfora Abattoir was estimated to be 12,810 ETB/17.2 ETB per head as reported by Nurit *et al*. (2012). And estimated economic loss due to organ condemnation by Ahmed *et al*. (2012) was 36,480 Egyptian pounds/43.95 Egyptian pounds per head at Ismailia abattoir. Differences in the amount of money lost in various abattoirs could be attributed to differences in the prevalence of diseases, differences in the rejection rate of organs, difference in the slaughtering capacity of abattoirs, differences in the cost of rejected organs of different animals, difference in animal species slaughtered (cattle vs shoats vs camels) and also variations in the livestock management practices in different parts of the country. In general the greater economic loss was due to liver condemnation and reasons for the condemnation needs more detailed research.

In conclusion, both liver and heart are edible organs, and the causes of the condemnation needs further research to identify the etiological agents. Understanding of the etiological agents can help institute suitable control measures that can ultimately leads to reduction in financial loss emanating from the organs condemnation.

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