

Health profile of frozen chickens sold on Kinshasa markets

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Abstract

To cover meat needs, the population of Kinshasa can buy frozen chicken meat either in open markets or in frozen meat retail outlets. The microbiological quality of this chicken meat is not well certified before consumption. The objective of this study was to determine the microbiological quality of frozen chicken meat sold in the municipal markets of Kinshasa. A descriptive study was conducted between May 15 and June 16, 2023 among frozen chicken sellers in three markets in Kinshasa. Sixty samples of frozen chicken were purchased randomly from different outlets in the targeted markets and analyzed at the veterinary laboratory using standard microbiological methods. Of the sixty samples of frozen chicken meat taken in the three markets, total germs (93%), fecal coliforms (60%), fecal streptococci (46.6%), *Staphylococcus aureus* (20%) and yeasts (6.7%) were present in half of the frozen chicken meat samples with proportions varying depending on the market. In light of these results, we can conclude that frozen chicken meat, sold in the Kinshasa markets, does not offer a sufficient guarantee of safety, particularly with contamination as significant as that found in this study.

Keywords: Hygiene, Slaughterhouse, Bacteriological Analysis, Chicken Carcasses

Résumé

Pour couvrir les besoins en viande, la population de Kinshasa peut acheter la viande de poulet congelée soit sur les marchés ouverts, soit dans les maisons de vente en détail de viande surgelée. La qualité microbiologique de cette viande de poulet n'est pas bien certifiée avant sa consommation. L'objectif de cette étude était de déterminer la qualité microbiologique de la viande congelée de poulet commercialisée dans les marchés communaux de Kinshasa.

Une étude descriptive a été menée entre le 15 mai et 16 juin 2023 auprès des vendeurs de poulets congelés de trois marchés de Kinshasa. Soixante échantillons de poulet congelé ont été achetés au hasard auprès de différents points de vente des marchés ciblés et analysés au laboratoire vétérinaire à l'aide de méthodes microbiologiques standards.

Sur les soixante échantillons de viande congelée de poulet prélevés dans les trois marchés, les germes totaux (93%), les coliformes fécaux (60%), les streptocoques fécaux (46,6%), *Staphylococcus aureus* (20%) et les levures (6,7%) ont été présents dans la moitié des échantillons de viandes congelées de poulet avec des proportions variant selon les marchés. A la lumière de ces résultats, nous pouvons nous permettre de conclure que la viande congelée du poulet, commercialisée dans les marchés de Kinshasa, n'offre pas une garantie suffisante de salubrité notamment avec une contamination aussi importante que celle trouvée dans cette étude.

Mots clés : Hygiène, abattoir, analyse bactériologique, carcasses de poulet

Introduction

Under the combined effect of urbanisation, income growth and new socio-cultural expectations, developing countries are witnessing the emergence of a growing demand for animal products, concentrated mainly in cities.

This is characterised both by an increase in the quantities marketed and by new demands from buyers in terms of quality [1].

Analysis of eating habits in the towns and cities of developing countries has shown that consumption is changing, with a diversification of products. Meat, milk and fish are particularly affected by these changes, because of their nutritional status [2]. The richness of

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these animal products in water and proteins of high biological value makes them essential for a balanced diet. However, these same reasons make them a favourable environment for microbial proliferation when hygiene conditions remain precarious, particularly in markets.

In the towns and cities of sub-Saharan Africa, poultry meat consumption continues to grow because, unlike pork (19 and 9), it is not subject to religious or cultural restrictions [3]. Chicken meat has a low proportion of saturated fat, and is considered to be a readily available source of high-quality protein and other nutrients needed for the body to function properly [4]. What's more, the relatively low retail prices of chicken meat compared with other types of meat argue in favour of increased consumption.

While in Europe it is mainly the breast meat (breast meat from poultry production) that is consumed, the remaining parts (cuts), such as chicken thighs and wings, are exported in large quantities to various countries on the African continent (12 and 2) [5]. Similarly, laying hens, whose laying capacity diminishes sharply after about two years and whose meat is considered too tough to be eaten by Europeans, are exported in large quantities in the form of whole chickens to Africa (27) [6].

The Democratic Republic of Congo, a country in Central Africa, is one of the biggest importers of frozen chicken meat, particularly in large urban areas. In Kinshasa, the level of poultry consumption is influenced by its high nutritional value, income level, eating habits, short cooking process, religious and festive events, and forms of processing [7].

As a result of inappropriate handling and processing, chicken cuts quickly deteriorate and present a serious microbiological risk to consumer health [8]. Bacteria such as *Campylobacter*, *Salmonella*, *Yersinia*, *Clostridium perfringens*, *E. coli*, *Listeria*, *Vibrio cholerae*, etc. are among the food-borne pathogens that contaminate chicken meat [9], affecting millions of people every year with serious or even fatal consequences. Most of these pathogens are of zoonotic importance, as they can have a significant impact on public health and economic sectors in the absence of official surveillance by the relevant health services [10].

The aim of this study is to determine the microbiological quality of chicken meat sold in the communal markets of Kinshasa. Specifically, it aims to analyse the level of microbial contamination of frozen chicken cuts and to identify the risk factors for this contamination at these markets.

Methods

Background to the study

This study was carried out in Kinshasa, a provincial city with 26 communes, a surface area of 9,965 km² and an estimated population of 16,316,000 in 2023 (29). There are several markets throughout the city; apart from the

central market, each commune has at least one communal market recognised by the political and administrative authorities, as well as small markets that are not officially recognised (pirate markets). This study was carried out in three markets, namely Kinshasa's central market and the communal markets of Selembao and Liberté (Masina). During the study period, the choice of markets was guided by their status, an assessment of their level of administrative functionality, the availability of frozen cuts displayed on tables at the points of sale, and the frequency with which these cuts were sold; markets that did not meet these criteria were excluded.

Sampling and data collection

All sellers of frozen chicken cuts found at the target markets were recruited for the study without using any particular selection technique. Each vendor was visited only once during the entire study. Thus, for this study, 60 samples, comprising frozen chicken cuts such as thighs, legs, wings, gizzards, rumps, skin, etc. displayed at the points of sale, were collected at random under aseptic conditions from the market stalls during the late hours of the day (afternoon). Each sample was examined for physical quality (texture, colour, odour) and packed in a sterile unit sachet, carefully sealed and labelled. The number of the sample, the date and the place of collection were noted on the bag. The samples collected were transported rapidly in a cool box not exceeding +4°C to the laboratory, where they should be analysed within 48 hours of sampling.

At the same time as the samples were being taken, a pre-established questionnaire was used to gather the necessary information (nature, source, handling, storage and management of unsold chicken cuts) from market vendors after obtaining their free and informed consent.

Laboratory analysis

At laboratory level, analyses were based essentially on culture to identify the presence of the microbial agents most frequently found in broiler meat, such as total aerobic mesophilic flora, total and faecal coliforms, *Escherichia coli*, *Staphylococcus aureus*, and *Salmonella* spp, hygiene indicator bacteria that include pathogenic microbes and spoilage microbes [11].

The samples were tested for these germs in 4 stages in accordance with the French standard ISO 6579: pre-enrichment, enrichment, isolation and biochemical identification. The chicken meat was first cut aseptically into 25g pieces using sterile scissors and forceps, and weighed using an analytical balance.

For pre-enrichment, each sample was suspended in a sterile flask containing 225 ml of buffered peptone water, and incubated at 37°C for 18 h. The pre-enriched solution was then added simultaneously to the following culture media: nutrient broth (sodium selenite) for enrichment, ordinary agar, Mac Conkey and Drigalski media for germ

isolation and Kligler, indole urea and citrate media for identification. The plates were then incubated at 37°C for 24 hours. For their isolation, the germs sought (aerobic mesophilic flora, enterobacteria, psychotrophs, staphylococci, clostridia, etc.) underwent the main characteristic tests: the catalase test and Gram staining and examination in the fresh state. Rod-shaped, catalase-positive and Gram-negative bacteria identified using API 20E galleries (presumed to be Enterobacteriaceae) were subjected to other biochemical tests to identify specific family characteristics.

Ethical considerations

Ethical authorisation was obtained from the Committee for the Protection and Use of Animals of the Université Pédagogique Nationale (UPN). The Provincial Veterinary Inspector also approved and supported the study. The owner of each poultry farm was informed of the purpose of the study and his consent was obtained before the interviews and sampling took place.

Statistical analysis

All data were checked for completeness, coded and entered using Epi-data version 4.6 and the data were exported to Stata software for further analysis. Frequency analysis was performed to determine the frequency of independent variables and the prevalence of multidrug-resistant isolates.

Results

Laboratory analyses showed that half of the samples taken from the 3 markets (30/60) were contaminated with total germs (93%), faecal coliforms (60%), faecal streptococci (46.6%), *Staphylococcus aureus* (20%) and, to a lesser extent, yeasts (6.7%) (**Table 1**).

The highest levels of contamination were found in samples taken from the Liberté market, where proportions of around 60%, 53% and 40% were found respectively for total germs, coliforms, streptococci and *S. aureus* (6.6%); followed by the Central market, but where *Staphylococcus aureus* was predominant (13.3%) (**Figure 1**).

Tableau 1 : Diversité de la flore de contamination de la viande de poulet

Sites de collecte	Nb Ech.	Ech. cont.	G. totaux	Coli	Strep	S. aureus	Lev.
Marché SELEMBAO	10	2	2	0	2	0	0
Marché CENTRAL	20	8	8 (26,6%)	2 (6,6%)	0	4 (13,3%)	0
Marché LIBERTÉ	30	20	18 (60%)	16 (53%)	12 (40%)	2 (6,6%)	2 (6,6%)
Total	60	30	28 (93%)	18 (60%)	14 (46,6%)	6 (20%)	2 (6,7%)
Légende : Nb Ech. (Nombre d'échantillons) ; Ech. cont. (Échantillons contaminés) ; G. totaux (germes totaux) ; Coli (Coliformes) ; Strep. (Streptocoque) ; Lev. (Levures)							

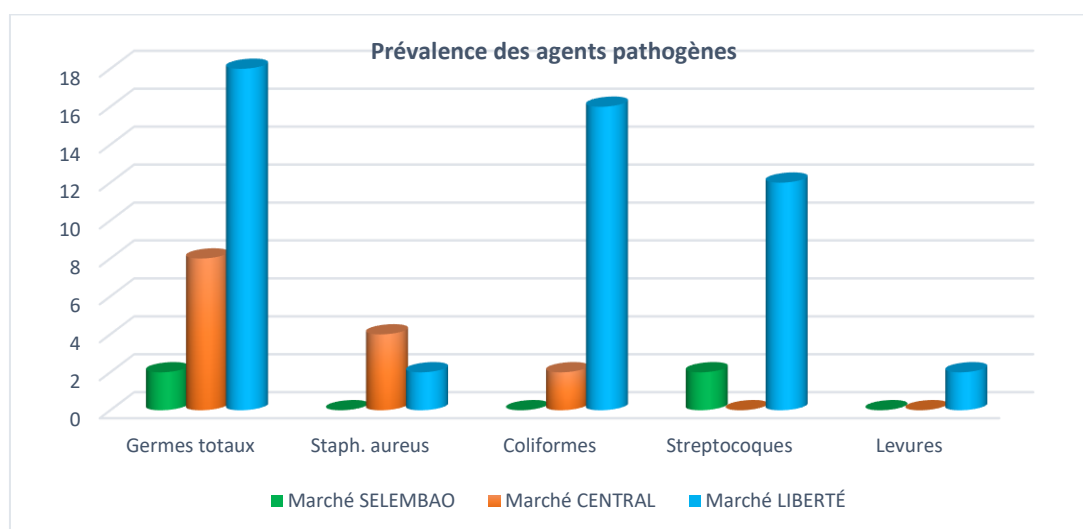


Figure 1. Prévalences des germes trouvés dans les échantillons de poulet

Discussion

Poultry meat is subject to the risk of contamination by various pathogens from different sources, primary during the pre-treatment and processing stages and secondary

after processing via packaging, marketing and storage [12]. Such contamination can make food products unfit for human consumption, or even harmful to consumers [13]. In this study, Figure 1 shows the prevalence of pathogens (total germs, coliforms, streptococci, *S. aureus*

and yeasts) found in samples of chicken meat sold at markets in Kinshasa. Total germs represent all the aerobic micro-organisms present in foodstuffs, whether useful or harmful [11]. Studies carried out by Kaci in Algeria (20), by Baily (5) in South Africa and by Sidiguitiebe in Morocco (33) describe very high rates of contamination by total germs, of 84%, 77.3% and 75% respectively [20, 5, 14, 33]. The sources of contamination of foodstuffs by total germs are very varied: the environment, cross-contamination with other carcasses or foodstuffs, contamination by the handler [30]. The coliform contamination rates found in this study are close to those found in other studies: 55% in Cameroon [28], 30% in Ethiopia [18] and 19% in Morocco [3]. Although the presence of faecal coliforms usually indicates contamination of faecal origin, several faecal coliforms are not of faecal origin [11]. The interest in detecting these coliforms in meat lies in the fact that their survival in the environment is generally equivalent to that of pathogenic bacteria and that their density is generally proportional to the degree of pollution produced by faecal matter and should raise serious suspicion of the presence of enteropathogenic micro-organisms, such as salmonella [34]. Counting faecal coliforms makes it possible to monitor the hygiene of meat handlers throughout the economic chain [22]. The presence of faecal coliforms, even at low levels, makes chicken meat of unsatisfactory quality, and its consumption can lead to health problems and serious poisoning [31,15].

As far as *Staphylococcus aureus* is concerned, there is great deference to its prevalence in chicken meat, where it was very high in certain countries: found in 80% of samples in Chad [26], 50% in Algeria [7] and 23% in France [32]. Contamination of food by staphylococci generally results from handling by people carrying the bacteria or from the contaminated environment [28]. This bacterium can produce toxins that often lead to food poisoning. Staphylococcal food poisoning is widespread, occurring frequently and sometimes violently [24]. *Staphylococci* are resistant to heat and are not destroyed by cooking. Roast chicken, blood sausages, sausages, chicken sandwiches, sliced meats and meat products are some common foods that are likely to become contaminated with these germs [16]. Among the risk factors that can have an effect on the number of staphylococcus present in the samples studied are the degree of hygiene in the slaughterhouse, the cleanliness of the water used, the cleanliness of the stalls, the hygiene of the staff and the precautions taken when handling during sale, all of which lead to a proliferation of pathogens on initially healthy carcasses [17].

Conclusion

In this study, we were interested in the bacteriological analysis of frozen chicken meat sold in the markets of Kinshasa with a view to contributing to the assessment of its health profile to determine compliance with chicken

meat specifications (microbiological criteria) in order to provide the consumer with a product free from food poisoning and/or food-borne illnesses. Of the 60 samples analysed, total germs (93%), faecal coliforms (60%), faecal streptococci (46.6%), *Staphylococcus aureus* (20%) and yeasts (6.7%) were present in half of the samples of chicken meat sold at the markets, with proportions varying from market to market. In the light of these results, we can conclude that frozen chicken meat sold in the markets of Kinshasa does not offer a sufficient guarantee of wholesomeness, particularly with such a high level of contamination as that found in this study.

Efforts still need to be made throughout the chain, from acquisition from wholesalers through to transport, handling and preservation at the point of sale, if we are to present a quality end product capable of inspiring confidence in the consumer, who is looking for a healthy, inexpensive and well-presented product. It would also be interesting in the future to measure the real impact of chicken meat consumption on consumer health by carrying out more in-depth studies on the pathogens that invade this meat, which is the most widely consumed in large conurbations such as the provincial city of Kinshasa. Raising awareness among the stakeholders involved in this sector, through training courses, could enable them to better master the techniques of handling, preserving and selling products of animal origin intended for human consumption, thereby contributing to food safety.

In recent years, the demand for and consumption of frozen chicken meat has increased due to advantages such as ease of digestion and availability in many cities. Due to the increase in demand, routine quality control of poultry meat is necessary to provide the public with healthy food. Poultry carcasses and parts are frequently contaminated with pathogens that can present a danger to human health. Several recommendations have been published to control pathogens throughout the chain, from slaughter to cutting, from hatcheries to home preparation.

The present study determined and analysed the bacteriological quality of chicken meat cuts sold in the markets of Kinshasa. Heavy contamination by micro-organisms revealed that good hygiene practices are defective, particularly when carcasses are handled. It is recommended that effective sterile measures be applied at all stages from product handling to consumer use.

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Conflict of interest

The authors declare no conflict of interest

Authors' contributions

Professor Prince KIMPANGA (PPK) and Dr. Daudet BYAKYA KIKUKAMA (DBK) conceptualised and designed the study, Dr. Charles KAMBALE VAGHENI (CKV) conducted the study, collected the data and carried out the data analysis.

PPK and DBK interpreted the results and participated in the drafting of the text, and affirmed that the manuscript was an accurate and transparent account of the reported study. CKV accepted full responsibility for the work and conduct of the study and organised the publication decision. All authors read and approved the final manuscript. The corresponding author confirms that all authors cited meet the authorship criteria and that no others have been omitted.

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