Detection of bacterial contamination in imported and local red and white meat in Tikrit city, Iraq

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Abstract
The present study has been designed to detect the bacterial contamination of red and white meat (America, Turkey, and Indian). 25 gm of meat was bought from three different places of Tikrit (Arbeyn Street, Al-Zuhur Street, and Al-Qadisia Street). Meat extraction samples were cultured in different diagnostic and nutrient cultures to detect bacterial contamination which represented mainly of *Staphylococcus aureus*, *Staphylococcus epidermidis*, *E. coli*, *Salmonella spp.*, and *Bacillus spp.* The results of sheep meat showed *Staphylococcus aureus* was (Al-Zuhur Street and Al-Qadisia Street) a high significant number compare with another type of bacteria. For Cow meat contamination, *E. coli* and *Salmonella spp.* (Al-Arbeyn Street) show a highly significant number compare with other types of bacteria. For chicken meat contamination, *Staphylococcus aureus* (in Chicken thighs/ Turkey) show a highly significant number compare with another type of bacteria. All of them reached the maximum level of the permitted range specified by the “Central Organization for Standardization and Quality Control”. Bacillus bacteria showed lower results in all samples.

Keywords: Meat contamination, *Staphylococcus* spp, *Salmonella* spp, *Bacillus* spp

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Introduction
Food-borne pathogens are the leading cause of illness and death in developing countries costing billions of dollars in medical care and medical and social costs [1]. Numerous cases of raw meat as one of the main sources of foodborne illness have been reported [2]. *E. coli* O157, *Salmonella* spp., and *Campylobacter* spp. were the most dominant pathogens involved and were often present in fresh meat and poultry [3]. Changes in eating habits, mass catering, complex and lengthy food supply procedures with increased international movement and poor hygiene practices are major contributing factors [4]. Typically, the meat of healthy animals is sterile; however, contamination may occur during the various stages of slaughter, preparation, and transportation.

A variety of microbes can contaminate meat, although different species may become dominant depending on factors that include pH, oxygen, water availability, and storage temperatures [5-6]. Schlegelova et al. reported that contamination of meat by resistant strains of *S. aureus* and *E. coli* during the slaughtering process dramatically have been increased indicating, secondary contamination from the environment of slaughterhouses [7, 18]. The frequency of *Salmonella* isolation in raw beef products is higher than *E. coli* O157, due to higher survival ability outside of the animal’s gut [8]. The observed prevalence of *E. coli* and *Salmonella* in beef and sheep meat varies considerably from survey to survey ranging from 11.9–50% to 7.1–33% for each bacterium, respectively using cultivation and PCR based methods [8-11]. So, the aim of the study is a diagnosis of bacterial contamination in red and white meat in Tikrit city.

Materials and methods
Meat sample collections
The meat of the market in Tikrit was used for this study. A total of 100 raw meat samples including beef (n =), chicken (n =) and sheep (n =) were randomly collected during the periods from December 2016 to January
2017. The samples were collected within 4 h post-slaughter and during the early afternoon in order to minimize the microbial changes due to environmental temperatures and post-slaughter timings. The collection was dependent on the co-operation of the shop owners. Butchers working in these outlets lack knowledge regarding the importance of disinfecting and sanitizing; consequently, they clean their shops once in 24 h with detergent and water. No sanitizers’ medium was used before sampling.

**Meat sample preparation**

Twenty-five grams of collected meat samples were weighed and transferred to sterile flasks containing 100 ml of phosphate buffer saline (PBS). Samples were homogenized using a meat grinder under aseptic conditions and were stored for further analysis.

**Total Viable Bacteria**

Count One ml of aliquots of each dilution was transferred in septic conditions to sterile Petri-plates and mixed with about 15 ml of nutrient agar tempered to 45- 50°C. The cooled plat was inverted and incubated at 37°C for 48hr. Following the incubation, the colonies on duplicate plates (Containing 30-300 colonies) were counted using the Quebec colony counter. The concentration of bacteria in the original sample was calculated by multiplying the number of colonies on a dilution plate by the corresponding dilution factor and the number of microbes was expressed as colony-forming units (CUF) per gram (APHA, 1985). More of 300 colonies in one plate negligible.

**Statistical Analysis**

The data were analyzed by using the Minitab program, according to Chi-square test.

**Results**

**Sheep meat contamination**

The present results show a different number of bacterial cells in 1gm of meat in different regions. Whereas, *Staphylococcus aureus* (Al-Zuhur Street and Al-Qadisia Street) show a highly significant number compare with another type of bacteria. Otherwise, contamination by *Staphylococcus epidermidis* and *E. coli* is present and the number of cells in 1gm reaches 7.405 and 11.11 respectively. Finally, there is no contamination by *Bacillus Spp.* As shown in table (1).

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Sheep meat/ Al-Arbeyn street</td>
<td>11.11</td>
<td>7.405</td>
<td>7.405</td>
<td>11.11</td>
<td>0.0</td>
<td>0.0001</td>
<td></td>
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<tr>
<td>Sheep meat/ Al-Zuhur street</td>
<td>14.81</td>
<td>3.705</td>
<td>3.705</td>
<td>3.705</td>
<td>0.0</td>
<td>0.0001</td>
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<td>Sheep meat (small sheep) Al-Qadisia street</td>
<td>7.405</td>
<td>7.405</td>
<td>7.405</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>Sheep meat/ Al-Qadisia street</td>
<td>14.81</td>
<td>3.705</td>
<td>11.11</td>
<td>7.405</td>
<td>0.0</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>

**Cow meat contamination**

The present results show a different number of bacterial cells in 1gm of meat in different regions. Whereas, *E. coli* and *Salmonella spp.* (Al- Arbeyn Street) show a highly significant number compare with another type of bacteria. Otherwise, contamination by *Staphylococcus epidermidis, Staphylococcus aureus* and *Bacillus Spp.* is present and the number of cells in 1gm reaches 14.82, 7.41 and 1.36 respectively. As shown in table (1).
Table (2): Cow meat contamination by different types of bacteria

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Cow meat/ India</td>
<td></td>
<td>7.52</td>
<td>2.22</td>
<td>6.17</td>
<td>5.31</td>
<td>1.36</td>
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<td>Cow meat/ best type</td>
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<td>11.31</td>
<td>3.34</td>
<td>9.26</td>
<td>7.97</td>
<td>1.36</td>
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<td>Cow meat/ Ground beef</td>
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<td>10.63</td>
<td>2.93</td>
<td>8.24</td>
<td>7.27</td>
<td>1.36</td>
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</tr>
<tr>
<td>Cow meat/ Al-Zuhur street</td>
<td></td>
<td>7.41</td>
<td>0.0</td>
<td>7.41</td>
<td>3.71</td>
<td>0.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Cow meat/ Al- Arbeyn street</td>
<td></td>
<td>14.82</td>
<td>7.41</td>
<td>18.53</td>
<td>18.53</td>
<td>0.0</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Chicken meat contamination
The present results show a different number of bacterial cells in 1gm of meat in different regions. Whereas, Staphylococcus aureus (in Chicken thighs/ Turkey) show a highly significant number compare with another type of bacteria. Otherwise, contamination by staphylococcus epidermidis, E. coli, Salmonella spp, and Bacillus Spp.

is present and the number of cells in 1gm reaches 3.45, 5.17, 5.17 and 3.45 respectively as shown in table (3).

Table (3): Chicken meat contamination by different types of bacteria

<table>
<thead>
<tr>
<th>Type</th>
<th>Bacteria</th>
<th>Staph. aureus</th>
<th>Staph. Epidermidis</th>
<th>E. coli</th>
<th>Salmonella Spp.</th>
<th>Bacillus Spp.</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken thighs/ America</td>
<td></td>
<td>3.45</td>
<td>3.45</td>
<td>5.17</td>
<td>5.17</td>
<td>3.45</td>
<td>0.0001</td>
</tr>
<tr>
<td>Chicken/ Turkey</td>
<td></td>
<td>5.17</td>
<td>1.72</td>
<td>1.72</td>
<td>1.72</td>
<td>0.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Chicken thighs/ Turkey</td>
<td></td>
<td>6.91</td>
<td>1.72</td>
<td>3.45</td>
<td>5.17</td>
<td>0.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Chicken breast/ gozda-Turkey</td>
<td></td>
<td>3.45</td>
<td>0.0</td>
<td>1.72</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Chicken breast/ Oglu-Turkey</td>
<td></td>
<td>6.91</td>
<td>3.45</td>
<td>1.72</td>
<td>1.72</td>
<td>0.0</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Discussion
The presence of bacteria in meat has been widely reported from different parts of the world [12-13]. Some groups recognized the presence of viable bacteria, especially Gram-negative organisms from 106 to 109, as an indication of open-air meat spoilage [14], while others argued this assertion and considered the presence of a high number of background organisms as a pathogen reduction strategy due to the organisms’ antagonistic effect against pathogenic bacteria and thus safer for meat quality. Therefore, it is considered that fresh meat that contains 105 – 106 of background organisms are inherently safer than those that contain less bioload; however, this hypothesis applies only to harmless bacteria [15]. In the study of [16] referred that predominant bacteria were E. coli then Staphylococcus spp. also, the study revealed the count of bacterial contamination near the standard Iraqi values, this agreed with our study. The contamination of carcasses by bacteria from Staphylococcus aureus is caused either by the animal itself or by the hands of the cutters. Therefore, intensifying the awareness of health, care, and cleanliness during the circulation of meat is important to reduce pollution. The difference in the isolation rates of the different bacterial species may be due to the extent to which the health conditions applied everywhere, the nature of the production and its intensity, and according to the country’s technical development or its backwardness, and through this study, we observed the non-typical reality of slaughter sites and avoided the most basic health ingredients [17].

Reference


