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Prevalence of *Staphylococcus aureus* and *listeria monocytogenes* Isolated From Processed Meat in El-Menoufia, Egypt

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ABSTRACT

Food safety and public health are greatly concerned about food-borne diseases. One of the food poisoning cases that causes the most economic damage worldwide is caused by *Staphylococcus aureus. Listeria monocytogenes* has a major effect on the general public's health as well as the economy. There is evidence linking *L. monocytogenes* to animal cases of clinical listeriosis. The total colony count and Staphylococcus count of the beef meat product under investigation were the goals of this investigation. *Staphylococcus aureus* and *Listeria monocytogenes* were found to be prevalent in beef meat products. From different supermarkets in the study area, a total no. of 100 randomly collected samples of processed meat products (25 of each). minced meat, kofta, burger and sausage were among the samples. *Listeria monocytogenes* and *S. aureus* were isolated and identified by culture of the samples using conventional cultural procedures. burger, sausage, kofta, and minced meat all included *S. aureus* at percentages of 44%, 36%, 40%, and 32%, respectively. *Listeria monocytogenes* was identified from minced meat, kofta, burger and sausage, with relative incidences of 12%, 8%, 16%, and 4% respectively.
Keywords: *Staphylococcus aureus*, Meat products, *Listeria monocytogenes*.

INTRODUCTION

The intoxication caused by food contamination is mediated via enterotoxins. Third globally, *S. aureus* is the main cause of food-borne infections. The variety of foods associated with staphylococcal food poisoning suggests that *S. aureus* is capable of growing and producing toxins in a range of nutritional and environmental contexts. Frequently associated with staphylococcal food poisoning are foods such as dairy products, beef, eggs, and poultry meat. Fast food that is ready to eat and convenient has been more popular lately (WHO, 2015).

Due to increasing international trade in products of animal origin, the global spread of foodborne pathogens is a growing concern. It has already been shown that meat can serve as a vector for pathogenic microorganisms such as *Salmonella* spp., Shiga toxin-producing *Escherichia* (*E.*) *coli* (STEC) and *Listeria* (*L.*) *monocytogenes.* Tcc should

be applied to detect the quality of meat (Rinn et al., 2024).

S. aureus is a key contributor to nosocomial infections in humans and affects both humans and animals in a variety of invasive illnesses. However, because *S. aureus* can dwell on hands and in nares and is not always dangerous, humans act as a reservoir for the germs. People who handle food and come into contact with aerosol droplets or who carry *S. aureus* (enterotoxin producing) on their hands or in their noses are thought to be the primary sources of food contamination (Reinoso et al., 2004).

Intoxication with *S. aureus* can cause severe vomiting, cramping in the stomach, diarrhea, and occasionally even collapse. According to reports, *S. aureus* food poisoning can develop in as little as two to six hours, and the sickness can last for six to twenty-four hours (Kwon et al., 2004).

Listeria monocytogenes has a significant impact on both the general public's health and the economy. Animal cases of clinical listeriosis, which manifests as encephalitis, septicemia, and miscarriage, have been associated with *L. monocytogenes*. Listeriois is a disease that, in comparison to other foodborne illnesses, has a considerable fatality rate (20–30%). *Listeria monocytogenes has* a significant impact on both the general public's health and the economy. Animal cases of clinical listeriosis, which manifests as encephalitis, septicemia, and miscarriage, have been associated with *L. monocytogenes* (WHO, 2014).

Listeria monocytogenes considered a significant risk in food, capable of causing common fever-related stomach illnesses, miscarriage, stillbirth, meningoencephalitis, and bloodstream infections. Numerous studies have documented the isolation of *Listeria* species in various types of meat and its derivatives (Ismaiel et al., 2014; Mazza et al., 2015; and Naas et al., 2017).

Hence, Study's objective was to find any instances of *Staphylococcus aureus* and to determine the extent of *Listeria* contamination in meat products within El-Menofia Governorate.

MATERIAL AND METHODS

1. Sample collection

Samples of processed meat were collected from different kinds of supermarkets. These businesses varied in size from different supermarkets. The specimens gathered between 2023 and 2024. One hundred samples were gathered from various supermarkets in El-Menofia governorate, Egypt (each 25 samples collected from minced meat, kofta, burgers and sausage).

Following collection, samples were immediately taken in an ice box to the laboratory to be cooled. To guarantee uniformity, each sample was blended. Sample was made by utilizing a stomacher in sterile polyethylene bags to homogenize 10 g of every sample individually in 90 ml of tryptic soy broth for two minutes, then cultivated on different media.

2. Aerobic Plate Count (ISO 4833-1, 2013)

Two distinct sterile Petri dishes were filled with one milliliter (ml) of each of the previously made dilutions. To each, was an addition of roughly 15 milliliters of sterile tempered plate count agar. The inoculation plates were thoroughly mixed, allowed to harden, and then incubated for 24 hours at 37^{o}C, the Aerobic Plate Count was determined, and each count was noted separately.

3. *Staphylococcus aureus* count (ISO/TS 4833-1, 2013)

S. aureus was count on Baired parker agar supplemented with pot. tellurite and egg yolk emulsion, after incubating plates at 37^{o}C for 1-3 days, typical colonies were counted.

4. Isolation and identification of S. aureus

The Baired-Parker agar base (Oxoid, CM 0275, UK) was streaked with the prepared incubated samples. After being incubated for 24 to 48 hours at 37°C, the inoculation plates were inspected for colony characteristics, cellular morphology and culture purity. The suspected colonies' biochemical and cultural characteristics were examined in accordance with (Quinn et al., 2011).

5. Isolation and identification of listeria spp (FAO, 1992)

Procedures for enrichment: To promote the development of *Listeria* spp., the first step in the isolation process is to employ Listeria selective enrichment broth (LSEB). The foundation of LSEB is trypticase soy broth with 0.6% yeast extract, acriflavin-HCL (15 mg/L), nalidixic acid (40 mg/L) and cycloheximide (50 mg/L) supplemented with Listeria selective supplement (HiMedia laboratories). Samples weighing ten grams were aseptically added to 90 milliliters of LSEB with carefully mixing. For 24 to 48 hours, all of the broths were incubated at 37°C and 30°C.

Selective plating: Following the enrichment procedure, a loopful of the homogenate was streaked onto the Listeria Selective Agar bases from Oxford - Listeria Selective Agar and Hi Media Laboratories. The plates were incubated at 35 °C for 24 to 48 hours (Seeliger and Jones, 1987).

RESULTS

Bacteriological examination of 100 samples of processed meat from El-Menoufia governorates revealed isolation of *Staphylococcus aureus* and *Listeria monocytogenes* strains.

Table 1. Aerobic plate count of beef meat product samples (minced meat, kofta, Burger and sausage) expressed as a $\log_{10}$ CFU/g. (n=100)

Meat product samples	Mean ±SE	Minimum	Maximum
minced beef	5.66±.07^{a}	5.11	6.30
kofta	4.30±.11^{ab}	3.30	5.21
burger	4.20±.11^{ab}	3.00	5.00
sausage	3.18±.10^{b}	2.00	4.89
P value	**0.004**		

The means that have distinct superscripts (a, b, and c) in the same column indicate statistical significance ($p \leq 0.05$), SE stands for standard error.

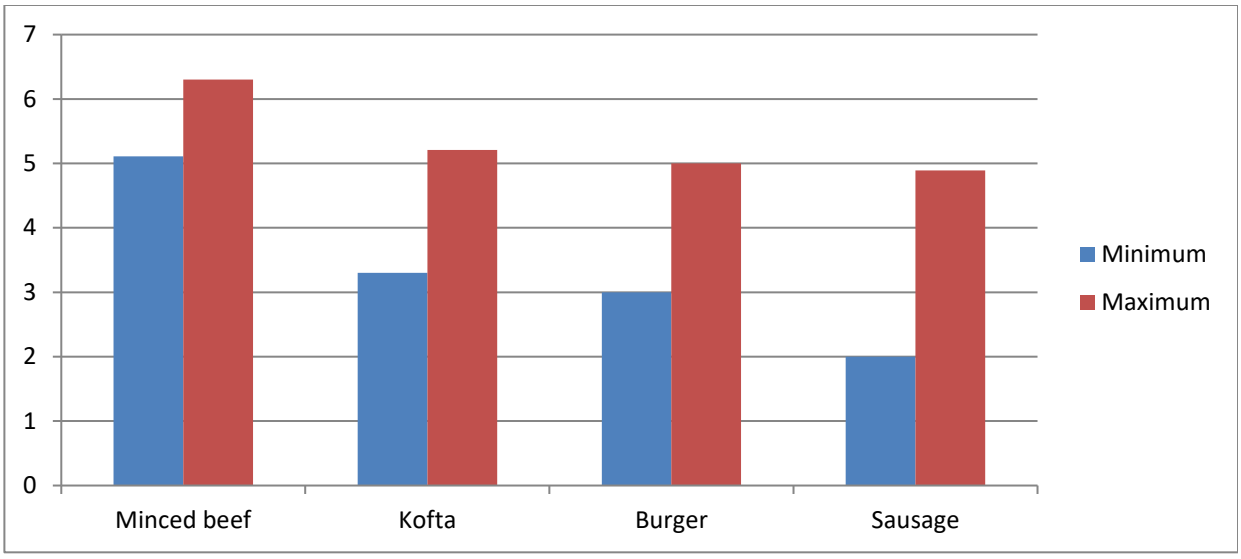

Figure 1. Aerobic plate Count of beef meat product samples (minced meat, kofta, burger, and sausage) expressed as Log_{10} cfu/g.

Table 2. *Staphylococcus aureus* count of beef meat product samples (minced meat, Kofta, Burger and Sausage) expressed as a log_{10} CFU/g.

Meat Product Samples	Mean ±SE	Minimum	Maximum
minced meat	4.67±0.17^{a}	3.11	6.3
kofta	3.22±0.15^{b}	2.3	4.48
burger	3.62±0.19^{b}	2	4.78
sausage	2.99±0.08^{c}	2	3.48
P value	0.002		

The means that have distinct superscripts (a, b, and c) in the same column indicate statistical significance ($p \leq 0.05$), SE stands for standard error

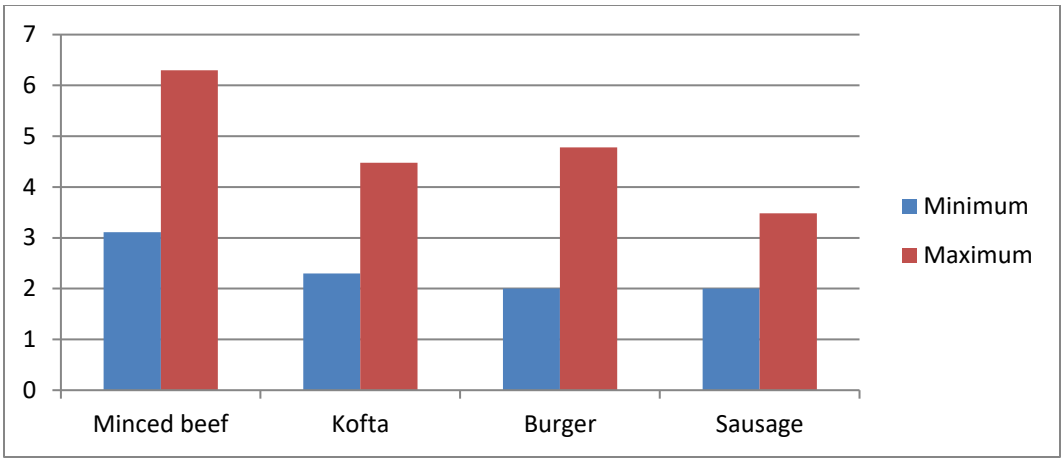

Figure 2. *Staphylococcus aureus* count of beef meat product (minced meat, kofta, burger and sausage) expressed as a $\log_{10}$ CFU/g. (n=100)

Table 3. Incidence of *Staphylococcus aureus* species identified in samples of beef meat products under examination. (n=25)

Samples (n=25)	*Staphylococcus aureus*		chi-square	p-value
	No. of positive sample	%		
minced meat	11	44%	0.848	.837
kofta	9	36%		
burger	10	40%		
sausage	8	32%		

The result is not significant at $p < 0.05$.

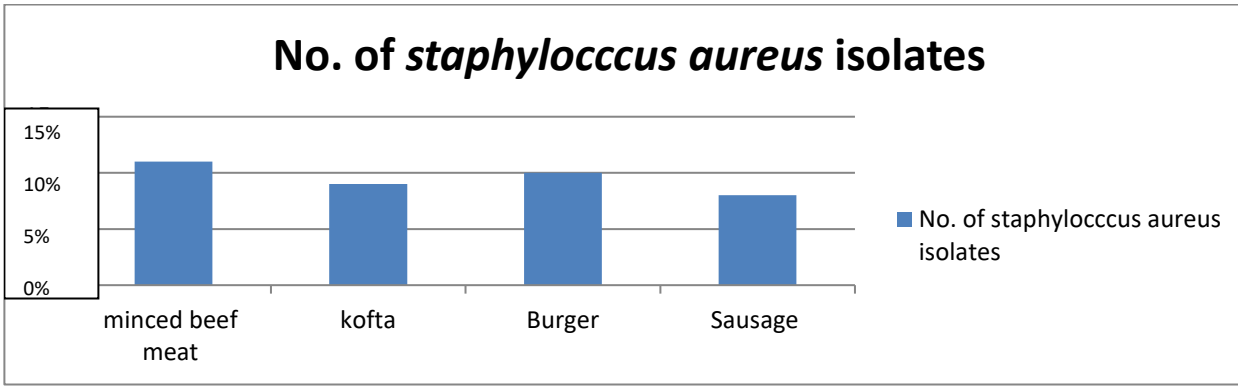

Figure 3. Incidence of *Staphylococcus aureus* in the meat products (minced meat, burger, kofta and sausage).

Table 4. Incidence of *Listeria monocytogenes* of meat products (minced meat, kofta, burger and sausage).

Samples (n=25)	*Listeria monocytogenes*		chi-square	p-value
Samples	No. of positive sample	%	2.22	.527
minced meat	3	12%		
kofta	2	8%		
burger	4	16%		
sausage	1	4%		

The result is not significant at p <0 .05.

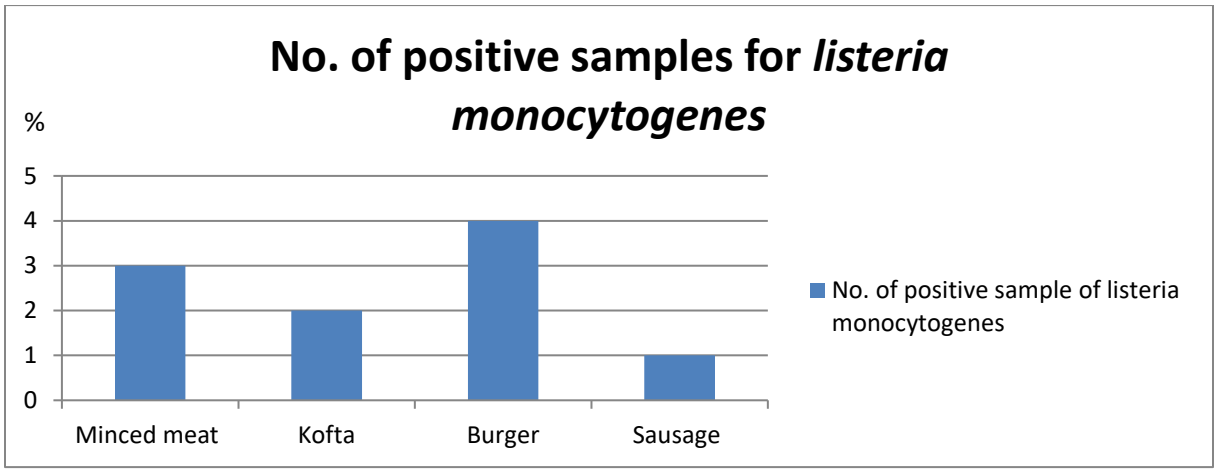

Figure 4. Incidence of *Listeria monocytogenes* in meat products (minced meat, kofta, burger and sausage).

DISCUSSION

The aerobic plate count for minced beef 5.6 $X10^5$, kofta $4.3X10^5$, burger $4.2X\ 10^5$and sausage 3.18 $X10^5$ (table 1, fig 1)، this according to the findings of (Shaltout et al., 2022), it was observed that the aerobic plate counts in the beef burger and kofta meat products varied between $7X10^3$ and $8.8X10^4$. The APC/g in the meat meals for beef 4.6×103 and 9.91×10^3cfu/g for kofta (Shaltout, et al., 2016). Therefore, this study, detect Staphylococcus *aureus* and the amount of *Listeria* contamination in meat products are investigated in the El-Menoufia Governorate.

Staphylococcus aureus count of meat product (minced meat, kofta, burger and sausage) 4.67±0.17, 3.22±0.15, 3.62±0.19 and 2.99±0.08 respectively (Table 2) this results agreed with Shaltout et al. (2022) reported that the staphylococcal count in the examined samples (kofta and burger) with a mean value as follow $6.3X10^2$±1.6 X10 and $5.3X10^2$±$1.1X10^2$ respectively.

The prevalence of positive samples displayed in (Table 3), with rates of 11 (44%), 9 (36%), 10 (32%), and 8 (32%) for minced beef, kofta, beef burger, and sausage, respectively. This agreed with the findings of Shaltout et al. (2022) who observed that *S. aureus* was present in 30 (54%) of kofta samples and 20 (25%). In contrast, Mousa et al. (2014) found a higher incidence of S. aureus in beef burgers.

Protocarrero et al. (2002) state that *S. aureus* in meat products is a sign of inadequate utensil sterilization and poor hygiene among meat handlers. In contrast, minced meat or beef burgers were not found to contain *Staphylococcus*, according to Abdel-Aziz et al. (2015). There were 38%, 22%, 30%, 32%, and 12% of *S. aureus* in the analyzed minced meat, burger, sausage, kofta, and luncheon.

Listeria monocytogenes is a significant risk in food, capable of causing common fever-related stomach illnesses, miscarriage, stillbirth, meningoencephalitis, and bloodstream infections. Several investigations have confirmed that different kinds of meat and their byproducts include Listeria species (Ismaiel et al., 2014; Mazza et al., 2015; Naas et al., 2017).

In the present study, Incidence of *Listeria monocytogenes* in meat products (minced meat, kofta, burger and sausage) 12%,8%,16% and 4% (Table 4, Fig. 4). The results are in line with Harper and Getty's (2012) analysis, which found that burgers, minced meat, and kofta had higher prevalence of *Listeria* spp. than other processed meat items. Listeria species were, however, less common in pasterma, which may have been caused by the salt that was put to the plant. Research has shown that the prevalence of *L. monocytogenes* in beef products varies: 19.4% recorded in Poland (Wieczorek et al., 2012), 6.5% recorded in Nigeria (Peter, 2016), 0.3% in Italy (Latorre et al., 2007) and in China (Wu et al., 2015), the rate is 20.0%. It has been shown that *L. monocytogenes* can contaminate beef products to differing degrees as they are being processed (Demaître et al., 2021).

CONCLUSION

In conclusion, the existence of two foodborne pathogens in fresh meat poses a significant health hazard to consumers. Enhancing the microbial quality of the product requires crucial steps to enhance hygiene, such as providing better information, guidance, and control.

DATA ACCESSIBILITY

This article contains the data that this study used to support its conclusions.

INTEREST CONFLICTS

The writers say they have no competing interests.

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