Incidence of Staphylococci and E. coli in Meat and Some Meat Products

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Received: January 18, 2019; Published: June 17, 2019

Abstract

Meat products are liable to harbour different types of micro-organisms during long chain of handling, processing, distribution and storage as well as preparation. A total of 100 random samples of locally manufactured meat products represented by frozen minced meat, Kofta, sausage and beef burger (25 of each) were randomly collected from different shops in El-Menoufia governorate, Egypt. All the examined samples were positive for Staphylococci and E. coli. Staphylococcus aureus detected in (40%), (68%), (72%) and (52%) in examined samples of Frozen minced meat, Kofta, sausage and beef burger, respectively. Escherichia coli strains isolated from Frozen minced meat were O26:H11 (4%) and O119:H4 (4%). While O86 (8%) and O127:H6 (4%) were isolated from Kofta. The present study revealed that meat and some of meat products were contaminated with E. coli and S. aureus especially (beef burger, kofta and sausage). The unhygienic and poor sanitary conditions under which these meat products were handled and processed act as the causes of the high count of Staphylococci, S. aureus and E. coli in this study. The contamination can be reduced by application of good manufacture practices.

Keywords: Staphylococci; S. aureus; E. coli; Kofta; Sausage; Beef Burger

Introduction

Microorganisms control in meat products is a major concern in the preparation of high quality foods. During slaughtering process, the meat is exposed to many sources of contamination including; environment, equipment and workers’ hands [1]. The hygienic state of animals prior, during and after slaughter can be critical to the finished product quality [2]. Also, during deboning process, the meat undergoes extensive handling and is susceptible to bacterial contamination resulting in decomposition, discoloration and development of off odors pigment [3].

Staphylococcus aureus can contaminate foods and cause illness in humans when ingested [4], so it is frequently implicated in food borne illness [5]. Convenience food offers a suitable growth environment for S. aureus, which is able to grow and express virulence in a wide variety of foods such as mixed foods, meat and meat products [6] and ready-to-eat foods [7]. Particular relevance to the food processing industry, the ability of some S. aureus strains to produce heat stable enterotoxins that cause staphylococcal food poisoning which ranks as one of the most prevalent causes of gastroenteritis worldwide [8].

The native habitat for E. coli is the intestinal tract of man and animals; therefore its presence in food generally indicates direct or indirect pollution of faecal origin. Escherichia coli is the classical indicator of the possible presence of enteric pathogens in food [9]. The incidence of human E. coli infection is one of the major outbreaks resulting from contaminated beef products [10].
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Therefore, this work was performed to study the bacteriological contamination in meat and some locally manufactured meat products from different local commercial shops in Menoufia government, Egypt.

**Materials and Methods**

**Collection of samples**

One hundred random samples of meat and locally manufactured meat products represented by frozen minced meat, Kofta, sausage and beef burger (25 samples of each) were collected from different shops supermarkets in Menoufia government, Egypt. All collected samples were separately kept in sterile plastic bag and transferred in an ice box to the laboratory under complete aseptic conditions without undue delay. The samples were subjected to the bacteriological examination for detection of *Staphylococcus aureus* and *E. coli* in such products.

**Preparation of samples [11]**

25 grams of each examined sample were aseptically transferred to aseptic blender jar and 225 ml of sterile buffered peptone water (0.1%) were added to the content of the jar. Then homogenized 1500 - 2000 rpm for 2 minutes to provide a homogenate (1:10) from which decimal serial dilutions was prepared. The prepared samples were subjected to the following examinations.

**Determination of *Staphylococci* and *S. aureus* counts [12]**

The developed colonies appeared on Baird Parker agar plate after incubation at 37°C for 48 hours were suspect to be *S. aureus* appear which as black, shiny, circular, smooth, convex with narrow white margin and surrounded by a clear zone extending into opaque medium and enumerated as *Staphylococcus aureus* count/g and recorded. Also, the suspected colonies were picked up and purified on nutrient agar slopes for further morphological, biochemical and serological identification.

**Detection of enteropathogenic *E. coli***

It was identified and isolated morphologically, biochemically and serologically according to ICMSF (1996).

**Statistical analysis**

It was done according to Feldman., et al [13].

**Results**

It is evident from the results recorded in table 1 that all the examined samples of frozen minced meat, kofta, sausage and beef burger were positive for *staphylococci* with a mean value of $2.11 \times 10^3 \pm 1.45 \times 10^3$, $5.41 \times 10^3 \pm 0.95 \times 10^3$, $6.23 \times 10^3 \pm 0.31 \times 10^3$ and $6.16 \times 10^3 \pm 0.82 \times 10^3$ (cfu/g) for the examined samples, respectively and 60%, 28%, 48% and 32% of the same samples, respectively were accepted according to “EOS” for *Staphylococci* count as recorded in table 2.

<table>
<thead>
<tr>
<th>Products</th>
<th>Min</th>
<th>Max</th>
<th>Mean ± S.E*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen minced meat</td>
<td>$3.0 \times 10^2$</td>
<td>$2.5 \times 10^4$</td>
<td>$2.11 \times 10^3 \pm 1.45 \times 10^3$</td>
</tr>
<tr>
<td>Kofta</td>
<td>$4.0 \times 10^2$</td>
<td>$3.0 \times 10^4$</td>
<td>$5.41 \times 10^3 \pm 0.95 \times 10^3$</td>
</tr>
<tr>
<td>Sausage</td>
<td>$6.0 \times 10^2$</td>
<td>$9.0 \times 10^4$</td>
<td>$6.23 \times 10^3 \pm 0.31 \times 10^3$</td>
</tr>
<tr>
<td>Beef burger</td>
<td>$5.0 \times 10^2$</td>
<td>$6.0 \times 10^4$</td>
<td>$6.16 \times 10^3 \pm 0.82 \times 10^3$</td>
</tr>
</tbody>
</table>

*Table 1:* Statistical analytical results of total *Staphylococci* count/g in the examined samples of meat and meat products (n = 25).

*S.E* = Standard Error of Mean.

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Table 2: Acceptability of the examined samples of meat and meat products based on their Staphylococci counts/g (n = 25).

Egyptian Organization for Standardization “EOS” (2005).

No 1688-2005 for beef burger.

No 1973-2005 for kofta.

No 1972-2005 for sausage.

*S. aureus* detected in 10 (40%), 17 (68%), 18 (72%) and 13 (52%) in examined samples of frozen minced meat, kofta, sausage and beef burger, respectively with mean value of $4.28 \times 10^3 \pm 0.86 \times 10^2$, $8.13 \times 10^3 \pm 2.04 \times 10^2$, $1.96 \times 10^3 \pm 0.37 \times 10^2$ and $7.54 \times 10^3 \pm 1.60 \times 10^2$ for the same examined samples, respectively as recorded in table 3.

Table 3: Statistical analytical results of total *S. aureus* count/g in the examined samples of meat and meat products (n = 25).

The incidence of *Staphylococcus* species from examined samples of meat and meat products is 28%, 8%, 4%, 4%, 4% and 8% for *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus saprophyticus*, *Staphylococcus intermedius*, *Staphylococcus capitis* and *Micrococii* spp., respectively isolated from frozen minced meat, 28%, 12%, 8%, 4%, 8% and 16% for *S. aureus*, *S. epidermidis*, *S. saprophyticus*, *S. intermedius*, *S. capitis* and *Micrococii* spp., respectively isolated from kofta, 36%, 12%, 4%, 8% and 16% for *S. aureus*, *S. epidermidis*, *S. saprophyticus*, *S. intermedius* and *Micrococii* spp., respectively isolated from sausage and 32%, 28%, 12%, 4%, 8% and 4% for *S. aureus*, *S. epidermidis*, *S. saprophyticus*, *S. intermedius*, *S. capitis* and *Micrococii* spp., respectively isolated from beef burger samples as recorded in table 4.

Table 4: Incidence of Gram positive cocci isolated from the examined samples of meat and meat products (n = 25).

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Citation: Fahim A Shaltout, *et al.* "Incidence of *Staphylococci* and *E. coli* in Meat and Some Meat Products". *EC Nutrition* 14.7 (2019): 538-544.
The data recorded in table 5 indicated that the incidence of *E. coli* serotypes in the examined samples were O26:H11 and O119:H4 (4%) of each in frozen minced meat, O86 (8%) and O127:H6 4% in Kofta, O26:H11 (4%), O55:H7 (4%), O86 (8%), O111:H4 (8%) and O124 (8%) in sausage and O26:H11 (8%), O55:H7 4%, O86 (4%), O111:H4 (4%) and O124 (4%) in beef Burger.

<table>
<thead>
<tr>
<th>Product</th>
<th>Frozen minced meat</th>
<th>Kofta</th>
<th>Sausage</th>
<th>Beef Burger</th>
<th>Strain characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>O26:H11</td>
<td>1</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>O55:H7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>O86</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>O111:H4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>O119:H4</td>
<td>1</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>O124</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>O127:H6</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>8</td>
<td>3</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 5: Incidence and serotyping of *E. coli* Strains isolated from the examined samples meat and meat products (n = 25).

EPEC: Enteropathogenic *E. coli*; EIEC: Enteroinvasive *E. coli*; ETEC: Enterotoxigenic *E. coli*; EHEC: Enterohaemorrhagic *E. coli*.

Table 6 declared that 8%, 12%, 32% and 24% of the examined samples of frozen minced meat, kofta, sausage and beef burger, respectively were unaccepted samples based on presence of *E. coli*. According to Egyptian Organization for Standardization “EOS” (2005).

<table>
<thead>
<tr>
<th>Meat Products</th>
<th><em>E. coli</em> /g†</th>
<th>Accepted samples</th>
<th>Unaccepted samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Frozen minced meat</td>
<td>Free</td>
<td>23</td>
<td>92</td>
</tr>
<tr>
<td>Kofta</td>
<td>Free</td>
<td>22</td>
<td>88</td>
</tr>
<tr>
<td>Sausage</td>
<td>Free</td>
<td>17</td>
<td>68</td>
</tr>
<tr>
<td>Beef burger</td>
<td>Free</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>Total (100)</td>
<td>Free</td>
<td>81</td>
<td>81</td>
</tr>
</tbody>
</table>

Table 6: Acceptability of the examined samples of meat and meat products based on their contamination with *E. coli* (n = 25).

*Egyptian Organization for Standardization “EOS” (2005).*

**Discussion**

Meat products are gaining popularity because they represent quick easily prepared meals of low price from one side and render the processors to convert the various types of meat into unified products from the other side. Also, raw foods can transmit pathogens to utensils and equipment which they contact to them as well as workers who handled raw food can transfer microorganisms from raw foods to cooked one Emam-Neveen [14].

According to table 1, lower results were reported by Badr-Sarah [15] who found that the mean *Staphylococci* count in sausage and beef burger samples was $2.38 \times 10^4 \pm 0.51 \times 10^4$, $4.07 \times 10^3 \pm 0.69 \times 10^3$ (cfu/g), respectively, but higher results was reported in kofta $9.52 \times 10^3 \pm 2.14 \times 10^3$ (cfu/g).
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Higher results were reported by Abou Hussein-Reham [16] who found that the *Staphylococcal* count (cfu/g) ranged from $4 \times 10^4$ to $2 \times 10^6$ with a mean value of $5.38 \times 10^5 \pm 9.7 \times 10^4$ for sausage and from $2 \times 10^4$ to $4.7 \times 10^6$ with a mean value of $9.6 \times 10^5 \pm 2.1 \times 10^5$ for beef burger, while the mean value of examined sausage and beef burger samples was $1.04 \times 10^2 \pm 4.3 \times 10^6$ for sausage, $1.46 \times 10^6 \pm 5.33 \times 10^5$ for beef burger as recorded by Talaat-Nagwa [17] and 100% of examined sausage and beef burger were positive for *staphylococci* with counts (cfu/g) ranged from $5.00 \times 10^2$ to $2.80 \times 10^6$ and $2.00 \times 10^3$ to $2.52 \times 10^6$ with a mean value of $1.97 \times 10^5 \pm 6.49 \times 10^4$ and $2.08 \times 10^5 \pm 5.56 \times 10^4$ for examined sausage and beef burger, respectively as recorded by Ibrahim–Shimaa [18]. While lower results of staphylococcal count (cfu/g) ranged from $2 \times 10^2$ to $7.5 \times 10^3$ with a mean value of $3.05 \times 10^3 \pm 0.97 \times 10^3$ for kofta samples as recorded by Abd El Satter-Alla [19].

Concerning the results of table 3 higher results revealed that 15 (37.5%) of the examined minced meat samples was positive for the suspected *S. aureus* and the count (cfu/g) was ranged from $1.00 \times 10^2$ to $5.00 \times 10^5$ with a mean value of $7.10 \times 10^4 \pm 2.88 \times 10^4$ as recorded by Ibrahim–Shimaa [18]. Lower results recorded by Hassani–Faten [20] 24% as positive samples for *S. aureus* and the count (cfu/g) was ranged from $2.00 \times 10^2$ to $7.00 \times 10^4$ with a mean value of $2.51 \times 10^4 \pm 0.31 \times 10^3$. The total *S. aureus* count (cfu/g) for examined kofta samples was ranged from $1 \times 10^6$ to $9 \times 10^5$ with a mean value of $4.3 \times 10^5 \pm 2.06 \times 10^5$ as recorded by Abd El Satter–Alla [19] and 46.67% as positive samples for *S. aureus* with a mean value of $3.10 \times 10^2 \pm 0.74 \times 10^3$ (cfu/g) as recorded by Badr–Sarah [15].

Nearly similar result had been recorded by Hassani–Faten [20] 52% as positive samples with *S. aureus* count ranged from $4.00 \times 10^2$ to $2.81 \times 10^3$ with a mean value of $1.12 \times 10^3 \pm 0.17 \times 10^3/g$, while higher results revealed that 11 (22%) of the examined sausage samples was positive for *S. aureus* and the count (cfu/g) was ranged from $1.00 \times 10^2$ to $1.00 \times 10^4$ with a mean value of $3.03 \times 10^3 \pm 6.33 \times 10^2$ as recorded by Ibrahim–Shimaa [18], with an incidence of 20% positive sausage samples and a mean value of $2.1 \times 10^4 \pm 0.5 \times 10^4$ as recorded by Eldaly, et al. [21], with an incidence of 63.33% positive sausage samples and a mean value of $5.96 \times 10^2 \pm 0.88 \times 10^3$ (cfu/g) as recorded by Badr–Sarah [15].

Nearly similar results revealed that 15 (30%) of the examined beef burger samples was positive for *S. aureus* and the count (cfu/g) was ranged from $2.00 \times 10^2$ to $7.00 \times 10^4$ with a mean value of $1.02 \times 10^4 \pm 2.53 \times 10^3$ as recorded by Ibrahim–Shimaa [18], with 36% positive samples and the *S. aureus* count ranged from $3 \times 10^2$ to $5.40 \times 10^4$ with a mean value of $6.34 \times 10^3 \pm 1.02 \times 10^3/g$ Hassani–Faten [20], lower result 40% positive samples for *S. aureus* and the count (cfu/g) was ranged from $1.0 \times 10^2$ to $2.0 \times 10^3$ with a mean value of $8.71 \times 10^2 \pm 1.49 \times 10^2$ as recorded by Badr–Sarah [15].

Ahmed–Neven [22] could isolate *E. coli* serotypes of $O_{111}:H_{11}, 2\%$, $O_{55}:H_2, 2\%$, $O_{111}:H_7, 2\%$, $O_{111}:H_{21}$ (one ETEC strain) 2%, and $O_{111}:H_2, 4\%$ from kofta, respectively.

On the other hand, Badr–Sarah [15] could isolate were $O_{26}:H_{11}, 10\%$, $O_{44}:H_{18}, 3.33\%$, $O_{92}:H_{21}, 3.33\%$ and $O_{124}, 3.33\%$ and $O_{165}:H_2, 3.33\%$ from sausage, respectively.

*Staphylococcus aureus* intoxication is a worldwide problem where several food poisoning outbreaks were reported due to consumption of meat products contaminated with this organism. Accordingly, the *S. aureus* count can be taken as an index of sanitary conditions under which meat and its products are manufactured and handled [23]. The symptoms of staphylococcal food poisoning are abdominal cramps, nausea, vomiting, sometimes followed by diarrhea (never diarrhea alone). The onset of symptoms remission is observed after 24 hrs [24].

*Escherichia coli* was associated with human and animal infections as well as the most common cause of urinary tract infections in human; also it was found in suppurative lesions, neonatal septicemia and meningitis [25].

Infection due to *E. coli* $O_{26}$ have increased over the past 5 years Kaper and O’Brien [26], Locking., et al. [27] and the $O_{26}$ serogroup was the most common cause of HUS in the United States between 1983 and 2002 [28]. On the other hand, Willshaw., et al. [29] concluded that *E. coli* $O_{111}$ $O_{165}$ and $O_{111}$ have been associated with human infection [30].

Conclusion

The present study revealed that meat and some of meat products were contaminated with *E. coli* and *S. aureus* especially (beef burger, köfta and sausage). The unhygienic and poor sanitary conditions under which these meat products were handled and processed act as the causes of the high count of *staphylococci*, *S. aureus* and *E. coli* in this study. The contamination can be reduced by application of good manufacture practices.

Bibliography

8. Hejazi M A. "Microbial changes in cattle carcasses stored at chilling condition". M. V. Sc. (Meat hygiene) Faculty of Veterinary Medicine, Alexandria University (2013).
Incidence of *Staphylococci* and *E. coli* in Meat and Some Meat Products

15. Badr-Sarah. "Follow up of *E. coli* and Staphylococcus aureus in some locally manufactured meat products". M.V.Sc., Thesis (Meat Hygiene), Faculty of Veterinary Medicine, Benha University, Egypt (2018).


17. Talaat - Nagwa W. "Bacteriological and histological evaluation of some meat products". M. V.Sc. (Meat Hygiene), Faculty of Veterinary Medicine, Kafr El-Sheikh University, Egypt (2009).

18. Ibrahim-Shima. "Detection of *S. aureus* classic enterotoxin genes in some meat products using multiplex PCR". M. V.Sc. Thesis (Meat Hygiene), Faculty of Veterinary Medicine, Benha University, Egypt (2016).

19. Abd El Satter-Alaa M. "Incidence and importance of some pathogenic microorganisms contaminating meat product". M.V.Sc. Thesis (Meat Hygiene), Faculty of Veterinary Medicine, Benha University, Egypt (2016).


22. Ahmed-Neven M. "Traceability Diarrheogenic *E. coli* in meat products with special reference to Enterohemorrhagic Srtains". PhD, Thesis (Meat Hygiene), Faculty of Veterinary Medicine, Benha University, Egypt (2016).


30. Ahmed MN. "Incidence and occurance of salmonella and *E. coli* organisms in impacted meat products in Assiut". M.V.Sc. Thesis (meat Hygiene), Faculty of Veterinary Medicine, Assiut University, Egypt (1992).

**Citation:** Fahim A Shaltout, et al. "Incidence of *Staphylococci* and *E. coli* in Meat and Some Meat Products". *EC Nutrition* 14.7 (2019) : 538-544.