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Research Article

MICROBIOLOGICAL ASSESSMENT OF RAW BEEF SOLD IN MAKESHIFT BUTCHER'S SHOPS IN LOME

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ABSTRACT

For several years, the slaughterhouse in Lome has become dilapidated and very unsanitary. The carcasses that come out of this slaughterhouse are only subjected to superficial visual inspection. In addition, the places where raw beef is sold are set up in an anarchic makeshift, butcher shops established along the streets, exposing meat to multiple sources of contamination. This study was conducted to assess the bacteriological quality of fresh raw beef sold in Lome. A total of sixty (60) fresh raw beef samples were randomly collected from 20 shops in 13 areas in two communes in Lome. The samples were analysed using the AFNOR routine method. Based on microbiological criteria, only two samples met the required standard for *E. coli* and 34 for Salmonella. All samples failed to meet the required standard for *S. aureus* and sulfite-reducing anaerobes. The transport and sale of meat carcasses take place under inadequate hygiene conditions. Wooden tables and cutting boards, the presence of flies, and dust accumulation on the meat are significant risk factors for contamination at the point of sale. The presence of these pathogenic and opportunistic microorganisms (*E. coli, Staphylococcus aureus*, sulfite-reducing anaerobes, and salmonella) in raw beef indicates poor hygienic practices during slaughtering, transport, handling, and marketing. These findings highlight a significant public health risk associated with the consumption of unregulated street-vended meat and underscore the urgent need to improve hygiene and food safety standards in the red meat sector in Lome.

Keywords: Raw meat, Public health hazard, Food safety, Intoxication, Lome.

INTRODUCTION

All foods degrade at a time longer or shorter from date of manufacture or preparation, losing their initial characteristics, thus becoming unfit for consumption and even dangerous for human health and life. Food spoilage is a natural process; through this process, food gradually loses its color, texture, flavor, nutritional qualities, and edibility (Steele, 2004). Considering the shelf-life food items can be classified as perishable, semi-perishable, and non-perishable (Doyle, 2009). Perishable foods have shelf life ranging from several days to about three weeks. Milk and dairy products, meats, poultry, eggs and seafood are the examples of perishable food items. If special preservation techniques are not apprehended, food items could be spoiled straight away (Doyle, 2009). Many factors are involved in food spoilage. Extrinsic factors (in the food's external environment) which affect both the microorganisms and the food itself during processing and storage. Extrinsic factors include temperature, humidity and oxygen (Doyle, 2007). Intrinsic factors exist as part of the food product itself. For example, meat has certain characteristics that may promote the growth of certain microorganisms. The pH, water activity (aw), nutrient content and structure of food items affect the growth and multiplication of microorganisms in foods (Gonzales-Barrona *et al*, 2021; Rawat, 2015). The main sources of microbiological contamination are environmental factors (soil, water, air etc.) vegetables, animals, insects, rodents. Besides these sources, food may be contaminated during processing, handling, storage, transport and marketing Fresh meat is Fresh meat is highly perishable, owing to its physical and chemical properties. Attributes such as high-water holding capacity and abundance of nitrogenous compounds, lipids, carbohydrates, and vitamins make meat

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a favorable environment for microbial growth (Odeyemi *et al*, 2020; Cobos and Díaz, 2021).

Due to its composition, beef is one of the most perishable food and an ideal substratum for the growth of a wide range of spoilage bacteria (Mayr *et al*., 2003; Williams, 2007; Komba *et al*, 2012) and also pathogens agents (Jahan *et al*.,2015; Yafetto *et al*. 2019). Therefore, on bad conditions, beef can be contaminated and become a poison for consumers. Food poisoning is caused by food or drink contaminated with pathogenic microorganisms such as bacteria, viruses or parasites. Contaminated food products have been reported to be responsible for numerous foodborne diseases all around the world. In tropical countries, due to high temperatures, such microorganisms multiply very rapidly in perishable foods. The increased risk of contamination is mainly caused by improper hygiene conditions, cooking, improper food storage and preservation. (Davis, 2018). In Africa, the demand for meat is increasing and meat consumption may be a status symbol, especially in low-income countries (Zerabruk *et al*., 2019). In Togo, as in most developing countries, collective food poisoning is largely underestimated because there is no mechanism to collect epidemiological information on these cases (Wola, 2014, Soncy, 2019). The conditions under which animals are slaughtered, the conditions under which meat is processed, the behaviour of butchers and the sanitation of the premises suggest that hygiene is the least important consideration in this place, which in principle should meet the highest standards to ensure the consumers' good health (Miabe Togo Actu, 2019). Some butchers transport carcasses unprotected or poorly protected on motorcycles. In 2022, researchers from the Higher School of Agronomy of the University of Lome (ESA-UL) showed that meat preparation and sales areas are located on the roads side or near gutters. This study revealed that of the 72 restaurants owners surveyed, 64.78% didn't cover their meat, while 30.43% didn't sell in glass cases (BARANADAO Konaka, 2023). To better understand the meat industry in Lome, we assessed the microbiological quality of meat sold in a few makeshift butcher shops in Golfe 1 and 2 communes of Lome.

MATERIAL AND METHODS

Study area

This study was carried out in Lome, the capital of Togo. The city is located at the extreme south-west of Togo and extends along the seacoast from the Gulf of Guinea. Lome has an area of 333 km2. The average temperature in Lome is between 23°C and 29°C and the relative humidity is 74%. The urban population counted in 2010 mounts to 2.183.376 inhabitants, while the city counts 1.305.682 inhabitants (RGPH-5, 2022). The active part represents nearly 80% (Lambony and Nyassogbo, 2008). In Lome, foods are often sold in organized outdoor markets or not (Soncy *et al* 2019). Like other commodities, meat products are sold in designated areas in the markets and also in lawless butcher installed in street corners, often in very unsanitary conditions.

Collection of biological samples

The study was carried out from July 2022 to April 2023 and consisted of assessing the bacteriological quality of raw beef sold in some markets and makeshift butcher shops in Lome. Samples were therefore collected anonymously in plastic bags from these sales outlets and were immediately transferred to the laboratory for bacteriological quality assessment. Sixty samples of raw beef were collected successively in triplicate within a week of each other from twenty butchers located in the streets and in some markets of Lome (Table1). On each occasion, approximately 250g of raw beef was purchased and transported immediately to the laboratory. At the same time, an inspection was carried out on the conditions of meat handling, the state of hygiene of the premises and equipment coming into contact with the carcasses. The meat samples were analysed at the "Laboratoire de Microbiologie et de Contrôle Qualité des denrées alimentaires" (LAMICODA) at University of Lome (Togo).

Sample analysis

From each raw beef sample, 25 g was aseptically weighed in 225 ml of buffered peptone water (BPW) and blended in stomacher (Jumbo Mix) to prepare initial suspensions. After a revival time of around 45 minutes, the initial suspensions and their dilutions (10^{-1} to 10^{-5}) were added to the various culture media for germ testing. Sterile Tryptone Salt (TS) medium was use as diluent.

Microbiological analysis

The microbial analysis concerns the following germs and methods: *Escherichia coli* (Brillance™ Ecoli), Anaerobic sulfite-reducing bacteria (XP V08-061), *Staphylococcus aureus* (NF V08057-1) and *Salmonella spp* (NF V08-052). All media used were purchased from OXOID (England). Microbial enumeration was performed as follows: 1 ml from initial suspensions or serial decimal dilutions was used to inoculate Petri dishes incubated in appropriate conditions. Results were expressed as colony forming units (CFU/ml). The specifics colony isolated were identified by remel RapID™ ONE System 20 for salmonella research. Criteria of General Direction for Food (DGAL/SDHA/N2000-8155) of France according to piece of butcher's meat set limits that must not be exceeded: Coliforms for 3.10^4 CFU/g, *S. aureus* for 100 CFU/g, Anaerobic sulfite-reducing for 10 CFU/g and that *Salmonella* are not found in raw meat samples.

Statistical analysis of data

The experimental data were analyzed using Analysis of Variance (ANOVA) to determine significant difference between the data of the samples analyzed. t-test was used to see whether compared to the results. The level of significance was set at $p \leq 0.05$. The data were analyzed using SYSTAT11.

Pictures1a and b: Beef observed at the butcher's.

Pictures 2c et d : Beef observed during transport.

RESULTS AND DISCUSSION

Clearly, consumer demand for meats continues to increase. This explains the anarchic installation of sales outlets for these products in Lome. Sale points are all located in the street under a tree or under a shed. The butcher's tables as well as the cutting boards are made of wood. They have many scratches containing meat debris. These scratches are potential sources of contamination for meat. Numerous flies were noticed on the meat carcass displayed on the tables. They are occasionally swatted away with makeshift fly swatters when a customer approached. In some places, the walls against which the makeshift butcher's shops are built are lined with debris of meat dating from their installation's period (Picture 1). The pieces of meat cut with knives almost never washed are served to the customers in roughly cleaned cement paper or in the plastic bags widely used in Lome. In Hawassa City Butcher Shops in Ethiopia, 83% of the meat was exposed to flies without protection, and 64% of meat handling equipment was not disinfected (Kenaw *et al*. 2024). A study conducted in 2024 by Yimana and Hassen in Ethiopia, in all butcher inspected shops, meat was displayed at room temperature without a cover. 29.2% of the butcher shops' walls had signs of dirt. Plastic, wood and marble cutting boards were used by 43.2%, 29.7%, and 27.1% of the butcher shops respectively. None of the butcher shop workers who took part in this survey wore gloves, and more than half of the respondents (58.3%) did not wear white coats and head covers (Yimana and Hassen; 2024). At all the collection points in Lome, the butchers were not wearing head covers or gloves. The aprons observed at some butcher shops were very dirty. According to Wela (2006), the slaughterhouse system in our municipality has been malfunctioning for several years. Furthermore, professionals in the field use unconventional means to transport carcasses. Thus, one can see people transporting carcasses on motorcycles or in taxis in Lome (Picture 2). This situation was still highlighted in a VSF-Suisse report more than fifteen years later and persists to this day (Dzakpata, 2022). These means of transport undoubtedly pose a major risk of carcass contamination.

The level of microbial contamination in the meat samples analyzed is highly varied. The extreme values observed for *E. coli*, *S. aureus* and *Clostridium perfringens* are respectively 280 at $1.3x10^6$, 250 at $8.9x10^5$ and 40 at $1.4x10^5$. In relation to microbiological criteria, more than 68.33% of the samples are unsatisfactory regarding *E. coli*; 71.66% are unsatisfactory about *S. aureus*. 56.6% are contaminated with Salmonella. Salmonella was found in at least one sample at all sampling points and in at least 2 sample at 13 sampling points. The same germs were found in raw meat sold in the markets of Dharan in Nepal (Bantawa *et al.* 2018). In this town, coliforms were found in 84% samples, *S. aureus* was found in 68% samples, *Salmonella* in 35% samples. Their presence in meat samples creates a hazard to consumers of contracting foodborne illness when they consume it. This were showing poor handling practices during the preparation of meat. In Ouagadougou, poor hygiene practices by food handlers along the food chain observed in three cafeterias at the national university in Ouagadougou justified the presence of salmonella, coliform and staphylococcal bacteria in raw meat. Over-all, 6.6% for salmonella of the raw meat samples were unsatisfactory (Ilboudo *et al.,* 2009). Statistical analysis of the results yields p-values > 0.05. Therefore, there is no correlation between the different results. The varying sales environment, mode of transport and hygiene practices from one site to another do not result in a consistent level of contamination, even though all the germs sought were present in all samples.

Table 1. Samples numbers and locations.

	Location	Butchers number	Samples number
Markets butcher's shops	Bè	2	6
	Amoutivé	2	6
	Hedzranawoé	3	9
	N'kafu	2	6
	Bassadji	1	3
	Adewui	1	3
	Soted	2	6
	Djidjolé	1	3
	Rail N'kafu	1	3
Street butcher's shops	Gakpoto	1	3
	Ahligo	1	3
	Gbonvié	2	6
	Hôtel Excellence	1	3
Total =		**20**	**60**

Anaerobic sulfite-reducing bacteria was found in all of samples. Meat and meat products have long been regarded as causative agents because, anaerobic sulfite-reducing and *C. perfringens* was ubiquitous in animal intestinal tracts and can be detected at high rates therein (Grass *et al*. 2013). In the event of improper handling, these bacteria can end up in the meat and meat products. (Ghoneim and Hamza, 2017; El Bayomi *et al.,* 2020). There is a relation between meat contamination and poor personal hygiene. Therefore, improper handling, poor personal hygiene and food storage in addition to poor knowledge of food handlers about the public health significance of foodborne pathogens are the main risk factors of meat contamination (Derbew *et al*, 2013; El Bayomi *et al*, 2020).

Table 2. Statistical analysis of data.

Type of germs		*E. coli*	*S. aureus*	Anaerobic sulfite-reducing
Number of germs	Min value	280	250	40
	Max value	1300000	890000	14000
Means (n=60)		102685.5	76135	20858.25
P value (p<0.05)		0.184	0.393	0.793
F. ratio		1.395	1.093	0.702

- ***Salmonella spp*** was detected in 34 (56,6 %) samples

According to microbiological criteria, none of the meat samples met the required standards. Thus, all meat samples in this study are of unsatisfactory quality and show a high level of contamination. This highlights the seriousness of the situation faced by customers of this makeshift butcher shops in the municipality. A similar study conducted on raw meat in butcher shops and retail outlets in the Northern Governorate of Lebanon revealed the presence of Salmonella spp. in 63.8% of the 55 samples analysed (Serhan *et al*, 2024). To prevent microbial contamination and the subsequent risk of foodborne infections, meat and meat products must be properly handled, processed, packaged, stored, and distributed under hygienic and temperature-controlled conditions (Heetun *et al*., 2015). In addition, rigorous veterinary control must certify the animals before slaughter (Wela, 2014) along with appropriate hygiene practices, to guarantee the quality of the meat to consumers.

CONCLUSION

In Lome, the meat supply chain for the population suffers from several problems. Poor slaughtering conditions, inadequate means of transport to get the meat to the sale points, and the conditions under which meat is sold in makeshift butcher shops could be responsible for the poor quality of the samples analyzed. The significant number of contaminants such as *E. coli*, *S. aureus* and *Salmonella* found at all sampling sites is indicative of this. It is especially important to provide training to meat handlers regarding food safety and also to improve the infrastructure for slaughtering, storing and transporting fresh meat to guarantee the safety of meat for consumers.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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