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Bacteriological Quality of Fresh Broiler Chickens Traded in the Markets

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Abstract

A total of 50 random samples of freshly slaughtered broiler chickens were randomly collected from different private local poultry retailers in Port-Said Province, Egypt, and then transferred to Animal Health Research Institute. The study was conducted for the determination of the total colony counts, *Enterobacteriaceae* counts, total *Staphylococcus aureus* count, and total *Escherichia coli* count. In addition to the detection of *Salmonella* spp. The obtained results revealed that the total colony count ranged from 3.98 to 6.91 log cfu/g with a mean value of 6.33±5.59 log cfu/g and the *Enterobacteriaceae* counts ranged from 2.23 to 4.82 with a mean value of 4.21±3.52. Meanwhile, the incidence rate of *S. aureus*, *E. coli*, and *Salmonella* in the examined samples was 10%, 70%, and 100%, respectively. The count of *S. aureus* ranged from 1 to 3 log cfu/g with a mean value of 2.47±1.61 log cfu/g and the *E. coli* count ranged from 2.11 to 3.74 log cfu/g with a mean value of 3±2.28 log cfu/g. The total colony counts were within the Egyptian Standard by 24% and exceed the standard by 76%. From the achieved results, it was concluded that chicken meat could be contaminated with several types of bacteria through slaughtering, handling, and cross-contamination in the market which affect the chicken meat quality and have public health hazards. The high contamination level of chicken meat indicates the poor hygienic measures applied during the slaughtering process and marketing.

KEYWORDS
Total colony counts, Broiler chicken, *E. coli*, *Salmonella*, *S. aureus*

INTRODUCTION

Chicken meat is a superior source of high-quality animal protein. It is characterized by a valuable protein that includes all essential amino acids and low-fat content which includes unsaturated fatty acids (Takma and Korel, 2019). However, chicken meat is a perishable food which very susceptible to microbial contamination, which causes foodborne illness and human health hazards (Karisma *et al*., 2021). The bacterial load in chicken meat increased through conversion from live birds to chicken meat sold in markets. Hygienic procedures in farms, slaughtering houses, and markets have a great influence on the chicken meat microbial quality. Handlers and instruments represent an important source of chicken meat contamination (Kuncara *et al*., 2021). Chicken meat can be exposed to bacterial contamination from farm to market. The most common bacteria transmitted from chicken meat to humans are *S. aureus*, *Salmonella*, and *E. coli* (Wardhana *et al*., 2021).

Poultry abattoirs are the principal source of bacterial contamination in chicken meat. Slaughterhouse structure, equipment like knives, workers, water source, scalding water temperature, and hygienic procedures applied during the slaughtering process affect the microbial quality of chicken meat and its products (Klaharn *et al*., 2022). During the different steps of slaughtering, the chicken meat is exposed to contamination. The most critical steps are plucking and removal of viscera. The level of contamination with *E. coli* increases through the evisceration step. Usually, contamination with *S. aureus* occurs due to inadequate personal hygiene (Maharjan *et al*., 2019).

Foodborne diseases caused by contaminated chicken consumption can be avoided through bacteriological examination, but it was important to evaluate compliance with the standard of chicken meat (Mahmoud *et al*., 2020).

S. aureus produces enterotoxins which are responsible for staphylococcal food intoxication. The major clinical signs of staphylococcal food poisoning are nausea, abdominal pain, vomiting, and diarrhea. The recovery usually occurs within 24–48 h (Grispoldi *et al*., 2021). *Salmonella* food poisoning is characterized by gastroenteritis (stomach flu). This sickness is associated with hyperthermia, headache, nausea, vomiting, abdominal pain, and diarrhea which may be bloody. Health Complications and death may occur in complicated in children and the elderly (Ehuwa *et al*., 2021). Ingestion of contaminated food with *E. coli* causes foodborne infection, which can cause significant health problems, including hemolytic uremic syndrome (Newell and La Ragione, 2018).

The study was conducted for the determination of the total colony counts, *Enterobacteriaceae* counts, total *Staphylococcus*

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aureus count, and total *Escherichia coli* count. In addition to the detection of *Salmonella* spp.

MATERIALS AND METHODS

Sampling

A total of 50 fresh chicken meat samples (grower broiler carcasses weighed about 2.0±0.10 Kg) were purchased from different local chicken shops just after slaughtering. All samples were put in sterile polyethylene bags and kept in the icebox, then immediately transferred to Animal Health Research Institute, Port-Said branch, for evaluation.

Bacteriological Evaluation of the samples

Twenty-five grams of individual chicken meat samples were aseptically removed from the polypropylene containers and transferred with 225 ml of sterile 0.1% peptone water to a stomacher bag. Serial decimal dilutions were prepared from the stomacher fluids.

All samples were subjected to bacteriological evaluation through the following; Total colony counts were determined using the technique recommended by Mooijman *et al.* (2019) and using standard plate count agar, *Enterobacteriaceae* counts were determined using the technique recommended by Sospedra *et al.* (2010) using violet red bile glucose agar, *S. aureus* count was determined using a technique recommended by Gaafar *et al.* (2019) using dried Baird Parker media with Egg yolk-Tellurite emulsion, *E. coli* was determined using a technique recommended by Suardana *et al.* (2010) using Eosin Methylene Blue agar and finally detection of *Salmonella*e through using a technique recommended by Temelli *et al.* (2012) using Xylose lysine desoxycholate agar.

RESULTS AND DISCUSSION

The bacteriological quality of chicken meat samples

The incidence of food-borne pathogens recorded in Table 1 was *Salmonella* (10%), *S. aureus* (70%) and *E. coli* (100%) in the tested samples, while Julqarnain *et al.* (2022) resulted that the *Salmonella* spp. (20%), *S. aureus* (36.8%) and *E. coli* (43.2%). Other research conclusions were conducted by Karisma *et al.* (2021) the contamination of chicken meat samples was (100%) contaminated with *E. coli* and (6.67%) contaminated with *Salmonella* sp. and *S. aureus*.

Determination of Aerobic colony counts in chicken meat samples

ACC is used to assess hygienic measures applied from the slaughtering process to marketing (Li *et al.*, 2019). The data recorded in Table 2 about (76%) of tested samples were exceeding the Egyptian Standard (ACC mean ≤ 5 log cfu/g).

Table 3 revealed the ACC ranged from 3.98 to 6.91 log cfu/g with a mean of 6.33±5.59 log cfu/g, this result was higher than that obtained by Usman *et al.* (2022) who showed that the mean of ACC was 4.76 log cfu/g in fresh chicken meat and also higher than Abdelrahman *et al.* (2020) who found that ACC mean value 5.65 log cfu/g, it also slightly higher than the obtained result by Rondón *et al.* (2021), Maharjan *et al.* (2019) and Chaudhrya *et al.* (2011) who found that the mean value of ACC 5, 4.45 and 5.07 log cfu/g respectively. Poor hygienic measures during slaughtering consider the main cause of high ACC. Lues *et al.* (2007) and Dias *et al.* (2017) revealed that the highest aerobic counts have gained in the initial steps of processing especially the defeathering stage. Another cause mentioned by Malher *et al.* (2011) that the tools used in evisceration process can cause cutting of the intestines and hence contamination of chicken carcasses occur.

On the other hand, these results were relatively similar to the result recorded by Ibrahim *et al.* (2015) in Egypt who stated that the mean value of the ACC was 6.18 log cfu/g. As compared to this study, a higher ACC for market chicken meat was reported by Murshed *et al.* (2016) and Julqarnain *et al.* (2022) who recorded that the mean value of the ACC was 8.46 and 8 log cfu/g respectively.

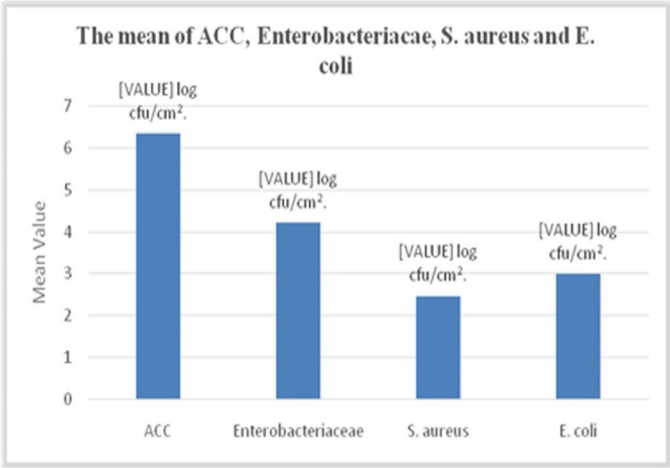

Fig. 1. The mean of ACC, *Enterobacteriaceae*, *S. aureus*, and *E. coli*

Determination of Enterobacteriaceae counts in chicken meat samples

The count revealed in Table 3 ranged from 2.23 to 4.82 log cfu/g with a mean value of 4.21±3.52 log cfu/g, this result was lower than previous reports by Yulistiani and Praseptiangga, (2019); Rindhe *et al.* (2008); Miranda *et al.* (2008) and Bhandari *et al.* (2013) where the mean value was log 6.14, 6.27, 2.66 and 8.5 cfu/g respectively. The higher counts in the chicken meat sold at the live bird market might result from fecal contamination during slaughter operations, evisceration, and poor hygienic measures.

Determination of S. aureus counts in chicken meat samples

The counts of *S. aureus* in tested samples ranged from 1 to 3 with a mean of 2.47±1.61 log cfu/g as recorded in Table (3), this result was nearly similar to previous reports (Álvarez-Astorga *et al.*, 2002; Chaiba *et al.*, 2007). The higher range was recorded by Julqarnain *et al.* (2022) who determined the mean ranged between 4.64±0.61 and 6.42±0.53 log cfu/g, higher mean was also

Table 1. Incidence rate of different bacterial contaminants

Samples	Aerobic colony counts	*Enterobacteriaceae*	*S. aureus*	*E. coli*	*Salmonella*
Random samples (n.=50)	+ ve	+ ve	+ ve	+ ve	+ve in 5 samples only
Incidence rate	100%	100%	70%	100%	10%

recorded by Sengupta *et al.* (2012) and Joshi and Joshi (2010) 3.7 and 4.07 log cfu/ g respectively. Maharjan *et al.* (2019) stated that contamination with *S. aureus* is usually due to inadequate personal hygiene and sanitation procedures and cross-contamination.

Table 2. Aerobic colony count (cfu/g) of chicken meat samples compared to Egyptian standard (ES)

	Chicken meat samples
*Within the ES	12 (24%)
Exceed the ES	38 (76%)

*Within the Egyptian Standard (ES No. 1651) mean the Aerobic colony counts not exceeding $1x10^5$ (cfu/g) according to Egyptian Organization for Standardization and Quality Control for poultry and chilled rabbit chicken carcasses (2005).

Table 3. The min, max, mean, SD, and SE of tested bacteria.

Sample	ACC	*Enterobacteriaceae*	*S. aureus*	*E. coli*
Mean	6.33	4.21	2.47	3
SD	6.44	4.36	2.46	3.13
SE	5.59	3.52	1.61	2.28
Max.	6.91	4.82	3	3.74
Min.	3.98	2.23	1	2.11

All values log cfu/g. SD: Standard Deviation; SE: Standard Error; max: Maximum; min: Minimum.

Determination of E. coli counts in chicken meat samples

The incidence of *E. coli* obtained in this study was 100%, this result was similar to that obtained by Karisma *et al.* (2021) but higher than that mentioned by Julqarnain *et al.* (2022) who reported incidence rates that varied between 43.2% and 90%. Elzaher *et al.* (2018) isolated *E. coli* at 87.5%. A study conducted by Julqarnain *et al.* (2022) revealed that the incidence of *E. coli* was 43.2%, while Rahman *et al.* (2020) reported that 63.5% of the chicken meat samples collected in Bangladesh tested positive for *E. coli*, they discovered that 96.7% of chickens were contaminated with *E. coli*.

The count of *E. coli* in this study ranged from 2.11 to 3.74 log cfu/g with a mean log of 3±2.28 cfu/g, this result is nearly similar to that obtained by Perez-Arnedo *et al.* (2021) and Vieira *et al.* (2022) who stated the mean value was log 3.52 and 3.7 cfu/g respectively. The count range was lower than that resulted by Karisma *et al.* (2021) who found the range of count between (4.7-7.34 log cfu/g). The presence of *E. coli* indicates fecal contamination which can occur during evisceration and poor hygiene (Kim and Yim, 2016).

Detection of Salmonella in chicken meat samples

Salmonella was detected in only 5 samples (10%), which was lower than that obtained by Shafini *et al.* (2017) who revealed the prevalence of *Salmonella* in chicken meat samples was 54.2%, M'ikanatha *et al.* (2010) detected *Salmonella* at 19% of samples and Guran *et al.* (2017) reported a higher prevalence of *Salmonella* in chicken meat at 44.7%. On the other hand, this result was higher than those reported by Guran *et al.* (2017), the prevalence of *Salmonella* in chicken carcasses was 2%. The lower contamination level of *Salmonella* in chicken meat was also obtained by Cosby *et al.* (2015) and Mpundu *et al.* (2019) at 1.5%. The contamination with *Salmonella* might be referred to as unhygienic sources of chicken and cross contamination during handling slaughtering process.

CONCLUSION

The results obtained in this study confirmed that the fresh chicken carcasses slaughtered in local poultry shops harbored high bacterial loads that exceed the Egyptian standard. Inadequate sanitary practices, cross-contamination, and poor personal hygiene during slaughtering and in markets are the main causes of bacterial contamination of chicken meat. The elevated prevalence rate of foodborne bacteria leads to human health hazards. The strict hygienic measures and sanitation throughout the chain of conversion of live birds to meat improve the bacteriological quality of chicken meat.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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