



Assessment of microbiological critical control points in Food processing and serving plant

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ABSTRACT

Restaurant chains are considered attractable places to people around the world; however prepared meals may be contaminated intentionally or accidentally. The examined samples (200) were collected from stages of preparation of grilled chicken (60), casserole beef and hawawshi (50 of each) as well as swabs from cutting boards, knives, mincer and worker hands (10 of each) in a food serving plant. The collected samples were bacteriologically examined for monitoring of APC, Enterobacteriaceae count, Coliform count, *Salmonellae*, *S.aureus*, *E.coli* and *Cl. perfringens*. The obtained results revealed that the most contaminated product was casserole beef followed by hawawshi and grilled chicken. The incidence of food borne pathogens were *S.aureus* (32%), *Salmonellae* (30.2%), *E.coli* (26.6%) and the lowest one was *Cl.perfringens* (8.8%).

Keywords: Bacteriological – plant –chicken –beef - hawawshi.

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1. INTRODUCTION

Restaurant chains are considered one of the most attractable places to people around the world, they attract to restaurants services, decorations and most of all quality of served food. The number of customers who are flocking to restaurants may expose to consumption of contaminated food. Restaurants vary greatly in appearance and offerings; include a wide variety of cuisines and service models ranging from inexpensive fast food restaurants and cafeterias to mid-priced family restaurants, to high priced luxury establishments. Some restaurants

serve all the major meals, such as breakfast, lunch and dinner (e.g., major fast food

chains, diners, hotel restaurants and airport restaurants). Other restaurants may only serve a single meal (e.g., lunch and dinner) or even kids' meal.

Food contamination at any food service establishment may be originated from raw food ingredients or poor food safety and hygiene. Improper handling and cooking, poor personal hygiene, inadequate cleaning methods and lack of facilities for the

segregation of raw and cooked food are significance for food contamination.

The failure of the food manufacture to assure the production and distribution of safe food products leads to many serious food borne diseases which cause considerable morbidity and mortality as well as reduction in economic productivity(*FAO, 1995*).

Globally, food safety problems in the most food serving establishments arise from bad holding (44%), inadequate cooking or reheating (9%), unsafe sources (18%), cross contamination from infected persons and contaminated equipment (27%) in addition to toxic chemicals (2%)(*WHO and FAO, 1999*).

Salmonellae, S.aureus, E.coli and Cl.perfringens are important bacteria causing food poisoning leading to gastroenteritis and other health complications (*Jay, 1992, Yves et al., 2003, CDC, 2009 and CDC, 2015*).

Therefore, the main target of the current study was to assess the bacteriological critical control points of some served foods as well as food instruments and handlers in food processing and serving plant through monitoring of different stages from receiving to serving.

2. MATERIAL AND METHODS

2.1. Collection of samples:

A total of 200 samples were collected from a food serving plant in Cairo including different stages of preparation till serving (raw, defrosted, marinated, defrosted and cooked) of grilled chicken (60), casserole beef and hawawshi (50 of each) and swabs

from cutting boards, knives, mincer and workers hands (10 of each).

The samples were kept in separate sterile plastic bags and transferred directly to the laboratory in ice box under complete aseptic condition to be bacteriologically examined.

2.2. Bacteriological examination:

2.2.1. Preparation of samples(ISO, 2003):

The samples were prepared according to the technique recommended by *ISO (2003)* as follows, 25 g of the examined samples were transferred to aseptic blender jar and 225 ml of 0.1% sterile buffered peptone water were aseptically added to the content of jar. Each sample was then homogenized in the blender at 2000 rpm for 1-2 minutes to provide a homogenate, from which tenth – fold serial dilutions were prepared.

2.2.2. Preparation of swabs (ISO, 2003):

Swabs are sterile cotton screw capped plastic tubes which are ready for use. A template made of metal having an exposed inner area of 10 cm² (2×5 cm) was used to delineate area of sampling. The templates were wrapped in aluminum foil and sterilized in hot air oven at 180°C for 20 minutes. Buffered peptone water (1%) was used as rinsing and diluent fluid. The solution was distributed to small heat resistant screw capped tubes, each containing 10 ml of rinsing fluid and then sterilized in the autoclave at 121°C for 20 minutes. For use, the sterilized template placed firmly against the surface of food contact surfaces and food handlers to limit the examined area. The sterile cotton swab was drawn from the tubes, moistened in rinsing fluid solutions. Finally, cotton swab was aseptically retained into the

rinsing fluid screw capped tubes containing 10 ml buffered peptone water 1%.

The prepared samples were subjected to the following examinations:

2.2.3. *Determination of Aerobic plate count*(**APHA, 2001**).

2.2.4. *Determination of Enterobacteriaceae count*(**ISO, 2004**).

2.2.5. *Determination of Coliform count* (**APHA, 2004**).

2.2.6. *Isolation and identification of Salmonellae*(**ISO, 2002**).

2.2.7. *Isolation and identification of S.aureus*(**FDA, 2001**).

2.2.8. *Isolation and identification of E.coli*(**APHA, 2004**)

2.2.9. *Isolation and identification of Cl.perfringens*(**Carter and Cole, 1990**).

3. RESULTS

The obtained results in table (1) and figure (1), showed that the highest mean value of APC (cfu/g) of examined chicken samples from receiving to serving was $2.6 \times 10^5 \pm 8 \times 10^4$ in defrosted chicken and the lowest was $5.5 \times 10^2 \pm 4.5 \times 10^2$ in grilled chicken, the highest mean value of examined meat samples was $4.3 \times 10^5 \pm 1.1 \times 10^5$ in raw meat and the lowest was $2 \times 10^3 \pm 1 \times 10^3$ in defrosted meat and the highest mean value of examined hawawshi samples was $2.8 \times 10^5 \pm 1.8 \times 10^5$ and the lowest was $2.2 \times 10^3 \pm 1 \times 10^2$ in defrosted meat. Also, in examined chicken samples the highest mean value of Enterobacteriaceae count (cfu/g) was $1.8 \times 10^5 \pm 1.3 \times 10^5$ in marinated chicken and the lowest was $1.2 \times 10^4 \pm 1.5 \times 10^3$ in defrosted chicken, the highest mean value of examined meat samples was $1.2 \times 10^4 \pm 1.5 \times 10^3$ in defrosted meat and the lowest was $2.8 \times 10^2 \pm 2.8 \times 10^2$ in casserole beef and the highest mean value in examined hawawshi samples was $1.6 \times 10^4 \pm 1 \times 10^4$ in minced meat and the lowest

was $6.7 \times 10^3 \pm 2.5 \times 10^3$ in frozen meat. Moreover, the highest mean value of Coliform count (cfu/g) in examined chicken samples was $3.5 \times 10^5 \pm 2.5 \times 10^5$ in frozen chicken and the lowest was $6.5 \times 10^3 \pm 1 \times 10^3$ in defrosted chicken, the highest mean value of examined meat samples was $1.1 \times 10^4 \pm 7.3 \times 10^3$ in chopped meat and the lowest was $1 \times 10^2 \pm 1 \times 10^2$ in frozen meat and the highest mean value of examined hawawshi samples was $9.4 \times 10^3 \pm 8.8 \times 10^3$ in frozen meat and the lowest was $4.3 \times 10^3 \pm 4.3 \times 10^3$ in minced meat.

As shown in table (2) and figure (2), the incidence of *Salmonellae*, *S.aureus*, *E.coli* and *Cl.perfringens* of examined samples from receiving to serving were 26.6%, 40%, 20% and 6.66% in grilled chicken. Also, in casserole beef, the incidences were 32%, 36%, 24% and 16%, respectively. On the other hand, these incidences were 32%, 20%, 36% and 4% in hawawshi.

The results in table (3) and figure (3), revealed that the highest mean value of APC (cfu/g) from contact surface swabs was $2.1 \times 10^5 \pm 1.8 \times 10^5$ from knives and the lowest was $3 \times 10^4 \pm 1.8 \times 10^4$ from workers hands in grilled chicken, the highest mean value was $2 \times 10^5 \pm 1.7 \times 10^5$ from knives and the lowest was $7.4 \times 10^4 \pm 8.6 \times 10^3$ from workers hands in casserole beef and the highest mean value was $2.5 \times 10^5 \pm 8.5 \times 10^4$ from mincer and the lowest was $9.2 \times 10^3 \pm 1.5 \times 10^3$ from workers hands in hawawshi, respectively. Also, in grilled chicken the highest mean value of Enterobacteriaceae count (cfu/g) was $1.5 \times 10^5 \pm 1.1 \times 10^5$ from cutting boards and the lowest was $8.8 \times 10^4 \pm 1.4 \times 10^4$ from knives, in casserole beef the highest mean value was $2 \times 10^5 \pm 1.7 \times 10^5$ from workers hands and the lowest was $5.7 \times 10^4 \pm 9.7 \times 10^3$ from cutting boards and knives and in hawawshi the highest mean

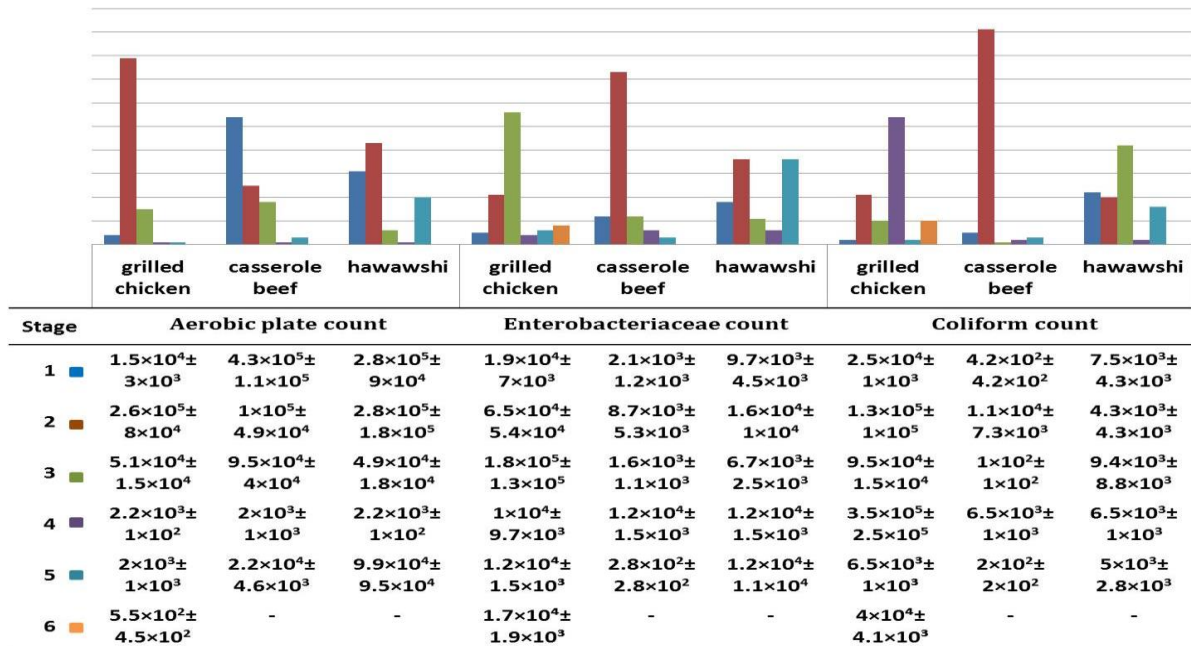
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value was $1.7 \times 10^5 \pm 1.4 \times 10^5$ from mincer and the lowest was $1.3 \times 10^4 \pm 1.6 \times 10^3$ from knives. Moreover, the highest mean value of Coliform count (cfu/g) was $1 \times 10^5 \pm 1.3 \times 10^4$ from cutting boards and the lowest was $8.1 \times 10^3 \pm 1.2 \times 10^3$ from workers hands in grilled chicken, the highest mean value was $2 \times 10^5 \pm 1.7 \times 10^5$ from knives and the lowest was $1.7 \times 10^4 \pm 2.8 \times 10^3$ from workers hands in casserole beef and the highest mean value was $1.1 \times 10^5 \pm 1.9 \times 10^4$ from knives and the lowest was $1.2 \times 10^4 \pm 2 \times 10^3$ from workers hands in hawawshi.

S.aureus, *E.coli* and *Cl.perfringens* from cutting boards swabs were 33.3%, 0%, 0% and 0% , from knives swabs were 33.3%, 66.6%, 0% and 33.3% and from workers hands were 0%, 33.3%, 66.6% and 0% in grilled chicken, 33.3%, 0%, 0% and 0% from cutting boards swabs, 0%, 33.3%, 0% and 0% from knives and 33.3%, 33.3%, 66.6% and 0% from workers hands in casserole beef and 0%, 33.3%, 0% and 0% from cutting boards, 0%, 0%, 33.3% and 0% from knives, 0%, 33.3%, 33.3% and 0% from mincer swabs and 0%,0%, 33.3% and 0% from workers hands in hawawshi.

In table (4) and figure (4), the results resembled that the incidence of *Salmonellae*,

Table (1) Figure (1): Mean values of APC,Enterobacteriaceae andColiform count (cfu/g) from receiving to serving of grilled chicken, casserole beef and hawawshi samples (n=10):



High significant differences (P<0.01)

Table (2) Figure (2): Percentage of bacterial incidence from receiving to serving of grilled chicken, casserole beef and hawawshi samples (n=10):

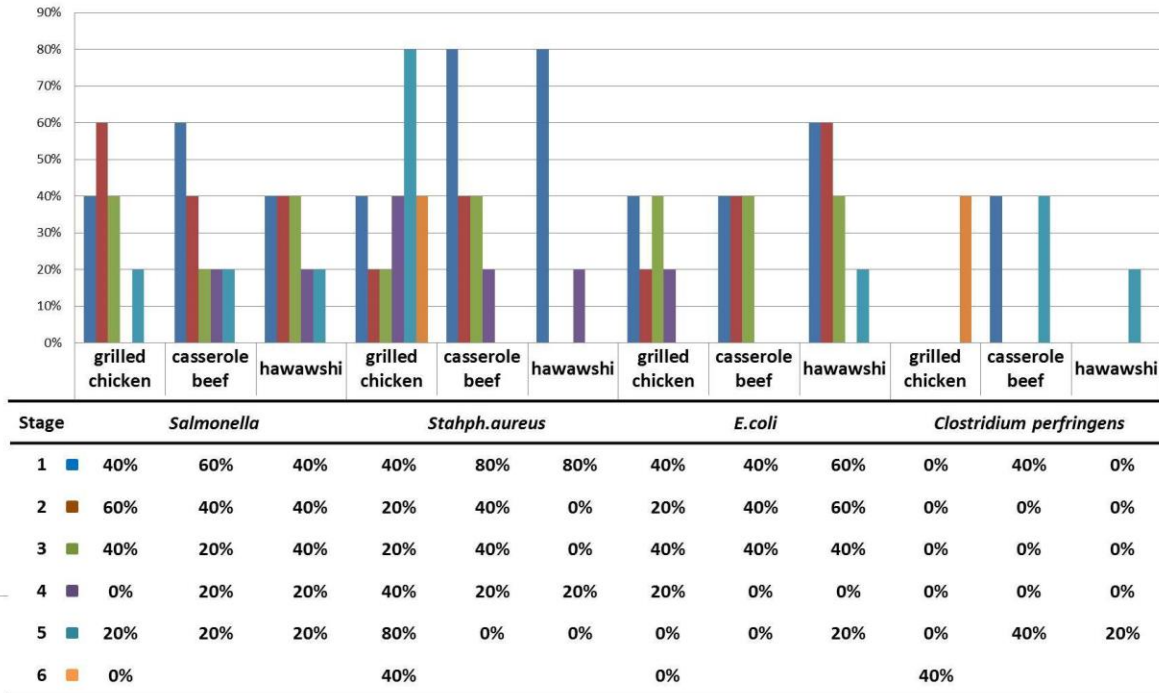
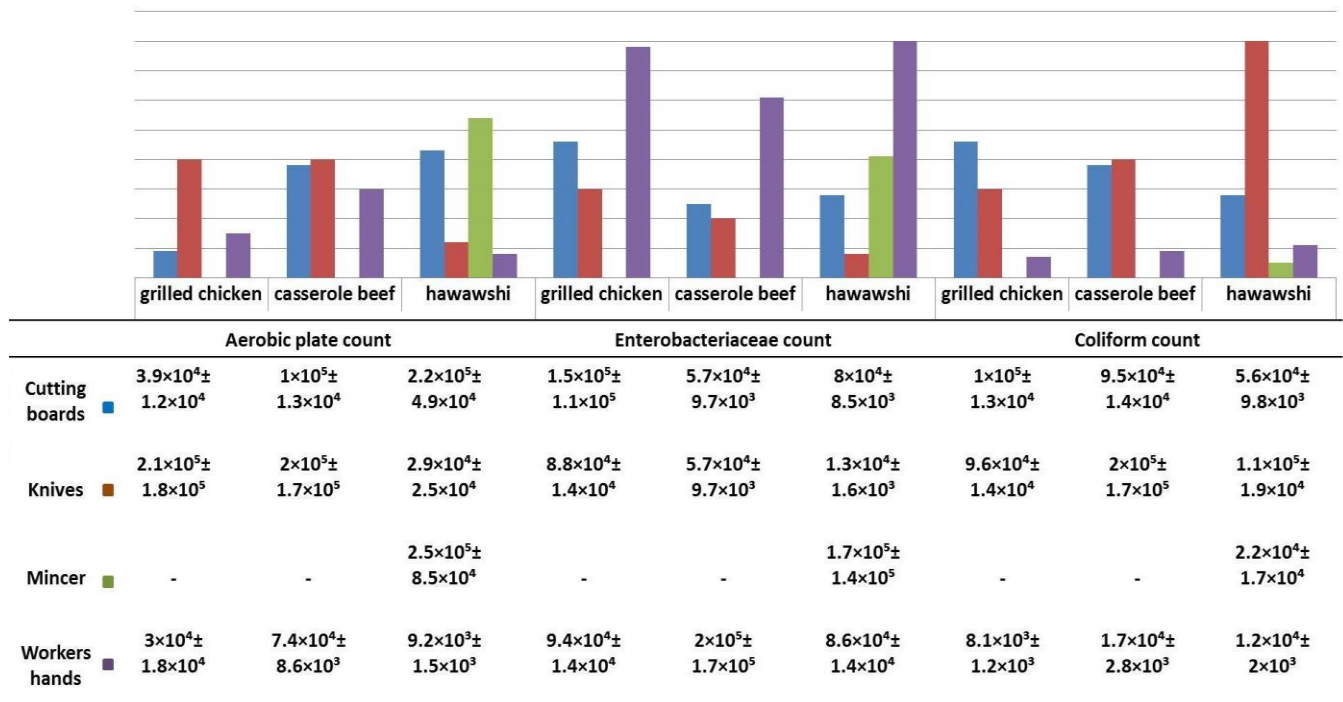


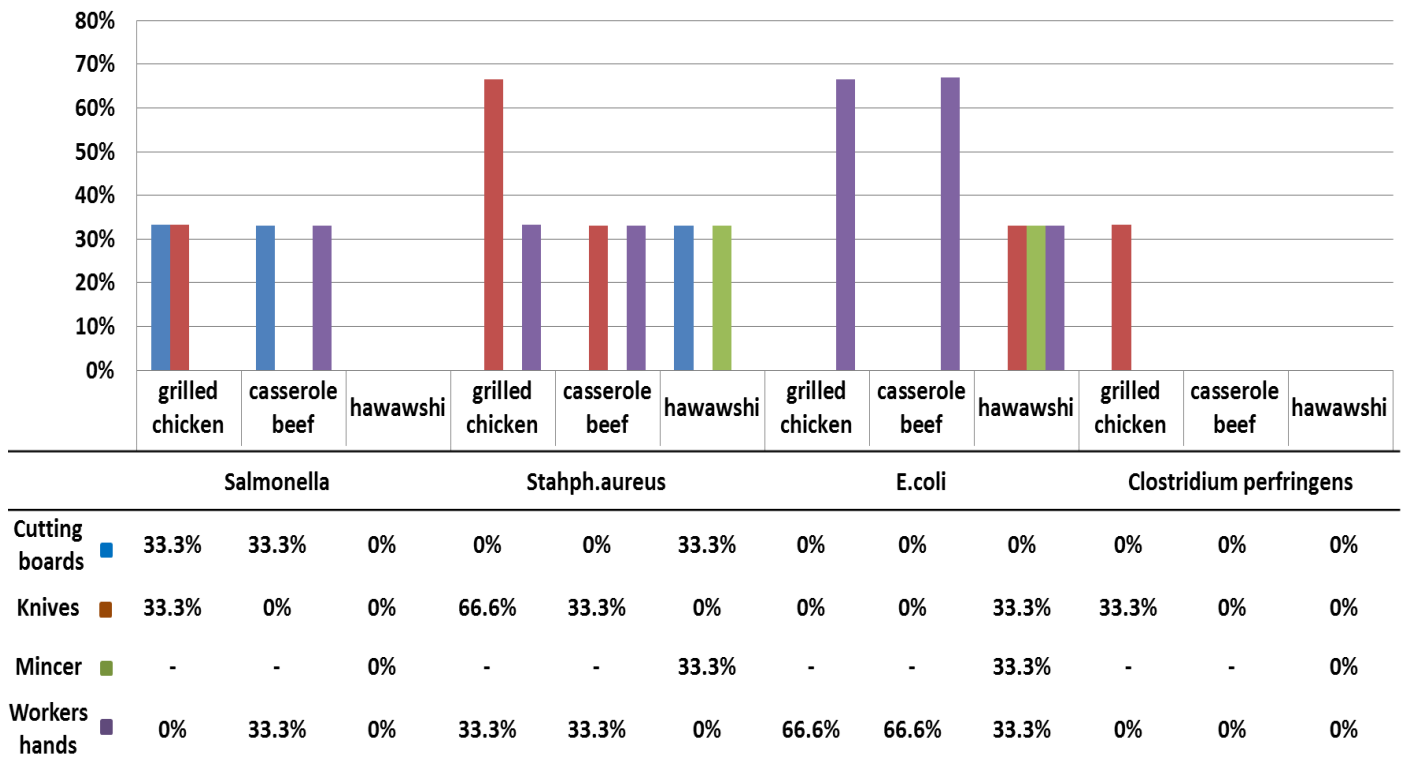
Table (3) Figure (3): Mean values of APC, Enterobacteriaceae and Coliform count (cfu/g) in swabs from contact surfaces and food handlers (n=10):

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High significant differences (P<0.01)

Table (4) Figure (4): Percentage of bacterial incidence in swabs from contact surfaces and food handlers (n=10):



4. DISCUSSION

As shown in table (1), the highest APC (cfu/g) in grilled chicken was 3.4×10^5 in defrosted chicken which reflects that the thawing process may occurred under the temperature danger zone which suitable for microbial growth. The obtained results were lower than those reported by *Abbas, O.M. (2011)* who found that APC in defrosted chicken was 9.1×10^7 (cfu/g) and higher than those reported by *Hashem(2015)* which was 2.6×10^4 (cfu/g), in casserole beef was 6.2×10^5 (cfu/g) in raw meat which reflects unhygienic and improper handling of animals during slaughter, dressing and evisceration. The obtained results were lower than those reported by *Radwa (2016)* which was 7.8×10^5 (cfu/g) and higher than *Vural (2006)* which was 3.6×10^5 (cfu/g) and in hawawshi was 4.5×10^5 (cfu/g) in raw meat and 6.1×10^5 (cfu/g) in minced meat which reflects unhygienic measures and improper handling of animals during slaughter, dressing and evisceration and unhygienic equipment and improper handling during mincing. Addition of certain spices during preparation may lead to marked increase in bacterial counts (*Sharaf, 1999*). The obtained results were nearly similar to those reported by *Vural (2006)* and *El-Taher(2009)*.

Also, the highest Enterobacteriaceae count (cfu/g) in grilled chicken was 3.2×10^5 in marinated chicken which may declare lack of sanitary conditions during preparation. Addition of certain spices during preparation may lead to marked increase in bacterial counts (*Sharaf, 1999*). The results were higher than reported by *Daif (1996)* and *NurYukesk et al. (2009)*, in casserole beef was 3.6×10^4 in chopped meat which may reveal lack of sanitary conditions and

improper handling during preparation. The results were nearly similar to those reported by *Ghanem (2009)* and *Hassan (2015)* and in hawawshi, the results was 3.6×10^4 in minced meat which refers to unhygienic equipment and improper handling during mincing. Addition of certain spices during preparation may lead to marked increase in bacterial counts (*Sharaf, 1999*). The results were higher than obtained by *Capita et al. (2002)*.

Moreover, the highest Coliform count (cfu/g) in grilled chicken was 6.1×10^5 in frozen chicken which indicate fecal contamination which may be due to bad personal hygiene. The results were higher than reported by *NurYukesk et al. (2009)*, in casserole beef was 3.6×10^4 in chopped meat which indicate lack of sanitary condition and improper handling during preparation. The results were higher than reported by *Radwa (2016)* and in hawawshi was 2.7×10^4 in frozen meat and 2.6×10^4 in defrosted meat which reflects bad personal hygiene during storage, transportation and during thawing. The results were lower than obtained by *Abdel-Hady (2015)*.

On the other hand, table (2) indicated that *S.aureus* the most incident bacteria in grilled chicken especially in defrosted chicken which indicate lack of sanitary condition and improper handling during thawing. The results were higher than reported by *Abou-Hussien (2007)*. In casserole beef, *S.aureus* is of highest incidence especially in raw meat which may due to improper handling during slaughtering, evisceration and receiving. The results were higher than obtained by *Saad et al. (2011)*. In hawawshi, *E.coli* is of highest incidence especially in raw meat and minced

meat which refers to fecal contamination due to bad personal hygiene during handling, slaughtering, evisceration and receiving. The results were higher than reported by *Saad et al. (2011)*.

In addition to, the highest mean value of APC (cfu/g) was $2.1 \times 10^5 \pm 1.8 \times 10^5$ from knives' swabs in grilled chicken. The results were lower than reported by *Khallaf (2014)*, $2 \times 10^5 \pm 1.7 \times 10^5$ from knives' swabs in casserole beef. The results were lower than reported by *Khallaf (2014)* and $2.5 \times 10^5 \pm 8.5 \times 10^4$ from mincer swabs in hawawshi. The results were lower than reported by *Radwa (2016)*. The high APC indicates lack of sanitary condition for food equipment. The highest mean value of Enterobacteriaceae count (cfu/g) was $1.5 \times 10^5 \pm 1.1 \times 10^5$ from cutting boards' swabs in grilled chicken. The results were lower than reported by *Khallaf (2014)*, $2 \times 10^5 \pm 1.7 \times 10^5$ from workers hands' swabs in casserole beef and $1.7 \times 10^5 \pm 1.4 \times 10^5$ from mincer swabs in hawawshi. The results were lower than reported by *Radwa (2016)*. The high Enterobacteriaceae count indicates improper handling and lack of sanitary condition for food equipment. The highest mean value of Coliform count (cfu/g) was $1 \times 10^5 \pm 1.3 \times 10^4$ from cutting boards swabs in grilled chicken. The results were higher than reported by *Khallaf (2014)*, $2 \times 10^5 \pm 1.7 \times 10^5$ from knives' swabs in casserole beef. The results were higher than reported by *Radwa (2016)* and $1.1 \times 10^5 \pm 1.9 \times 10^4$ from knives' swabs in hawawshi. The results were higher than reported by *Radwa (2016)*. The high Coliform count reflects bad personal hygiene through handling food equipment.

Moreover, the highest incident bacteria was *Salmonellae* from cutting boards swabs, *S.aureus* from knives and *E.coli* from workers hands in grilled chicken and casserole beef. *Staphylococcus aureus* was the highest from cutting boards and *E.coli* was the highest from knives, mincer and workers hands in hawawshi. Incidence of such pathogens refers to lack of sanitary condition and improper handling of food equipment.

5. CONCLUSION

In conclusion, some served foods in serving plants may be exposed to bacterial contamination as well as presence of some pathogens during different stages of preparation. Therefore, all the above mentioned results suggested the problems associated with consumption of food served in unhygienic plants. So, to improve the hygienic status and safety of served food, certain policies must be applied for public health safety.

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