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Major cause and economic impact of organ condemnation in slaughtered camels at jigjiga municipal abattoir, eastrern Ethiopia

Chalchisa A[1] and Gutema F[2]
[1]College of Veterinary Medicine, Haramaya University, Dire Dawa, Ethiopia
[2]Ethiopian Institute of Agricultural Research, Holetta Agricultural Research center, Holeta, Ethiopia

Corresponding author: chalchisaadu2021@gmail.com

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ABSTRACT

Aim: The study study was conducted to determine the major causes of carcass condemnation, rate of organs condemned and economic loss in camels slaughtered in Jigjiga municipal abattoir of Jigjiga region.

Method and materials: A total of 384 camels were slaughtered during the study period and thoroughly examined by following a standardized post-mortem procedure. After evisceration of the liver, lungs, kidneys, heart, masseter muscles and carcass, a thorough examination was made by visual, palpation and systematic incisions for the detection of the presence of cysts, adult parasites and other abnormalities.

Results: Diseased conditions or abnormalities found in 250 (65%) and 184 (50%) male and 66 (17.2%) female camels, respectively. Out of total 384 camels slaughtered, 162 (42.2%) lungs, 122 (31.8%) liver, 26 (6.8%) hearts and 8 (2.1%) kidney were condemned. Out of 303 male camels slaughtered, 122 (40.3%) lungs, 86 (28.4%) liver, 15 (5%) hearts and kidney 4(1.3%) were condemned; and of 81 female camels slaughtered, 40(49.4%) lungs, 36(44.4%) livers and 11 (13.6%) hearts and 4(5%) were condemned. The risk factors analysis indicated that body condition and sex were significantly associated with organ condemnation in lungs and livers ($P<0.05$). The total financial loss calculated in the present study, due only to offal organs (liver, lungs, heart, and kidneys) condemnation, was 270,711.4 ETB /5,228.5 USD/annually.

Conclusion: It was concluded that hydatidosis, marbling appearance of the lung, emphysema, abscessation, cirrhosis, pericarditis, nephritis and calcification were the major causes of organ condemnation in camels slaughtered in Jigjiga municipal abattoir resulting in considerable economical loss in camels production. Therefore, developing of animal health strategies, enforcement of slaughter policy and training of slaughterhouse personnel on standard slaughter operationsin area are recommended to prevent and reduce the causes of organ condemnation, rate of organ condemnation and economic loss.

Keywords: Abattoir, Camel, Inspection, Jigjiga, Organ Condemnation.

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Introduction

Livestock production covers about 30% of the agricultural gross domestic product in developing countries, which could be projected to increase by about 40% by 2030 and is becoming fastest growing sub-sector of agriculture (Abunna et al.,2010). Several factors influenced livestock resource utilization, including population growth, increases in demand for livestock products as incomes rise and urbanization (Abebe, 1995). Camels are even-toed ungulates belonging to the genus Camelus, which distinguishes two species: the two-humped Bactrian camel (Camelus bactrianus) and the one-humped Arabian camel (Camelus dromedarius).

In many developing countries in Asia and Africa, camels are the most important source of income for the nomadic population (Abbas and Agab, 2002).

The exact number of camels in the world is difficult to determine, first because it is primarily an animal of nomadic people and pastoralists who move frequently, and second, because camels are not usually subjected to mandatory vaccination. So, an exhaustive census of the camels is quite difficult. Officially, the total number of camels in the world is around 27 million heads (Faye, 2014). Therefore, more than 60% of the dromedary camel population is concentrated in the four North East African countries, viz. Somalia, Sudan, Ethiopia, and Kenya (FAO, 2004). Other areas of distribution of the humped camel include the Middle East, parts of Central Asia, and Australia. Ethiopia has an estimated camel population of 2.3 million and

ranks third in Africa, next to Somalia and Sudan (FAO, 2008).

Abattoirs play an important role in developing countries in examining for unusual signs, lesions, or specific diseases surveillance of various diseases of human and animal health importance.Surveillance at the abattoir allows for all animals passing into the human food chain to be (Chhabra and Singla, 2009 and Alton et al., 2010). Meat inspection plays several roles in safeguarding public health, removing gross abnormalities from meat and its products, preventing the distribution of contaminated meat and assisting in the detection and eradication of certain livestock diseases and potentially zoonotic infections. Endemic and exotic diseases that result in mortality and morbidity are the main constraints to efficient livestock production because they decrease the available food from farming systems.

The importance of food safety for human health has been widely known. The safety of foods of animal origin is particularly relevant because the large majority of foodborne diseases come from poultry, eggs, meat, milk and dairy products, and fish (Buncic, 2006). Camel meat is one of the staples of the Ethiopian pastoralist community's diet (Muskin et al., 2011). As meat is the main source of protein for human beings, it should be clean and free from diseases of particular importance to the public, such as tuberculosis and cysticercosis. Meat is also condemned at the slaughter house to break the chain of some zoonotic diseases which are not transmitted to man directly via meat, like hydatidosis and other important diseases of animals such as fasciolosis (Nigatu et al., 2015 and Fufa et al., 2010).

In countries having a low level of camel disease diagnosis and detection, the abattoir plays a major role in providing and serving as a source of information and reference centre for disease prevalence. Meat inspection is conducted in the abattoir for the purpose of screening animal products with abnormal pathological lesions that are unattractive and unsafe for human consumption (Nurit et al., 2012). Meat inspection assists in detecting certain diseases of livestock and preventing the distribution of infected meat that could give rise to disease in animals and humans and to insure the competitiveness of products in the local market (Hinton and Green, 1993). Abattoir meat inspection is essential to remove gross abnormalities from meat and its products, to prevent the distribution of contaminated meat and to assist in the detection and eradication of certain livestock diseases (Alemayehu et al., 2013).

The results of meat inspection at slaughterhouses with appropriate trends indicate possible risks due to unsafe meat obtained from camel carcasses at the slaughter houses. Such risks are eliminated by strict veterinary inspection of animals prior to slaughter as well as of meat and parenchymatous organs after slaughter. Slaughterhouses provide an excellent opportunity for detecting pathological lesions of both economic and public health importance (Ahmed et al., 2013).

Diseases in camels cause considerable economic losses due to condemnation of edible organs and decreased meat and milk production (Romazanvoc, 2001). Among the diseases and abnormalities causing organ condemination in the camel industry, hydatid cyst, calcified cyst, calcification, abscess, hepatitis, discoloration, emphysema, pneumonia, pericarditis, heamorrhage, adhering, hydronephretus, and fatty change were the major causes of organ condemnation that were reported by different researchers. The most common organs that are affected due to different diseases, pathological lesions, and abnormalities are the liver, lungs, heart, spleen, and kidneys (Mekuanent et al., 2015).

In Ethiopia, it was found a lack of information in quality and quantity on the causes of carcass condemnation and status of camel diseases that puts the public at risk of acquiring zoonotic food-borne diseases. In this regard, as Ethiopian dromedaries were primarily reared by pastoralists, abnormalities in carcass and edible organs could have significant economic and public health consequences in the regions. However, abattoir-based epidemiological studies were needed to show real picture of abnormalities and lesions resulting in carcass and organ condemnation in camels so that it would be suggested an impact on the economy and public health. Therefore, the objectives of the study were to identify the major causes of organ condemnation in camels slaughtered at Jigjiga Municipal Abattoir, to detect antmortem and postmortem abnormalities and pathological lesions and to estimate the direct economic losses those arise from organ condemnation in camel slaughtered abbitors.

Materials and Methods

Study Area

The study was conducted in Jigjiga town. Jigjiga is the capital city of the Somali Regional State, which is found in the eastern part of Ethiopia, about 630 km and 105 km away from Addis Ababa and Harar towns, respectively. The human population size of Jigjiga is estimated at about 763,509. Jigjiga is situated at an altitude ranging from 1,660 to 1,710 meters above sea level at geographic coordinates of approximately 9020′ North latitude and 45056′ East longitude. The climate of Jigjiga is of the semi-arid type, which is characterized by high temperatures and low rainfall. The mean annual temperature and mean annual rainfall are about 220°C and 543 mm, respectively. The farming system of the area includes mixed-crop livestock production. The vegetation of the area includes different plants, where sorghum, maize, barley, wheat, and beans are the most important agricultural crops (Belaynesh, 2006).

Study Population and sampling method

The study population was local dromedary camels that were slaughtered at Jigjiga Municipal Abattoir. The camels slaughtered at the abattoir were both male and female and originated from different areas of the country, mainly from the Jigjiga, Babile, Gursum, and Fika areas of the eastern parts of Ethiopia. The simple random sampling method was used for sampling. All camels presented for slaughter during the investigation period were sampled for this epidemiological study. Accordingly, during the period of investigation averagely fifteen (15) camels were slaughtered each day and a total of 384 camels were examined. The animals were observed in their antemortem and postmortem conditions, respectively.

Study Design:

A cross-sectional study was conducted from September 2020 to August 2021 to determine the prevalence of major causes of organ condemnation in camels slaughtered at Jigjiga Minicipal Abattoir and to analyze the economic impact of condemned organs. The organs of the camels in the abattoir during the study period were investigated, and the causes for the condemnation of the organs were recorded. All camels that had been examined during ante-mortem inspection were all subjected to post-mortem examination. A total of 384 camels were slaughtered during the study period and thoroughly examined by following a standardized post-mortem procedure. After evisceration of the liver, lungs, kidneys, heart, masseter muscles, and carcass, a thorough examination was made by visual, palpation, and systematic incisions for the detection of the presence of cysts, adult parasites, and other abnormalities.

Sample size determination

By using simple random sampling methods and a 95% confidence interval with a required 5% precision, the sample size was determined by the formula (Thrusfield, 2007).

$$n=\frac{1.96^2 Pexp\ (1- Pexp)}{d^2}$$

Where; n= required sample size
Pexp=expected prevalence
d= required precision

The expected prevalence of major causes of organ condemnation in camels is 50% with the required precision (d) of 5% (0.05). By substituting the value in the above formula, we get the sample size.

$$n=\frac{1.96^2 x\ 0.5(1-0.5)}{(0.05)^2}$$
$$=384$$

Study Methodology

Sample collection

Antemortem Examination

The following variables were observed during antemortem inspection: lameness, poor body condition, branding, herina, lesion, sex, and age. Identity tag numbers were given to the selected animals and a simple rondom sampling method was used.

*Pormortem Examination***:**

A postmortem examination was conducted based on the guidelines set out in the manual on meat inspection for developing countries (FAO, 2004). As a result, the liver, lung, heart and kidney were examined for any pathological lesion(s) using visualization, palpation, and systematic incision.

Direct Financial Losses

The direct financial loss from organ rejection was calculated by considering the overall average weight of organs. The market price of organs was obtained from the abattoir workers and camel butcher houses. An estimated financial loss due to condemnation of organs was calculated according to (Ogunrinde and Ogunrinde, 1980) as follows:

EL = srx X Coy X Roz

where: EL = Annual economic loss estimated due to organ condemnation

srx = Annual number of camel slaughtered at the abattoir.

Coy = Average cost of each liver/lung/heart/kidney
Roz = Condemnation rate of each liver/ lung/heart/ kidney

Data Analysis

The data collected was entered into the Microsoft Excel spreadsheet and analysed by using SPSS version 20. The data was summarized as a table, and a Chi-square (x2) test was used to compare prevalence among sex, age, body condition, and peasant associations. In all cases, 95% confidence intervals and $p < 0.05$ were considered statistically significant.

Results and Discussion

Antemortem Examination

Of a total of 384 camels examined during antemortem inspection, camels were found to have one or more abnormalities. In the current study, the most frequently observed abnormalities during antemortem inspection were poor body condition, branding, localized swelling, localized lesion, lameness, blindness, and hernia.The most commonly observed abnormalities during ante-mortem inspection and the overall prevalence of abnormalities were shown (Table 1).

Table 1: The summary of abnormal conditions observed on slaughtered camels during antemortem examination at Jigjiga Muncipal Abbattior.

Abnormalities on slaughtered camel	No. of Positive camels	Prevalence(%)
Poor body condition	90	23.4
Branding	161	42
Localised lesion	76	19.8
Localised swelling	31	8.07
Lameness	9	2.3
Blindness	6	1.5
Hernia	8	2.08

The present study revealed that branding and poor body condition was the most common abnormalities that are encountered during an antemortem examination. Blindness, hernia, and lameness are among the uncommon conditions discovered during an antemortem examination.

Postmortem Inspection

Out of the total organs examined, 162 lungs, 122 livers, 26 hearts and 8 kidneys were condemned.The most common pathological findings in the slaughtered camels at the abattoir were lung abnormalities, followed by liver. The heart and kidneys have an approximately less contribution to the condemnation of the organs.

The overall proportion of organ condemnation rate and prevalence due to various pathological conditions and their causes were shown (Table 2).

The current study found that the overall proportion of organ condemnation rates was common in all organs due to various pathological conditions such as hydatid cysts (lung, liver, heart, and kidney), discolaration (liver), emphysema, abscess, pneumonia (lung), pericarditis, and adering and hydronephroritis (kidney) were differentially distributed in relation to body condition, sex, and age of animals.

The current study revealed that the overall prevalence of organ condemnation rate is due to various pathological conditions in relation to body condition, sex, origin, and age of animals. Females had a higher prevalence of lung diseases (49.4%) than males (40.3%), and camels with a poor (54.3%) body condition score had a higher prevalence of lung diseases than those with a medium (30.8%) or good (14.8%) body condition score. In the liver, in females (44.4%) and males (28.4%) were high. The greater prevalence was observed in poor body condition camels, similar to that of the lungs. The prevalence of hydatidosis, cirrhosis, emphysema, pneumonia, and fatty changes in the lungs and liver differed significantly between camel sexes, age, and body condition. The female camels with poor body condition, adults, and camels originating from Jigjiga area were significantly highly affected ($p<0.05$) by pneumonia, emphysema, and cirrhosis as compared to those with medium and good body condition scores (Table 3).

Assessment of Direct Economic Loss

The annual slaughter rate of the abattoir was estimated to be 5,475 camels and the average camel slaughtered in the abattoir was 15 per day. According to abbitors' workers, the average price of liver, lung, heart, and kidney was 100, 15, 35, and 25 ETB, respectively. The direct annual economic loss due to rejection of organs, calculated based on the average price per organ in Jigjiga town, was estimated to be using the formula set by Ogunrinade (1980). The annual estimated economic loss was found to be (270,711.375ETB or 5,228.5USD) per annum (Table 4).

Table 2: Major causes of organs condemnation, frequency, prevalence and its proportion (%) of organ condemnation.

Organs	Causes	No.Organ condemination	Prevalence(%)	Rate of condemnation
Lung	Hydatid cyst	87	22.6	53.7%
	Emphsema	47	12.2	29%
	Pneumonia	36	9.4	22.2%
	Abscess	12	3.1	7.4%
Total		162	47.3	100%
Liver	Hydatid cyst	62	16.1	50.8
	Cirrhosi	55	14.3	45.1
	Calcification	23	6	18.8
	Discoloration	7	1.8	5.7
Total		122	38.2	100
Heart	Hydatid cyst	4	1.04	15.4
	Adhering	11	2.9	42.3
	Pericarditis	11	2.9	42.3
Total		26	6.7	100
Kidney	Hydatid cyst	4	1.04	50
	Hydronephoritis	4	1.04	50
Total		8	2.08	100

Table 3: Summary of lung and liver condemnation, its prevalence relative to sex, age, body condition and origin of slaughtered camel at Jigjiga municipal abattoir

Varabile	Category	Lung condemened (%)	Chi-square value	P-value	Liver Condemend (%)	Chi-square value	P-value
Sex	Male	122(40.3)	1.765	0.123	86(28.4)	0.467	0.087
	Female	40(49.4)		0.001	36(44.4)		0.031
Age	Young	50(37.8)		0.091	40(29.6)		0.457
	Adult	112(50)		0.000	82(33)		0.004
Body condition	Poor	88(54.3)	0.453	0.012	53(43.3)	2.834	0.045
	Medium	50(30.8)		0.065	39(32)		0.038
	Good	24(14.8)		0.145	30(24.6)		0.072
Orgin	Babile	50(30.8)	3.456	0.087	36(30)	0.382	0.078
	Jigjiga	63(38.8)		0.001	45(36.8)		0.006
	Gursum	28(17.3)		0.125	22(18)		0.088
	Fik	21(13)		0.345	19(15.6)		0.312

Table 4: Summary of total number of organ condemnation, its condemnation rates and financial losses of slaughtered camels at Jigjiga municipal abattoir.

Organ condemned	No.organ condemned	percent of condemnation	Money lost (ETB)
Lung	162	51	41,883.75
Liver	122	38.3	209,692.5
Heart	26	8.2	15,713.25
Kidney	8	2.5	3,421.875
Total	318	100	**270,711.375**

The main purposes of meat inspection are to assist in monitoring diseases in the national herd and flock by providing feedback information to the veterinary service to control or eradicate disease, and to produce wholesome products and protect the public from zoonotic hazards (Kambarage et al., 2000). In the present study, routine antemortem and postmortem inspections were conducted to detect any abnormalities encountered in Jigjiga municipal abattoirs. During antemortem inspection, different abnormalities were found. However, no camel was condemned due to these abnormalities all over the study period. In the present study, out of 384 examined camels slaughtered, 28.4% of the lungs, 15.4% of the liver, 6% of the heart, and 2.8% of the kidney were rejected from the local market based on their parasitic and gross pathological lesions.

The most recorded pathological findings in the slaughtered camels at the abattoir were the lung abnormalities, and a total of 162 (42.2%) lungs were found with abnormalities. In particular, hydatidosis was more frequently found in the lung due to its size, blood supply, and availability of oxygen supply (Romazanvoc, 2001) and the camel slaughtered at adult age, during which period the liver capillaries are dilated and most onchospheres pass directly to the lung (Regassa et al., 2009). The present study showed that the most commonly encountered abnormalities during post-mortem inspection were hydatid cyst, cirrhosis, pneumonia, calcification, emphysema, discoloration, abscess, adhering, pericarditis, and hydronephritis.

Major causes of organ condemnation among the disease conditions encountered during the post mortem examination, were hydatid cyst, pneumonia, and emphysema were the major causes of lung condemnation, while cirrhosis and hydatid cyst were the major causes of liver condemnation. However, the disease conditions or abnormalities detected in the heart and kidney have an approximately less contribution to the condemnation of the organs as well as economic losses (Thrusfield, 2007).

The overall prevalence of hydatidosis at Jigjiga manucipal abattoir was (22.6%) among the pathological lesions observed and it has been observed that it occurred predominantly in the lungs. This finding is higher than that reported by (Regassa et al., 2009) from Wolaita Sodo abattoir (15.4%). However, this finding is closer to that reported by Yifat et al. (2011), Jobre et al. (1996) and Kebede et al. (2009) from Gondar (24.2%), South Omo (25.7%) and Tigray (22.1%) regions respectively. This report is also higher than the report of Alembrhan and Haylegebriel (2013) who reported 5.1% from Adigrat.

Differences in culture, social activity, animal husbandry systems, lack of proper removal of infected carcasses, and approach to dogs in different regions may have accounted for the variation in prevalence (Yifat et al., 2011). The lung is the organ that most frequently has hydatidosis due to its size, blood supply, and availability of oxygen supply (Amene et al., 2012).

The prevalence of emphysema and pneumonia was 12.2% and 9.4%, respectively. These findings were higher than the rejection rate of 1.5% for emphysema and 1.8% for pneumonia as reported by Marta (2010) and Yifat et al. (2011) at Gondar and Sebeta abattoirs, respectively. Emphysema and pneumonia could be due to exposure of animals to bacterial or viral infections, stress factors including exposure to dust and starvation. Moreover, penetration of the lungs by foreign bodies, adverse weather conditions, or accidental inhalation of liquid may cause pneumonia (Amene et al., 2012). The prevalence of emphysema in the present study was lower than reported by Kambarage et al. (2000) with 22% in Tanzania and with 43.75% in Addis Ababa Municipal Abattoir (Seboka, 2008)). But, this findings were closer to the results (16.53%) reported by Abayneh (1999) in Assela Municipal Abattoir.

Pneumonia, which was another pathological condition attributed to the 9.4% rejection rate. A lower rejection rate of 31.02% was reported by Cadamus and Adesokan (2010) in Nigeria. Whereas a higher rejection rate of 3.33%, 1.8%, 1.07%, and 11.11% were reported by Alembrhan and Haylegebriel (2013) and Kambarage et al. (2000) in Tanzania, Gondar, Adigrat, and Jimma abattoir, respectively.

The rate of liver condemnation in this study was 38.3%, which is higher than the report of Denbarga et al. (2011) in Gondar ELFORA abattoir (31.1%), Yifat et al. (2011) in Gondar ELFORA abattoir (31.1%), and Alembrhan and Haylegebriel (2013) in Adigrat abattoir (17.58%). Liver condemnation due to hydatid cyst (16.3%) in the present study was higher than studies conducted by Gebretsadik (2009), who reported 12.56% from Tigray and 10.2% from Bahir Dar municipal abattoirs. It is, however, lower than the previous

reported values of Miheret et al. (2013) 33.33% from Dire Dawa and Zelalem et al. (2012) 31.70% from Addis Ababa.

The rate of heart condemnation in this study was 1.55%, which was close to Yifat et al. (2011) in Gondar ELFORA abattoir (1.0%) and higher than studies conducted by Amene et al. (2012) in Jimma abattoir (0.44%). However, a lower rejection rate of pericarditis (36.0%) was reported by Kambarage et al. (2000) from cattle slaughtered in Tanzania. There was a need for adequate meat inspection in abattoirs in order to identify diseases and thereby minimize associated public health risks.

The total financial loss calculated in the present study, due only to offal organs (liver, lungs, heart and kidneys) condemnation, was 270,711.375 ETBEthiopian Birr /5,228.5 USD /year, which was lower than the report of Nigatu et al. (2015) 320,760 Ethiopian Birr/year. In the present study, hydatidosis is the main cause of economic loss in all organs annually. Variation in the amount of economic loss in different parts of the country abattoir is probably due to the differences in the prevalence of disease, rejection rates of organs, slaughtering capacity of the country abattoir, local market prices of the organs and management ways of the animal.

Conclusion

It was concluded that hydatidosis, lung marbling, emphysema, abscessation, cirrhosis, pericarditis, nephritis and calcification were the leading causes of organ condemnation in camels slaughtered in Jigjiga municipal abattoir, resulting in a significant economic loss in camel production. The differences in rejection rates of organs with different causes may be due to the differences in prevalence of the disease, variation in animal management systems, agro-ecological conditions and strategic control of internal parasites at different study sites. Hence, this study may be valuable to give regular current information on parasitic and pathological lesions. In addition, it helps estimate the economic loss of a country every year. Among all causes of organ condemnation, hydatidosis is most important disease warranting serious attention for prevention and control actions.

Therefore, following recommendations are forwarded:

-There should be strict or proper routine meat inspection of slaughtered camels so that infected organs are condemned accordingly and incinerated.

-Proper disposal of condemned organs is necessary in order to break the life cycle of disease conditions.

-Regular deworming of camels should be introduced, and research into alternative meat sources should be intensified.

Further studies should be carried out on camels slaughtered in different abattoirs in order to design appropriate control and prevention methods.

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