



Research Article

## Beef safety and hygiene in the process of slaughtering bovine animals in a public Abattoir: A cross sectional study

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### Abstract

Bovine meat is vital in the daily diet of populations in general and sub-Saharan Africa. However, the process of slaughtering cattle and the distribution route to the hands of consumers is still not respected. Thus, this study aimed to evaluate beef safety and hygiene from the slaughter process up to its marketing in the Lushois market. This was a cross-sectional descriptive observational study (April 1st to September 1st, 2020). The study population consisted of cattle slaughterers, herders, veterinary inspectors, meat drivers and beef sellers from the public slaughterhouse in Lubumbashi. Data was collected using observation, semi-structured interviews and documentary analysis. Three (3) health conditions were encountered in beef portions from the public Abattoir in Lubumbashi: distomatosis, nephritis and cysts in the liver. To counteract this in the event of these health conditions was the scraping and ablation; lack of database on health problems encountered at the public slaughterhouse; All the bovine animals, i.e. 100% (254) of the bovine animals sent to the public slaughterhouse had no indication or document on their state of health. No microbiological or physicochemical analysis was carried out at the public Abattoir of Lubumbashi for the health monitoring of beefs. Hygiene conditions in the slaughtering process did not meet the standards of good hygiene practices in the breeding, slaughtering-cutting and charcuterie industries. Measures must therefore be taken at several levels by the players in the sector (public authorities, veterinarians and breeders) to guarantee the safety of foodstuffs of animal origin.

**Keywords:** Health status, Slaughterhouse, Bovine meat, Market, Lubumbashi

### Introduction

Consumers want the food product to give them good sensations in terms of taste and to provide them with the necessary nutritional elements. Still, they ask, above all, that this product does not risk their health. These risks essentially consist of pathogenic micro-organisms, toxins and other contaminants. Consumers are, therefore, increasingly looking for food safety and the assurance of microbiological and toxicological quality. This safety is a significant concern of public health workers (Châtaigner & Stevens, 2003). Food

safety is an increasingly important public health concern (Bagré et al., 2015). Bovine meat represents an essential place in the daily diet of populations in the world in general and in sub-Saharan Africa in particular (Antri-Bouzar, 2017; Bagré et al., 2015; Steinfeld et al., 2006). The consumption of contaminated food poses a direct risk to public health (Halloum, 2017).

Beef is intensely consumed in Lubumbashi, as it is easy to obtain it even late at night in the markets known as "pirate", meaning free market and in many butchers and food shops in

the city's neighborhoods. This bovine species consumed in Tanzania; it is only slaughtered in the Lubumbashi public abattoir as the law requires. However, there is no control over the food consumed in the city or even at the points of border entry of animals intended for human consumption. The population's poverty is one disadvantage that pushes them to buy low-value pieces on the market (cuts and offal: legs, tail, throat, etc.).

## Material and Methods

### Study setting

The city of Lubumbashi, capital of the province of Haut-Katanga in the Democratic Republic of Congo. The city has an area of 747 km<sup>2</sup>, its density is 3730 inhabitants /km<sup>2</sup> and a population of 2,786,397 inhabitants (Mpala-Lutebele, 2013).

Lubumbashi is produced locally or imported from Zambia and Lubumbashi includes one public Abattoir, several private butchers and slaughterhouses. There are also numerous markets, with a public market for each municipality.

The main activities found in Lubumbashi are small trade (50%), mining (25%), urban agriculture (market gardening) (22%) and livestock (3%). Lubumbashi is a sizeable commercial centre where almost 50% of the population survives mainly in small businesses. A small population (3%) survives in animal husbandry; therefore, most of the beef consumed in Lubumbashi comes from outside the country although its number of 10,000 economically registered operators. These economic operators sell products imported from Europe, Asia, America and African countries (especially Zambia, South Africa and Tanzania) (Mpala-Lutebele, 2013).

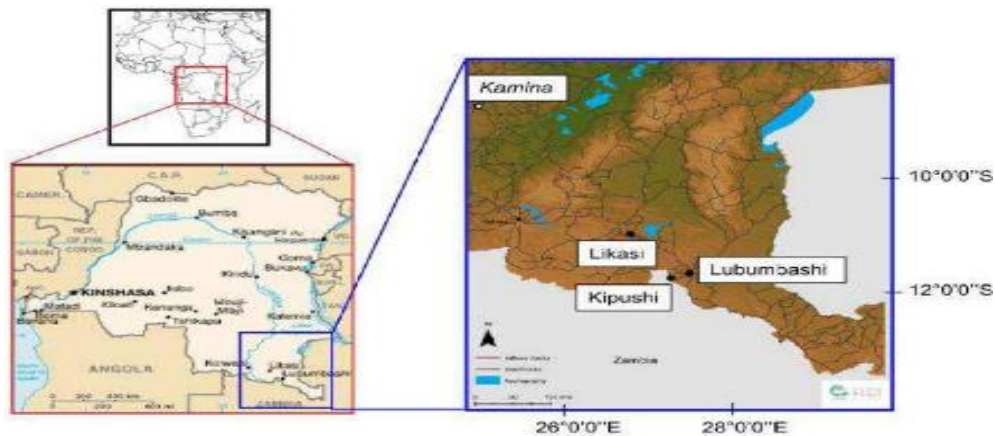


Fig 1. Map of the study setting

### Study design

This study used a cross-sectional descriptive observation approach, which allowed the description of the safety and hygiene process of slaughtering cattle at the public slaughterhouse in Lubumbashi over five months, from April to September 2020.

Materials used: For the realization of our work, we used an observation guide and a questionnaire.

### Data collection technique

Interviews, observation and documentary analysis were used as Data collection techniques.

### Study population

Our study population consisted of cattle slaughterers, veterinary inspectors, animal car drivers and beef sellers.

### Inclusion criteria

Any cattle sent to the Lubumbashi public abattoir for slaughter and the slaughter process were included in our study.

### Non-inclusion criteria

Our study did not include other animal species slaughtered at the Lubumbashi public abattoir

### Variables studied

Carrying out the antemortem and post-mortem examination, information on the state of health of bovine animals in the waiting area of the slaughterhouse, the existence of a database on information on slaughtered animals and health problems encountered, sample collection for laboratory

analysis, origin of the animal/meat and destination of the meat, action to be taken in the event of a health problem.

**Data analysis procedures**

We collected information from vendors, slaughterers, trekkers, meat drivers and veterinary inspectors from the public Abattoir of Lubumbashi. They included the following data: Origin of the bovine animal, destination of the meat, treatment received by the animal before being transported to the Lubumbashi public abattoir, and the number of days spent in the waiting area of the Lubumbashi public abattoir. This information was encoded using the Excel 365 spreadsheet and analyzed with Epi-info 7.2 and R version 4 software.

**Results**

This study focused on slaughtering cattle at the Lubumbashi public abattoir up to transportation to markets and supermarkets in Lubumbashi. Results are presented in different tables and figures according to different distributions.

**Table 1 Distribution of samples according to the origin of cattle**

Origin (city/country)	Effective	Percentage
L'shi Farms (Mashamba and Kafre)	108	42.5
Kamina (GRELKA)	2	0.8
Zambia	144	56.7
Total	254	100

This table reveals that more than half of cattle came from Zambia, i.e. 56.7%.

**Table 2 Distribution of bovine animals according to the number of days spent in the public Abattoir before their slaughter**

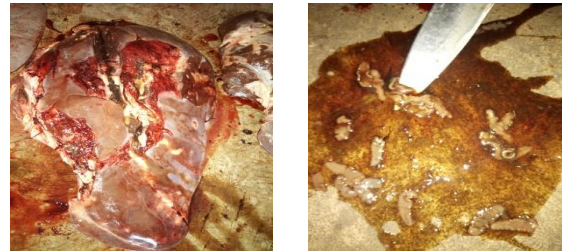
Number of days	Effective	Percentage	Average duration ± SD
1-7	244	96.1	2.4 ± 2.6
8-14	10	3.9	
Total	254	100	

The average stay of animals at the public Abattoir was 2.4 days with a standard deviation of ± 2.6.

**Table 3 Distribution of meat samples according to their destination**

Destination	Effective	Percentage
Markets, Foods and Butchers	194	76.4
Supermarkets	54	21.2
Households	6	2.4
Total	254	100

The majority of meat, 76.4%, was intended for sale in markets, grocery stores and butchers. However, 6 or 2.4% were intended for households.



**Fig 2 Case of distomatosis observed at the public slaughterhouse in Lubumbashi**



**Fig. 3 Post-mortem inspection and health stamping of beef at the public Abattoir in Lubumbashi**



**Fig. 4 Case of nephritis observed at the public Abattoir in Lubumbashi**

**Discussion**

This study focused on evaluating the safety and hygiene process of slaughtering bovine animals in the public Abattoir of Lubumbashi. The majority of cattle were imported from Zambia (144/254; 56.7%) and from farms in Lubumbashi (108/254; 42.5%) (Table 1) to the public Abattoir of Lubumbashi.

**Table 4. Bovine slaughter stages at the Lubumbashi public abattoir**

Activity/Task	The situation at the Lubumbashi public abattoir	Responsible/executor of the task
Unloading cattle at the slaughterhouse	Trucks and cattle trekking: depends on the financial means of the owner of the animals)	Cattle owners, Herdsmen and slaughterers
Cattle reception/control	Slaughterhouse Animal Park	Herdsman and slaughterers
Animal care and ante-mortem inspection	Not observed	-
Bringing animals to the slaughterhouse	Sometimes done using the electric stimulator and/or a whip	Slaughterhouses
Restraint/stun	To stun the animal, the knife is stabbed at the level of the occiput and the first cervical vertebra with the aim of touching the spinal cord.	Slaughterhouses
Lowering / lifting: the stunned and unconscious animal falls	Happens in the last box (stun box)	Slaughterhouses
Bleeding	Happens in the ground slaughter room	Slaughterhouses
Draft: the leather is separated from the carcass	Takes place on the ground	Slaughterhouses
Head removal	Takes place on the ground	Slaughterhouses
Split: the carcasses are then split in 2 for commercial constraints and to facilitate inspection	<ul style="list-style-type: none"> <li>- The carcass is hung on the hooks then divided into two then into 4 quarters using the machete.</li> <li>- Evisceration: the digestive system is transported to the dirty compartment of the slaughterhouse and the noble organs (lungs, liver, heart and kidneys are placed on the table of the veterinarian-inspector)</li> </ul>	Slaughterhouses
Blunting/trimming: removing surface fat for better carcass presentation	Done with knives	Slaughterhouses
Post-mortem inspection	<ul style="list-style-type: none"> <li>- Clinical examinations of the organs: lungs, liver, kidneys and heart and of the 4 quarters of the meat (appearance, search for visible abnormalities, etc.)</li> <li>- Remove the glands from 4 quarters of the meat</li> <li>- Stamp: pose of the health visa on the meat declared safe;</li> <li>- Scraping of cysts, flukes...</li> <li>- Seizure of the meat and/or organ declared unfit for human consumption.</li> </ul>	Veterinarian-Inspector and Hygienist
Weighing/grading/marketing	Weighing carried out in the event of sale and therefore requires the presence of the seller and the customer within the slaughterhouse	Slaughterers, animal owner and reseller (customer)
Carcass refrigeration	Not observed since the slaughterhouse does not have animals or a refrigerator	-

This table reveals that the situation observed within the public Abattoir is such that the animals that are transported are under the direct control of their owners and the slaughterers; the veterinary inspector only intervenes in the event of post-mortem inspection.

**Table 5 Health conditions encountered post-mortem at the Lubumbashi public abattoir**

Health condition	Procedure undertaken
Distomatosis (liver flukes)	Scraping of the part parasitized by flukes
Nephritis	Scraping of the inflamed part
Liver cysts	Cystectomy on the affected organ

Three health problems were encountered during our visit to the public slaughterhouse in Lubumbashi, these are distomatosis, cyst in the liver and cases of nephritis, the action to be taken consisted only of scraping the parts affected by the health problem; all this for a commercial purpose in favor of the owners of the meat.

Veterinary inspection in Abattoirs can significantly reduce potential threats to human health. As echoed in our study results, animal owners are there when animals are slaughtered, which means they have a word to say whenever there is a problem with the animal. Animal slaughterers are there to please them, sometimes in the absence of veterinary inspectors. During the period of this study, all the animals that arrived at the Abattoir were under the direct control of their owners and the slaughterers, while the veterinary inspector only intervened at the post-mortem inspection (Table 4, Figure 2, Figure 3 and Figure 4). Inadequate structures and poor hygiene in the Abattoir were also observed during our study, this can lead to meat contamination and occupational hazards for workers. European Council Regulation (EC) No 1099/2009 on the protection of animals during slaughter provides the seizure of an animal that would present a health risk to consumers (Basulira et al., 2019). This is done for protection of consumers and not for pleasing animals owners. A study revealed a high prevalence of brucellosis, toxoplasmosis and leptospirosis, as zoonotic diseases during the slaughter of animals at a public Abattoir, which constituted a public health consequence for Abattoir workers and consumers (Swai & Schoonman, 2012); Post-mortem inspection is the basis for planning preventive measures against risks to consumers and ensuring the safety of meat to limit economic losses. A 2018 report indicated that out of 436,646 slaughtered animals, a total of 61,799 were seized because, among the diagnostic results, zoonotic diseases were observed, including distomatosis (Ceccarelli et al., 2018). In addition, a 2017 African Union report on animal health and production in Africa reportedly seized 773 animal carcasses during post-mortem inspection due to two main pathologies, namely tuberculosis and distomatosis (Perovic et al., 2018). Serious veterinary inspections and control strategies can be developed to safeguard consumers from exposure to zoonotic diseases that can spread through the environment.

Non-compliance with Abattoir laws by Abattoir workers is a significant deficit, and this gap can be addressed through public awareness and some relevant seminars or workshops. The results of our study revealed good information on the number of days the animals spent at the Abattoir. The management of an Abattoir and/or the regulation law on Abattoirs recommends that the workers also have information

on the number of days that the animals spend in the waiting area; For example, the number of days that animals spend at the Abattoir before slaughter (Table 2), and most of the animals (244/254; 96.1%) were at the abattoir for a stay of at least one week (7 days) before their slaughter, and the average stay in the abattoir waiting area was  $2.4 \pm 2.6$  (Table 2). The slaughter of animals requires respect and observance of the international slaughterhouse regulations as published by European Council Regulation (EC) No 1099/2009, which states: "A person in an abattoir shall comply with all respects under the terms of any direction given under this regulation by the meat inspector or the veterinary meat inspector", and this regulation added that: "An animal must be inspected on the day of its arrival at the abattoir, and the inspection must be repeated on the day of slaughter if the animal has been in the stable for more than 24 hours. No animal can be slaughtered if it has not been rested overnight in the stable abattoir" (Paolucci et al., 2015). On the contrary, abattoir workers in Malaysia showed a low level of knowledge of the rules governing the operation of a abattoir (64/165, 38.8%) (Abdullahi et al., 2016). This may be due to the lack of motivation of abattoir workers regarding existing international and governmental regulations on the operation of the abattoir.



**Fig 5 Scraping of the parasitized liver through flukes at the public Abattoir in Lubumbashi**

The resting time granted to the animal at the abattoir before slaughter is part of animal rights. Transport can induce fatigue in animals, especially if the transport has not been good, it allows animals to rest. Animals are allowed to rest for ethical reasons, and also because they are exposed to a new or unfamiliar environments, food and water deprivation and changing climatic conditions. These challenges can significantly alter animal physiology and adversely affect meat quality (Ferguson & Warner, 2008). The situation observed at the public abattoir of Lubumbashi was that the number of days spent at the abattoir depended on demand from beef sellers and/or beef buyers.

Lack of information on hygiene practices for livestock, lack of information on whether there has been the use of antibiotics on livestock, and lack of formal transport of animals from the country of origin to importing country may increase the exposure of meat or livestock tissues to pathogens (zoonotic diseases) and antimicrobial resistance.



**Fig 6. Beef transport conditions at the public Abattoir in Lubumbashi**

This study reveals three significant cases of health conditions, distomatosis, cyst and nephritis as threats to the health of the bovine species (Table 5, Figure 2, Figure 4 and Figure 5) whose parts infected or affected by the health problem have been beatings; all this for a commercial purpose in favour of the sellers. Fluke and nephritis have reached a critical stage since their occurrence in humans, and the high and severe pathogenicity of these infections in humans frequently lead to death (Ashrafi et al., 2015). The lack of intense surveillance and inspection control during the animal slaughter process can facilitate the spread of zoonoses from animals to humans. Many zoonotic diseases were reported in an abattoir in Italy, including fluke and nephritis (Vecerek et al., 2003). Along the same line, Giaccone et al., also reported distomatosis as the main reason for the condemnation and seizure of all meat from infected cattle after inspection (Giaccone et al., 1994).

## Conclusion

The safety and hygiene in the slaughtering process did not meet the standards of good hygiene practices in the breeding, slaughtering-cutting and charcuterie industries. Carcass transport conditions were not complied with in the majority of cases, and behavior regarding of specific health conditions encountered post-mortem was not to be encouraged (scraping in the event of distomatosis). In addition, certain zoonoses have been detected after the slaughter of animals, such as distomatosis, nephritis and cysts in the liver. Diseases seen in livestock pose a public health threat to animals, humans and the environment. However, there is no database on diseases and/or health problems encountered at the public abattoir of Lubumbashi.

The results show that the quality of beef is not good. Nevertheless, these results must lead us to the introduction and improvement of the available techniques and to develop the control methods necessary to reducing the risk of consuming the meat of less good quality based on a hygienic perspective. Hygiene conditions in the beef sector at the public abattoir in Lubumbashi are also a concern, from unloading animals to transporting carcasses to places of sale and households.

The Democratic Republic of the Congo lags in terms of control regulations for foodstuffs of animal origin and does not have accurate monitoring plans in the animal sector from

breeding to slaughter and use. Thus, we suggest the creation of scientifically exploitable databases by the public authorities to develop regulations and decision-making aimed at protecting the health of beef consumers. After this light on the safety and hygiene, this study could extend to other private slaughterhouses in other cities of the province of Haut-Katanga and assess the microbiological quality of the beef consumed by the population.

## Conflict of Interest

The author hereby declares no conflict of interest.

## Ethical considerations

The Faculty of Veterinary Medicine, the Director of the Lubumbashi public abattoir and the beef vendors granted us the authorization for data collection. Volunteering and anonymity were respected among veterinary inspectors, sellers, slaughterers and trekkers.

## Acknowledgements

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## Consent for publication

The author declares that the work has consent for publication.

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