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BACTERIAL STUDIES ON READY-TO EAT MEAT PRODUCTS VENDED IN DIFFERENT SHOPS AT GIZA GOVERNORATE

By

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ABSTRACT

This study aimed to bacteriological assessment of some street vended meat products sold by different shops and restaurants localized in different regions of Giza Governorate. A total of 350 samples were randomly collected from Ready to eat meat products including beaf kofta, beaf shawerma, chicken shawerma, pasterma, meat luncheon, sausage and chicken luncheon (50 of each). Each sample was kept in a separate sterile plastic bag and transferred while cold to the laboratory with minimum delay. All the collected samples were examined sensory and bacteriologically. The most incident bacterial isolates recovered from meat kofta, beaf shawerma, chicken shawerma, pasterma and sausage were *Staphylococcus aureus* (*S. aureus*) followed by *E. coli* and *Salmonella*. Concerning beaf and chicken luncheon samples, *E. coli* was recovered from 6 out of 50 samples (12 %) while *S. aureus* and *Salmonella* were not isolated. The obtained results revealed that, the retailed meat of different species might be exposed to microbial contamination from different sources at any stage (Processing, marketing or cooking). Presnece of any of the above mentioned bacterial species in such kinds of food is alarming as it represents a potential public health hazard. The neglection of sanitation, lack of experience and ignorance of food handlers are the major reasons for contamination of retailed meat products.

Key words:

Reatailed meat, ready to eat, *S. aureus*, *E. coli*, *Salmonella*.

INTRODUCTION

Meat products are important food items in most countries due to its contribution in solving the problem of shortage in food of animal origin. Also, they contain proteins at high levels and of high biological value **(Abu Zaid *et al.*, 2020).** Retail meat products play an important role in

filling the gap of protein deficiency and considered as choice in solving the human nutritional problems **(Zafar *et al*., 2016).**

Unfortunately, meat products are considered as ideal culture media for growth of many organisms because of the high moisture, high percentage of nitrogenous compounds, plentiful supply of minerals, some fermentable carbohydrates (Glycogen) and favorable pH for most microorganisms resulting in their spoilage, economic losses, foodborne infections in human and health risk **(Komba *et al.*, 2012).**

Therefore, bacteriological assessment of meat products and their environments at different stages of processing has to be conducted during the manufacture of ready-to-eat (RTE) types of meat products to ensure their safe consumption **(Sinew *et al*., 2013).**

Environmental contamination includes, air, water, dust, insects, rodents, vehicles, dirty floors, tables, holding pens, equipment and knives. In addition, contamination may occur during slaughtering, evisceration and dehiding, deboning, hands of butcher **(Little and De Louvois, 1998).**

The pathogenic contamination of meat and its products has prompted consumer fear and global concern, threatened trade and economic profit and stimulated ideas in developing new process control measures. Public awareness has increased, such that in recent surveys, food poisoning from meat was cited as the fifth biggest fear of U.S.A consumers **(Smith *et al.*, 2000).**

Technological development in meat processing, preservation and handling have given consumers much greater choice over the food they can buy. So, meat hygiene comprises very important issue in every aspect of processing from the health of the living animal to the distribution of the final product **(Soliman, 2013).**

As for the item of business, the processing and selling of RTE meat products have been widely carried out in almost all large supermarkets at present. Hence, the sanitary condition of the processing and selling of RTE meat products was surveyed in several Chinese regions and other countries **(Ghosh *et al.*, 2007).**

Since customers rarely reprocess these foods before consumption, food poisoning cases on account of RTE meat occasionally happen. Many studies have indicated the contamination of food caused by *E. coli*, *Salmonella typhi* and *S. aureus* during preparation, postcooking, and various handling stages **(Hanashiro *et al.*, 2005).**

GillespieI and Mitchell (2000) investigated cold sliced RTE meats from catering enterprises in the United Kingdom. They found that 74% of 3,494 samples met the standards of the European Union (EU), while 15 samples (<1%) were completely unacceptable. In Southern Italy supermarkets,10% (105/1045) of selected RTE food samples were detected with *Listeria monocytogenes* **(Di Pinto *et al.*, 2010).** In a word, unhygienic conditions behind RTE meat products may cause the final product contaminated with pathogens that increases the risk of food poisoning in consumers.

Pasterma, shawarma, luncheon and sausage are the most ready to eat sandwiches sold in fast food restaurants. There is an increase in the consumption of ready-to eat fast food because of changes in social patterns characterized by increased mobility, large numbers of itinerary workers and less family centered activities.Thus, good manufacturing practices of foods taken outside the home such as good sanitation or sanitary measure and proper food handling have been transferred from individuals/families to the food vendor who rarely enforces such practice **(Musa and Okande, 2002).**

Sandwiches are manipulated extensively during processing and there for have a potentiality for high bacterial contamination level on the surface and depth of meat so there is an increased risk of pathogens surviving and transferring not only by cross contamination but also through undercooking as in fast food industry **(Nimri- Laila *et al.*, 2014).**

The high number of bacteria in RTE foods indicates potential food safety risks and the need to improve the health of supermarket sales staff. The most important thing is to determine how to raise hygiene awareness of employees through food safety education. Meanwhile, a comprehensive set of regulations on hand cleaning and disinfection should be developed to facilitate public health and reduce foodborne illness caused by the consumption of RTE food **(Shaltout *et al.*,2019 and Wang *et al.*,2020).Abuzaid *et al.* (2020)** reported that, the bacterial counts and incidences in ready to eat meat products differ according to the type of meat products, degree of handling and hygienic measures.

Therefore, the present study aimed at thawing light on the most prevalent bacterial species in some street vended meat products through bacteriological investigations.

MATERIAL AND METHODS

1- Samples:

A total of 350 random samples of retailed meat representing ready to eat meat products including beaf kofta, beat shawerma, chicken shawerma, pasterma, beaf luncheon, sausage and chicken luncheon (50 of each) were collected from different retail shops. Each sample was kept in a separate sterile plastic bag and transferred cold to the laboratory with a minimum of delay.

2- Bacteriological examination.

2. 1. Bacteriological isolation (ISO 6887-2, 2003 and ISO 4832, 2006):

Five grams from each sample were transferred into a sterile homogenizer flask containing 45 ml of 0.1 % sterile peptone water.

After sample preparation, samples were cultivated and incubated to isolate *S. aureus, E. coli* and *salmonella*. Isolates were identified morphologically and biochemically.

Suspected isolates were subjected to biochemical tests namely, indole production test, methyl red test, Voges-Proskauer test and citrate utilization test where *E. coli* profile was defined as ++-- with the tets, respectively. In addition, urease test, TSI agar test and sugar fermentation tests were carried out to ensure identification.

Identification of salmonella isolates was conducted according to **(Cruickshank *et al.*, 1975; ICMSF, 1978; ICSMF, 1996).** After Gram staining and morphological examination, the suspected isolates were subjected to biochemical identification employing the tests mentioned above with *E. coli*.

Isolation of *S. aureus* was carried out using Baird-parker agar as a selective medium. Identification was carried out as described by **Koneman *et al*. (2004).**

Statistical analysis:

Statistical analysis was carried out using one way analysis of variance (ANOVA) for determinations of the minimum, maximum and mean values of the different organisms. Also Chi^2-test was used for determination of the significance of the incidences of different isolated organisms among examined samples according to **(SAS, 2004).**

RESULTS

A-Incidences of different bacteria in the examined meat products.

1-Kofta:

Results depicted in (Table 1) indicate that, the incidences of different species of bacterial isolates recovered from kofta differ ($P < 0.01$). The highest incidence was *S. aureus* (29/50: 58 %) followed by *E. coli* 10 (10/50: 20%) and *Salmonella* 4 (4/50: 8%).

Table (1): Incidences of different bacteria in kofta samples.

Bacteria	Number	Percentage
S. aureus	**29**	**58**
E. coli	**10**	**20**
Salmonella	**4**	**8**
Negative samples	**7**	**14**
Total	**50**	**100**

$Chi^2 = 5.35$** **** = Significant at ($P < 0.01$)**

2-Beaf shawerma:

Conecrning beaf shawerma, the results depicted in (Table 2), Fig (2) indicate that *S. aureus* was the most prevalent species (12/50: 26%) followed by *E.coli* 9 (9/50:18%) and *Salmonella* 4 (4/50: 8%).

Table (2): Incidences of different bacteria in beaf shawerma samples.

Bacteria	Number	Percentage
S. aureus	**13**	**26**
E. coli	**9**	**18**
Salmonella	**4**	**8**
Negative samples	**24**	**48**
Total	**50**	**100**

$Chi^2 = 8.25$** **** = Significant at ($P < 0.01$)**

3-Chicken shawerma:

Of 50 chicken shawerma samples (Table 3), *S. aureus* was isolated from 10 (20%) followed by *E. coli* (12%) and *salmonella* (6%).

Table (3): Incidences of different bacteria in chicken showerma samples.

Isolated bacteria	Number	Percentage
S. aureus	**10**	**20**
E. coli	**6**	**12**
Salmonella	**3**	**6**
Negative samples	**31**	**62**
Total	**50**	**100**

Chi^2 = 8.25** **** = Significant at (P < 0.01)**

4-Pasterma:

Out of 50 pasterma samples (No.= 50), results observed in (Table 4) show that *S. aureus*, *E. coli* and *salmonella* were recovered from 32, 12 and 12 samples in percentages of 64 %, 24% and 24 %, respectively.

Table (4): Incidences of different bacteria in pasterma samples.

Bacteria	Number	Percentage
S. aureus	**32**	**64**
E. coli	**12**	**24**
Salmonella	**0**	**0**
Negative samples	**6**	**12**
Total	**50**	**100**

Chi^2 = 8.25** **** = Significant at (P < 0.01)**

5-Beaf luncheon:

As shown in (Table 5), *E. coli* was the only recovered from 6 out of 50 beaf luncheon samples (12%).

Table (5): Incidences of different bacteria in meat luncheon samples.

Bacteria	Number	Percentage
E. coli	**6**	**12**
S. aureus	**0**	**0**
Salmonella	**0**	**0**
Negative samples	**44**	**88**
Total	**50**	**100**

Chi2 = 5.21** **** = Significant at (P < 0.01)**

6- Chicken luncheon:

E. coli was recovered from 7 out of 50 chicken luncheon samples (14%) while neither *S. aureus* nor *salmonella* was recovered (Table 6).

Table (6): Bacterial incidence in chicken luncheon samples.

Isolated bacteria	Number	Percentage
E. coli	**7**	**14**
S. aureus	**0**	**0**
Salmonella	**0**	**0**
-ve samples	**43**	**86**
Total	**50**	**100**

Chi^2 = 4.25** **** = Significant at (P < 0.01)**

7- Beaf sausage:

As shown in (Table 6), *S. aureus* recorded the highest incidence beaf sausage (28 %) followed by *E. coli* (18 %) and *Salmonella* (6 %).

Table (6): Incidences of different bacteria in meat sausage samples.

Bacteria	Number	Percentage
S. aureus	**14**	**28**
E. coli	**9**	**18**
Salmonella	**3**	**6**
Negative samples	**24**	**48**
Total	**50**	**100**

Chi^2 = 10.22** **** = Significant at (P < 0.01)**

B- The overall incidences of *S. aureus, E. coli* and *Salmonella* in different types of meat products:

Out of 350 meat product samples, 171 were positive for bacterial isolates recovered in this study (48.85%) with *S. aureus* being the most prevalent (60.81% of the isolates and 29.71% of the samples) followed by *E. coli* (30.99% of the isolates and 15.14% of the samples) and *salmonella* (8.18% of the isolates and 4% of the samples). Concerning the contamination

level, the examined products can be listed in order starting with the highly contaminated product as follows: pasterma, kofta, beaf shawerma and susage, chicken shawerma, chicken luncheon and beaf luncheon with 88%, 86%, 52%, 38%, 14% and 12%, respectively of the samples resulted in positive bacterial isolation (Table 8). From the table, pasterma and kofta were the most polluted while beaf and chicken luncheon were the least polluted.

Table (8): The overall incidence of *S. aureus, E. coli* and *Salmonella* in different types of meat products.

The product	S. aureus		*E. coli*		*Salmonella*		Total	
	No.	%	No.	%	No.	%	No.	%
Kofta	29	58	10	20	4	8	43	86
Beaf shawerma	13	26	9	18	4	8	26	52
Chicken shawerma	10	20	6	12	3	6	19	38
Pasterma	32	64	12	24	0	0	44	88
Beaf luncheon	6	12	0	0	0	0	6	12
Chicken luncheon	0	0	7	14	0	0	7	14
Beaf sausage	14	28	9	18	3	6	26	52
Total/No. of isolates (171)	104	60.81	53	30.99	14	8.18	171	100
Total to/No. of samples (350)	104	29.71	53	15.14	14	4	171	48.85

DISCUSSION

Ready-to-eat (RTE) food refers to the prepared food that can be consumed immediately or after taking a few steps such as heating before consuming **(Microbiological Guidelines, 2007; Thienhirun and Chung, 2018).**

RTE food is easily contaminated by a variety of foodborne pathogens and would be a major source of foodborne diseases. Meat and meat products are considered to be excellent sources of support for the growth of such pathogens **(El-Shenawy *et al.*,2016).**As social, demographic, and consumption trends change, the proportion and types of meat and meat products, as well as RTE foods, have steadily increased on the international market **(Havelaar *et al.*, 2010; Sofos, 2008).**

Results of the present study indicated contamination of heat processed meat products with bacteria during storage and handling through the equipment and workers. The results agreed

with those of **Syne *et al*. (2013)** where they reported that, both pre-and post-cooking air and surfaces including equipment and gloves of employees had relatively high levels of *S. aureus* and coliforms. Adrastic decrease in aerobic counts and *S. aureus* levels following heat treatment and subsequent increase in counts of these bacteria are suggestive of post-cooking contamination.

Also, the presence of anerobic bacteria in heat processed meat products, indicate the lack of sanitary measures during processing, handling and storage that may act as main sources of food contamination **(Torky, 2004).**

The high level of bacterial existence in different ready to eat meat products could be attributed to over handling of such products. Also, the spices added during manufacturing may represent another source of contamination which is the case of sausage. Concerning pasterma, luncheon and kofta characterized, less handling and good preservation may result in less bacterial contamination **(Ahmed, 2002).**

Torkey (2004) reported that, the lack of sanitary measures during processing, handling and storage may act as the main source of food contamination with bacteria. In a similar study, **Soliman (2013)** surprisingly reported that bacterial contamination was detected in luncheon, hot dog and frankfurter in 94%, 85.7% and 82.8% of the examined samples, respectively. The presence of high count of bacteria in heat-processed meat may be attributed to the high content of curing salts and spices in addition to all problems of fluctuation of temperature during cooking. The bacterial load of sausage may be due to several reasons such as cross-contamination during processing in addition to unsanitary conditions during handling, storage, transportation and marketing **(Hemmat. M. Ibrahim *et al.*, 2014)**.

Presence of Enterobacteriaceae in high incidences is a proof for enteric contamination. Carelessness during animal evisceration leads to intestinal rupture and release of intestinal contents will lead to heavy contamination of different carcass parts by enteric bacteria **(Mercuri and Cox, 1979).**

The presence of Enterobacteriaceae members in sausage indicates poor sanitary conditions in the butcher's shops especially mincing machines used for meat mincing wthout periodical washing or cleaning.

Fathi *et al.* (1994) reported that, the incidence of *E. coli* in luncheon was 41.67% in samples collected from different shops in Assiut city.

E. coli is the most common organism in the intestinal tract of human and animals. It has a traditional role in food and water microbiology as an index of faecal contamination. The presence of *E. coli* in food is mainly associated with outbreaks of gastroenteritis syndrome**.** The presence of *E. coli* in food may induce severe diarrhea in infants and young children as well as cases of food poisoning among consumers andit was also implicated in cystitis, pyelonephritis and pyelitis. **(Hamdy *et al.*, 1989).** In a study conducted in Egypt by **Marzouk (1985),** *E. coli* was the cause of 54% of diarrhea in infants.

As reported in the current study, **Fatin (2004)** reported the highest rate of contamination with *E. coli* was in sausage (20%) followed by beef burger (12%), kofta (8%) and luncheon (4%). Similarly, 5 *E. coli* serovars were recorded by **Azab Rashaan (2010) and Mohammed *et al* (2014)** in beef sausage samples.

Our results agreed also with results of **Azab-Rasha, 2010** where they reported that, the incidence of *E. coli* in the examined beef kofta samples, 6 serovars were recorded as O111, O26, O91, O128, O86, and O146. Finally, O119 was the only serovar isolated from beef luncheon.

Concerning *salmonell*a, the highest incidences observed in this study were in kofta samples (8 %). On serotyping, *salmonella* serotypes were polyvalent O125 (2), poly valent O78 (4), polyvalent O114 (9) and polyvalent O55 (2).

Changes in the prevalence of specific *salmonella* serotypes can result from the movements of people, animals and foods **(Chang *et al.*, 2016)**.

Fatin (2004) detected *salmonella* organisms in 12%, 8% and 4% of sausage kofta and beef burger samples, respectively. Meanwhile, samples of luncheon were all *salmonella*-free.

S. Enteritidis and *S. Typhimurium* have been most frequently implicated in salmonellosis outbreaks from foods in Taiwan, Greece, Qatar and South Africa **(Smith *et al.*, 2000; Papadopoulos *et al.*, 2016; Hung *et al.*, 2017).**

In the present study, the highest incidence of *S. aureus* was observed in kofta and chicken shawerma (12 % each), followed by pasterm (8 %), beaf shawerma (4 %) and chicken luncheon samples (2 %). Presence of *S. aureus* is suggestive of post-cooking contamination **(Syne *et al.*, 2013).**

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