Bacteriological profile of some raw chicken meat cuts in Ismailia city, Egypt

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ABSTRACT
One hundred random samples of raw chicken meat cuts represented by breast and thigh (50 of each) were collected from an automatic poultry slaughtering plant in Ismailia city, Egypt. The samples were examined to investigate their bacteriological aspect, where the mean values of aerobic plate count and Enterobacteriaceae were 5.9x10⁴ and 5.1x10⁴ CFU/g for breast samples and 7.1x10⁴ and 6.1x10⁴ CFU/g while for thigh samples as well as the incidence of Enterobacteriaceae contaminated the breast and thigh samples were 42 and 54%, respectively. Moreover, S. aureus, Salmonellae, E. coli, Enterobacter spp., Proteus spp., Shigella spp. and C. perfringens were detected in 10, 14, 12, 4, 2, 2 and 16% of the examined breast samples, respectively. Referring to thigh samples, S. aureus, Salmonellae, E. coli, Klebsiella spp., Enterobacter spp., Proteus spp., and C. perfringens were detected in 4, 8, 18, 4, 2, 2 and 10%, respectively. The obtained results indicated that the raw chicken meat cuts may harbor many food poisoning bacteria from different sources, which strongly recommends following strict hygienic measures through slaughtering, handling and cooking processes.

1. INTRODUCTION

Rapid reproductive cycle, high acceptability of chicken meat due to its high biological value, palatability and many production processing variables; made poultry production one of the major worldwide food industry. Selection of broiler chickens has been primarily directed at economic traits which have reduced costs of production as it is the major brand of production and consumption among poultry (Nabil, 2018). Chicken meat is one of the most popular foods worldwide as it contains many essential amino acids, minerals as sodium, potassium, calcium, iron, phosphorous besides traces of vitamins such as vitamin B12 and niacin required for maintaining life and promoting growth (FAO, 2014). Poultry meat is an ideal medium for bacterial growth and known to harbor a large number of bacteria that are pathogenic to human being. Typically, these occur in low sanitation levels, and only pose a threat to the consumer if the product is not handled in a safe manner (Zakaria, 2005). In processing plants, contamination of poultry meat may be recorded throughout initial slaughtering processes, packaging and storage. Heavy bacterial loads enter the processing operations with the living birds or raw materials utilized during processing (Zhang et al., 2001). Regarding to slaughtering abattoirs and processing plants hygiene, the presence of pathogenic and spoilage microorganisms in poultry meat and its products represent a significant concern for suppliers, consumers and public health officials worldwide. Bacterial contamination of food products is undesirable but unavoidable; it depends on the initial bacterial load of the fresh raw materials, hygienic practices during manufacturing and on time/temperature factor (El-Bassuony, 2008). The detection of foodborne pathogens using conventional culture methods have traditionally been considered as the “gold standard” for the isolation and identification of foodborne bacterial pathogens (Jasson et al., 2010). They consist of a series of steps that include nonselective enrichment, selective enrichment, selective/differential plating and, finally, morphological, biochemical, and serological confirmation. This standardized classical culture method is known to be sensitive and inexpensive.

Therefore, the current study aimed to investigate the bacteriological profile of raw chicken breast and thigh samples through bacteriological and serological techniques.

2. MATERIAL AND METHODS

2.1. Collection of samples:
One hundred samples of raw chicken breast and thigh (50 of each), weighed about 250 g/sample, were collected after complete slaughtering, scalding, defeathering, evisceration, and cold washing processes. The samples were obtained from an automatic poultry slaughtering plant in Ismailia city, Egypt. The collected samples were prepared as recommended by ISO 6887-1 (2017), then subjected to the following examinations:
3. RESULTS

Results of the study revealed that fresh chicken thigh samples were more contaminated according to the mean values of APC and Enterobacteriaceae. Results, as mentioned in Table (1), showed that the mean values of APC of raw chicken breast and thigh samples were 5.9x10^2 and 7.1x10^3 CFU/g, respectively.

Table 1 Statistical analytical results of aerobic plate count (APC) of the examined chicken meat samples (n=50).

<table>
<thead>
<tr>
<th>Chicken meat samples</th>
<th>Count (CFU/g)</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken breasts</td>
<td>5.1x10^2</td>
<td>8.2x10^2</td>
<td>5.9x10^2±0.97x10^2</td>
<td></td>
</tr>
<tr>
<td>Chicken thighs</td>
<td>5.4x10^3</td>
<td>9.6x10^3</td>
<td>7.1x10^3±1.1x10^3</td>
<td></td>
</tr>
</tbody>
</table>

The same value within the same column superscript letter indicated absence of significant difference at (P >0.05).

Table (2) revealed that the prevalence and the mean values of Enterobacteriaceae in the examined breast and thigh samples as 5.1x10^4 (42%) and 6.1x10^4 (54%) CFU/g, respectively.

Table 2 Prevalence and count of Enterobacteriaceae of the examined chicken meat samples (n=50).

<table>
<thead>
<tr>
<th>Chicken meat samples</th>
<th>Prevalent samples</th>
<th>Positive samples</th>
<th>Count (CFU/g)</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken breasts</td>
<td>21</td>
<td>42</td>
<td>3.5x10^4</td>
<td>7.2x10^4</td>
<td>5.1x10^4±0.32x10^4</td>
<td></td>
</tr>
<tr>
<td>Chicken thighs</td>
<td>27</td>
<td>54</td>
<td>4.6x10^3</td>
<td>8.8x10^3</td>
<td>6.1x10^3±0.54x10^3</td>
<td></td>
</tr>
</tbody>
</table>

(*) The same value within the same column superscript letter indicated absence of significant difference at (P >0.05).

Bacteriological classification and identification of Enterobacteriaceae isolates revealed detection of Salmonella spp., E. coli, Enterobacter spp., Proteus spp. and Shigella spp. with incidence of 14, 12, 4, 2 and 2% in breast samples; while Salmonella spp., E. coli, Klebsiella spp., Enterobacter spp. and Proteus spp. with incidence of 8, 18, 4, 2 and 2%, respectively. Furthermore, S. aureus and C. perfringens were detected by the incidence of 10 and 16% of breast samples; while were 4 and 10% in thigh samples, respectively as recorded in table (3).

Table 3 Prevalence of isolated bacteria from the examined chicken meat samples (n=50).

<table>
<thead>
<tr>
<th>Identified bacteria</th>
<th>Chicken breasts No.</th>
<th>Chicken thighs No.</th>
<th>%*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>5</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Salmonella spp.</td>
<td>7</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>E. coli</td>
<td>6</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Proteus spp.</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Shigella spp.</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>8</td>
<td>16</td>
<td>5</td>
</tr>
</tbody>
</table>

Escherichia coli isolates were serotyped as E. coli O157:H7, O111:H11, O227:H6 and O26 with incidence of 33.3, 16.6, 16.6 and 33.3% in breast samples, while E. coli O157:H7, O111:H11, O227:H6 and O26 were isolated from thigh samples with incidence of 22.2, 11.1, 33.3 and 33.3%, respectively as recorded in table (4).

Table 4 Serotyping of the isolated E. coli strains from the examined chicken meat samples.

<table>
<thead>
<tr>
<th>E. coli</th>
<th>Examined chicken samples (n=50)</th>
<th>No.</th>
<th>%*</th>
</tr>
</thead>
<tbody>
<tr>
<td>O111:H11 (EPEC)</td>
<td>2</td>
<td>33.3</td>
<td>2</td>
</tr>
<tr>
<td>O111:H2 (EPEC)</td>
<td>1</td>
<td>16.6</td>
<td>1</td>
</tr>
<tr>
<td>O111:H1 (ETEC)</td>
<td>1</td>
<td>16.6</td>
<td>3</td>
</tr>
<tr>
<td>O26 (ETEC)</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>O26 (EHEC)</td>
<td>2</td>
<td>33.3</td>
<td>0</td>
</tr>
</tbody>
</table>

% was calculated according to total number of isolates.

Moreover, table (5) revealed the results of Salmonella serotypes as S. Typhimurium and S. Enteritidis with the incidence of 14.2 and 71.4% in breast samples; while were 50% for both strains in thigh samples. In addition, S. Typhi was detected in breast sample with incidence of 14.2%.

Table 5 Serotyping of Salmonellae isolated from the examined chicken meat cuts.

<table>
<thead>
<tr>
<th>Salmonella spp.</th>
<th>Examined chicken samples</th>
<th>No.</th>
<th>%*</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Typhi</td>
<td>1</td>
<td>14.2</td>
<td>0</td>
</tr>
<tr>
<td>S. Typhimurium</td>
<td>1</td>
<td>14.2</td>
<td>2</td>
</tr>
<tr>
<td>S. Enteritidis</td>
<td>5</td>
<td>71.4</td>
<td>2</td>
</tr>
</tbody>
</table>

% was calculated according to total number of isolates.

4. DISCUSSION

Contamination of fresh chicken meat with different food pathogens may be occurred due to many improper hygiene and personal faults occurred during different slaughtering, storage, transportation and handling processes, such as contaminated water, gastrointestinal contamination, and air, dust, sewage and food or on food equipment, environmental surfaces (USFDA, 2012).

In general, APC gives an idea about the hygienic measures applied during processing and also helps in the determination of the keeping quality of the poultry carcasses. Nearly similar results were reported by Khalifa (2018) (2.3x10^4 and 6.9x10^5 CFU/g in breast and thigh.
samples, respectively). On the other hand, higher counts were reported by Wahbah (2019) (5.5x10^6 and 6.8x10^6 CFU/g for breast and thigh samples, respectively). Comparatively, lower counts were reported by Atia (2018) (9.28x10^3 and 2.91x10^4 CFU/g for breast and thigh samples, respectively). High determination of Enterobacteriaceae in fresh meat indicates enteric contamination with intestinal contents and declares the fact that the GIT is common habitat of the enteric bacteria and is considered the main source of contamination with these organisms during slaughtering, dressing, evisceration, handling and transportation to butcher shops (Hassanin et al., 2013).

Enterobacteriaceae count is more frequently used to assess enteric contamination. Nearly similar results were reported by Wahbah (2019) (3.5x10^4 and 7.8x10^4 CFU/g for breast and thigh samples, respectively). Moreover, higher counts were reported by Shaltout et al. (2019) (4.5x10^6 and 5.7x10^6 CFU/g in breast and thigh samples, respectively). On the other hand, lower count was reported by Khalifa (2018) (1.3x10^3 and 2.0x10^3 CFU/g for breast and thigh samples, respectively).

The presence of E. coli in food of animal origin is considered as an indicator of faults during preparation, handling, storage or service (Tebbut, 1999). Nearly similar results were reported by Ibrahim et al. (2015) (13.3% of the examined chicken thigh samples), Shaltout et al. (2019) (10% of the examined breast samples). Moreover, higher percentages of E. coli were reported by Elisy (2019) (45 and 30% of the examined breast and thigh samples, respectively), and Arakeeb (2020) (42.8 and 62.5% of thigh and breast samples, respectively). On the other hand, lower incidence of E. coli was reported by Atia (2018) (8 and 16% of the examined breast and thigh samples, respectively), and Elshora (2019) (8.57%) of the examined breast samples.

Moreover, serological typing revealed detection of various E. coli serotypes in different percentages, which is agree with several previous studies as the results recorded by Elboghdady (2019), Elshora (2019), and Elisy (2019), who recorded detection of several E. coli serotypes including O111:H2 (EPEC), O127:H6 (ETEC), O126 (ETEC), and O86 (EHEC) in their examined fresh breast and thigh samples with different incidences. Furthermore, El-Ramy (2017) and Khalaf (2019) detected E. coli O157:H7 in their examined samples of chicken meat cuts. Actually, the different strains of E. coli are the major cause of many gastric disturbances, where symptoms appear within 12 to 36 hours and characterized by fever, nausea, vomiting and watery stools, which occasionally contain mucous, but without gross blood; therefore, E. coli showed to be the first bacterial cause of diarrhea in infants and its proportion may reach 54% (Varnam and Evans., 1991).

Salmonella species is an important food-borne pathogen responsible for disease in animals and humans. It has been the cause of many outbreaks and infections around the world and is considered as one of the major causes of human gastroenteritis worldwide (Rasschaert et al., 2005). The obtained results of Salmonella detection in fresh chicken meat cuts are in agree with those reported by Kalall et al. (2014) (detected Salmonella in 12.66% of the examined raw chicken meat samples), Hashem (2015) and Ibrahim et al. (2015) who found Salmonella in 12% of their examined chicken carcass samples.

Moreover, higher prevalence of Salmonella spp. was reported by Hassanin et al. (2017) (24 and 36% of the examined breast and thigh samples, respectively), Elisy (2019) (20 and 25% of the examined breast and thigh samples, respectively), and Wahbah (2019) (33.3 and 46.6% of breast and thigh samples). Comparatively, low percentages of Salmonella spp. were reported by Colmegna et al. (2009) (4.7% of examined chicken meat samples), and Anju et al. (2014) (4.44% of the examined chicken carcass samples). In addition, many other studies did not detect Salmonellae in the chicken meat samples as performed by Killinger et al. (2010), and Javadi and Safarmashaei (2011). In addition, Salmonella organisms were isolated by Abd El-Aziz (2013) who detected S. typhimurium in 44% of the examined chicken meat samples, and Wahbah (2019), who detected S. Typhimurium and S. Enteritidis in the examined breast and thigh with incidences of 13.3 and 20%, 13.3 and 6.7%, respectively.

Several numbers salmonellosis were recorded due to serious hygienic deficiency in food technology during processing, production and storage as well as poor hygiene of food handlers (Koutikoyks and Kasijanenka, 1991). Referring to Shigella spp., the obtained results are in variable compatibility with the reported results of El-Ramy (2017) (60% of the examined fresh chicken carcasses), Hozayn (2018) (24% of fresh chicken carcass samples), and Khalifa (2018) (30 and 42% in breast and thigh samples, respectively). In addition, Saad (2016) detected Shigella, Klebsiella, Enterobacter, and Proteus spp. in incidences of 40%, 18, 25, and 20% in the examined chicken carcasses; while Younes (2014) failed to detect Shigella spp. in the examined thigh samples, but found klebsiella, and Enterobacter spp. in 33.3% and 6.67% of the examined thigh samples, respectively.

In regard to C. perfringens, it is considered as foodborne pathogen of public health importance due to its ability to produce many enterotoxins. Clostridium perfringens food poisoning may occur after consumption of improper handled, cooked and stored poultry meat; where some heat resistant spores (100°C for more than 1h) can survive, subsequently spor germination and rapid multiplication leading to food poisoning (Mokhtari and Doosti, 2015).

Nearly similar results were recorded by Afshari et al. (2015), who detected C. perfringens in 15.5% of examined chicken meat samples; while higher results were recorded by Zakaria (2005) who detected C. perfringens in 25 and 35% of the examined breast and thigh samples, and Nabil (2018) revealed detection of C. perfringens in 40 and 52% of the examined breast and thigh samples; moreover, lower results were reported by Thangamani and Subramanian (2012) who detected C. perfringens in 3.81% of the examined chicken meat samples. Furthermore, reported results were disagreed with Ibrahim et al. (2015) who failed to detect C. perfringens in any examined chicken meat sample.

In addition, presence of S. aureus in food refers to poor personnel, and hygienic conditions with great hazard. Staphylococcus food poisoning is considered as one of the frequent foodborne diseases, where its symptoms usually appear within 30 minutes to 8 hours after consumption of contaminated food by staphylococcal enterotoxins including nausea, vomiting, retching and less frequently diarrhea, headache and weakness in minority of cases (Hashim, 2003). The obtained results somewhat agreed with those reported by Elshora (2019), who found S. aureus in 14.28% and
8.57% from chicken breast and chicken thigh samples, respectively. Higher results were reported by Atia (2018) (28 and 44% of breast and thigh samples, respectively), El-Sheikh (2018) (30 and 40% of breast and thigh samples, respectively), and Abdelkarim (2020) who detected S. aureus in 27.08% of the total examined samples of breast and thigh; while lower result was recorded by Abd El-Fattah-Shereen (2014) who detected S. aureus in 4.0% of the examined raw chicken carcasses.

Differences between different authors may be referred to the variation between the source of the examined samples, method of rearing, and the hygienic quality of the slaughterhouse and slaughtering processes.

Detection of such food poisoning bacteria indicated poor hygienic condition during slaughtering, handling and storage. Accordingly, the healthy status of the slaughtered birds, hygienic practices performed during slaughtering and processing; the storage time/ temperature, and distribution conditions are important determinant factors for bacteriological profile of fresh poultry meat. Therefore, regular bacteriological assessment of slaughtered fresh carcasses is essential.

5. CONCLUSIONS

From the obtained results, it can be concluded that commercial chicken meat cuts may be loaded with many food poisoning bacteria rendering it of inferior quality or even possess health hazards to consumers. In addition, isolation of E. coli O157:H7, S. Typhi, S. Typhimurium, and other food poisoning bacteria from such examined samples may be serious to the human being. As recommendations, strict hygienic measures and personal hygiene should be applied in poultry slaughterhouses especially during slaughtering process to avoid such serious contaminants and to verify human safety.

CONFLICT OF INTEREST

The authors declare no conflict of interest

REFERENCES
