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(RESEARCH ARTICLE)

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Practices and transmission of zoonotic diseases in slaughterhouses and meat product trade in the south of the Democratic Republic of Congo: A state of play

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Abstract

Meat consumption is increasing worldwide to meet protein needs, which also raises concerns and challenges regarding the hygienic quality of meat from its production to its consumption. This study proposes to investigate the practices and working conditions in slaughterhouses in southern DR Congo in order to assess the risk of transmission of zoonotic diseases.

To do this a descriptive study was conducted and during the study period, a total of 29 slaughterhouses were inspected. The results revealed poor hygiene practices in the vicinity of the slaughterhouse, the slaughtering area, the staff as well as the meat vendors through long-term contact with meat, whole carcasses, lungs, livers, hearts and offal which have zoonotic implications in cattle at slaughter, intended for human consumption, and thus constitute significant economic and public health risks. It is therefore necessary to introduce appropriate hygiene measures in slaughterhouses to minimize.

Keywords: Slaughterhouses; Transmission; Zoonosis; DR Congo

1. Introduction

In the livestock sector, different types of livestock are capable of carrying a wide range of zoonotic pathogens [1]. Zoonoses can be transmitted to humans through several routes, including: direct contact with infected animals, through handling of aborted animals, slaughtering and through consumption of various products including milk, blood and raw meat; and indirectly from infected livestock [2]. Zoonotic pathogens are normally present in slaughtered animals, raw hides, blood, meat and agricultural environments, but are often difficult to diagnose. [3]. Indeed, contact with infected livestock poses an occupational risk to workers, and among the many microbes that interact with animals, some of these pathogens can become zoonotic and cause disease in humans, posing a threat to public health [4]. Because human infection by pathogens in slaughterhouses can then lead to local outbreaks among workers and spread throughout a community [5].

This transmission is the result of insufficient veterinary infrastructure, poor hygiene, inadequate meat inspection, shortage of protective clothing [6], lack of knowledge about working practices and insufficient staff numbers reduce work efficiency and increase the risk of infection of slaughterhouse workers. [7]

Given that most slaughterhouses are not properly regulated and the level of contact with different slaughter products is higher, it can be argued that the risk of meat-borne zoonoses is even higher in this type of facility [8]. There is a need for livestock owners, traders, butchers and policy makers to be informed about the risks posed by meat-borne zoonoses

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through slaughterhouses and commercial displays [9]. The information provided should also explain how zoonoses are transmitted to enable those at risk to make informed decisions about how best to protect themselves [10].

This study was conducted with the aim of generating epidemiological data in order to better understand the implications of practices in slaughterhouses in the transmission of zoonoses in the South of the Democratic Republic of Congo.

2. Methods

2.1. Study site

The study was conducted in southern Democratic Republic of Congo Kenya, on the border with Zambia which is the gateway for cattle from East and Southern Africa.

2.2. Study population and recruitment

A census of slaughterhouses was carried out from May to July 2024. The location of slaughterhouses in the study area was obtained from the former Data collection was carried out between August and September 2024.

2.3. Data collection

All the slaughterhouses in the study area were visited on a single day for data collection. The slaughterhouses were visited by students who evaluated each structure by direct observation and by a questionnaire administered to workers and traders of slaughterhouse products.

On the day of data collection, informed consent was obtained from all participants individually. The investigator described the objectives of the study and the questionnaire. Participants had to voluntarily agree to participate in this study. The inclusion criterion specified all workers, aged over 18 years and present at the slaughterhouse on the day of the visit.

Google form was used to obtain data on slaughterhouses and workers.

Data analysis was performed using SPSS software.

3. Results and discussion

After analysis, the results are presented in the form of tables and graphs.

Table 1 Sectors of activity according to length of experience

Work sector	0-5	6-10	11-15	16-20	≥ 20	Total
Slaughterhouse worker	12	29	10	8	6	65
Butcher	2	9	6	1	0	18
Breeder	3	6	4	2	4	19
Meat seller	37	22	12	6	7	71
Total	54	66	32	17	17	174

In the slaughterhouses, we encountered a strong presence of meat sellers and slaughterhouse workers, this fairly significant presence of meat sellers suggests that just after slaughtering, the parts of the animal are bought by sellers who in turn will directly make them available on the market and yet, The susceptibility of meat and meat products (MP) due to their nutritional composition also makes them susceptible to deterioration [11,12] by auto-oxidation and microbial spoilage poses a risk to the nutritional quality, safety and shelf life of the product [13,14]. Traditionally, meat processing is a means of extending shelf life (preservation) and producing a convenient product for later use and elsewhere. Processing aims to reduce the enzymatic activity of the meat, delay fat oxidation and prevent spoilage by microorganisms [15].

Table 2 Area of activity and regular contact with parts of the animal

Work sector	Slaughterhouse worker	Butcher	Breeder	Meat seller
Animal	65	15	19	11
Meat	59	18	19	71
Intestine	60	18	13	71
Tripe	55	17	12	68
Liver	62	18	9	70
Lung	63	16	9	71
Carcass	64	18	10	79

From this table, it follows that all personnel are in contact with the different parts of the animal including meat, intestines, tripe; liver, lung and carcass. Which are potential sources of contamination. Human infection by pathogens in slaughterhouses can then lead to local epidemics among workers who are in contact with blood, placenta, fetuses and uterine secretions [16] and spread throughout a community either by ingestion or by direct or indirect contact [17]. Animal carcasses remain outside after slaughter and are scavenged by wild animal communities could potentially become a source of infection to humans [18]

Table 3 Rep

	Slaughterhouse worker	Butcher	Breeder	Meat seller	Total
1-8 hours	23	8	6	57	94
≥ 8 hours	42	10	13	14	79
Total	65	18	19	71	174

Human contact and offal was between one hour and eight hours for 54.02% of cases and greater than eight hours for 45.98% of cases. Indeed, the increase in zoonotic diseases in humans is spread by close contact with other vertebrate animals through inhalation, ingestion , via the conjunctiva, aerosols contaminated with microorganisms from respiratory sources , or by fluids [19] In her study Nathalie van Vliet and her collaborators on understanding the factors influencing exposure to zoonotic and foodborne diseases in wild meat trade chains , states that the frequency of contact with wild meat and bodily fluids was highest among hunters and traders throughout the butchering process [20], a situation also observed in the slaughterhouses of the city in the south of the DR Congo because the staff handle the animals without any specific personal protective equipment. (Photo 1)

Various techniques are used to dispose of slaughterhouse waste: collection in bins, followed for some by collection and disposal by landfill or incineration. However, the management of liquid waste is poor and there is runoff of liquids (blood and serosity) from the slaughterhouse to outside the site (Photo 1). Environmental contamination is an additional risk since wastewater and effluent from slaughterhouses can contain animal products, pathogens (including antimicrobial-resistant microbes), parasites and residues; runoff from slaughterhouses can cause harmful algal blooms [21] and lead to the formation of antimicrobial-resistant bacteria [22] if animal remains are not disposed of properly [23]. Additionally, some surface waters such as streams and wells near slaughterhouses are heavily contaminated with microbes and chemicals and become unfit for human consumption [24].

Figure 1 Flow of effluents during felling

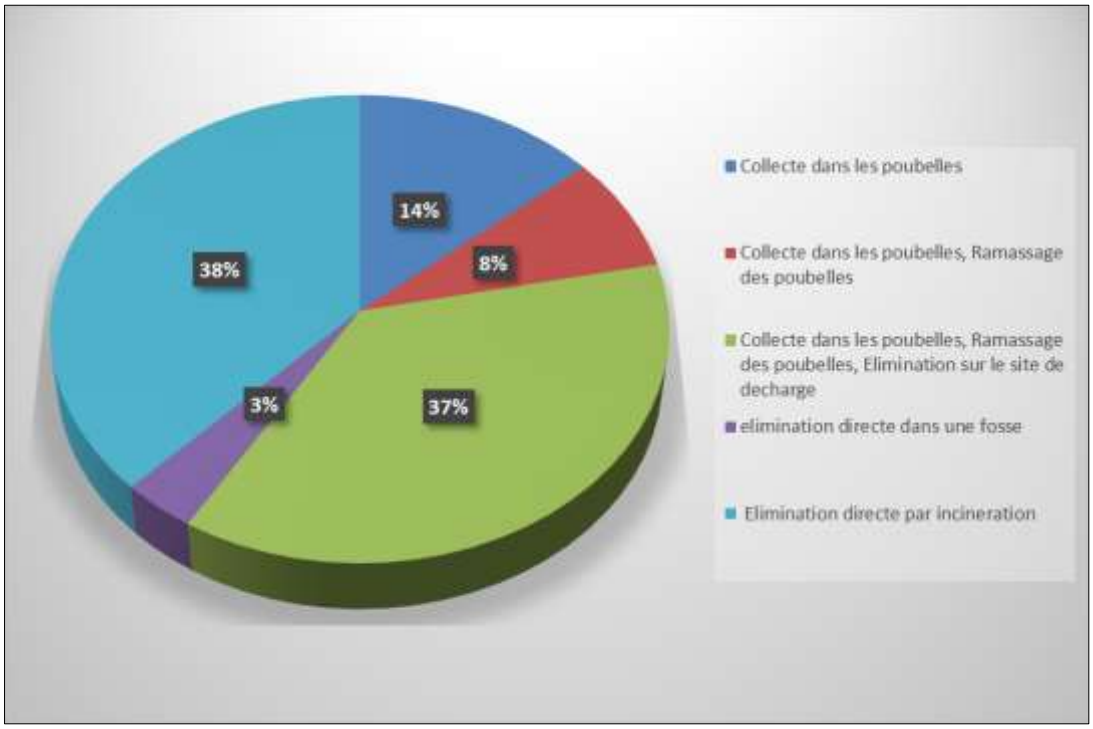

Figure 2 Slaughterhouse waste management

Figure 3 Handling animals without PPE

Table 4 Distribution of disinfectants in meat sales areas

	70% alcohol	**2% bleach**	**1% bleach**	**Vinegar**	**Souma mousse**	**JiK**	**water**	**Liquid Omo**	**Hydroalcoholic gel**
balance	135	68	46	50	57	12	134	81	43
showcase	87	76	53	24	104	19	96	99	52
work plan	60	67	64	28	133	22	123	61	42
fridge	75	54	53	36	63	21	144	81	54
knife	94	50	46	46	27	11	198	102	29

It is clear from this table that water is used more for cleaning work surfaces and sometimes mixed with liquid OMO soap or 2% or 1% bleach or vinegar or even Soumamousse (a local disinfectant without a defined composition) and 70% alcohol is a recourse in case of difficulty in water supply. Indeed, the transmission of pathogens between different species, the crossing of interspecific barriers, is an ecological phenomenon known as "host jump", "interspecies transmission", "zoonotic transfer", "pathogen spillover" or "zoonotic spillover" [25]. It is a complex and multifactorial phenomenon, involving aspects associated with hosts, microorganisms and the environment [26]. Among these aspects, figure, the frequency of human contact with animals as well as the dose and route of exposure to pathogens will modulate the risk of spillover. [27], This situation is further encouraged by livestock farming, which plays a major role

in the emergence and spread of zoonotic pathogens [28] from animals intensively exposed to antimicrobials, either to prevent their contamination due to the immunosuppression that transhumance or long journeys to slaughter sites could induce [29]. This use of antimicrobials is believed to be the basis for the weakening of the immune system of farm animals, which can lead to a vicious circle [30] and facilitate the emergence of pathogenic strains resistant to antimicrobials [31]. Because a significant proportion of antimicrobials end up in the environment, either directly or via the water network, which further increases the risk of developing resistant strains in wildlife and humans [32].

4. Conclusion

Meat-borne infections are a definite reality and pose a significant threat to public health in both developed and developing countries due to the facts and realities observed in the livestock farming and slaughtering process that favor the colonization and transmission of pathogens from animals to humans and vice versa. To prevent this, appropriate hygiene standards and strict precautions in production, processing and handling must be observed to limit the risk of transmission of pathogens from animals to humans through meat.

Also for animal diseases and given that AMR is increasing, it is important to use antibiotics responsibly in animal production and treatment. Vaccination of slaughterhouse personnel, implementation of the Codex Alimentarius Commission and the “One Health” approach endorsed by WHO, FAO and OIE are solutions to reduce foodborne diseases and the prevalence of pathogens and this through substantial political commitment.

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