Bacterial Status of Food Meals served at Governmental Hospital

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A B S T R A C T

A grand total of 80 random samples of cooked beef and chicken meat (40 of each) represented by boiled beef (20), fried beef (20), boiled chicken meat (20) and fried chicken meat (20)sample weight 100gram from a governmental hospital at various times in Kalyobia governorate, Egypt were collected for microbiological examination. The average values of APC, Enterobacteriaceae, coliform and staphylococcal counts were $5.07x10^4 \pm 1.12x10^4$, $7.48x10^4 \pm 1.29x10^4$, $5.67x10^3 \pm 0.87x10^3$ and $3.27x10^3 \pm 0.46x10^3$ cfu/g for boiled beef meat ,$8.31x10^3 \pm 2.05x10^3$, $3.95x10^3 \pm 0.62x10^3$, $2.01x10^3 \pm 0.33x10^3$ and $9.58x10^3 \pm 2.08x10^3$cfu/g for fried beef meat, $9.64x10^4 \pm 2.25x10^2$., $2.21x10^4 \pm 0.38x10^4$, $1.06x10^4 \pm 0.17x10^4$ and $4.42x10^3 \pm 0.75x10^4$ cfu/g for boiled chicken meat and $7.18x10^4 \pm 1.44x10^4$, $8.73x10^3 \pm 1.96x10^3$, $6.40x10^3 \pm 1.23x10^3$ and $2.10x10^3 \pm 0.32x10^3$ cfu/g for fried chicken meat. Moreover, the incidence of serologically identified *E. coli* as Enteropathogenic *E. coli* (*E. coli* O_1:H_7, *E. coli* O_{78} and *E. coli* O_{114}: H_{21}), Enterotoxogenic *E. coli* (*E. coli* O_{125}:H_{18}) Enteroheamorrhagic *E. coli* (*E. coli* O_{26}:H_{11} and *E. coli* O_{111}:H_4) and Enteroinvasive *E. coli* (*E. coli* O_{124}). The public health importance of the isolated microorganisms and the recommended points were discussed.

Keywords: Food meals, Enterobacteriaceae, staphylococci, coliform.

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1. INTRODUCTION

Meat is considered as an important source of protein, essential amino acids, B complex vitamins and minerals. Therefore, it offers a highly favorable environment for growth of pathogenic bacteria. Poultry meat is one of the most popular food products worldwide containing several nutritional factors such as high level of protein and low fat content. On the other hand, poultry meat is an excellent substrate for the growth of a wide variety of microorganisms including pathogens and spoilage microorganisms. The importance of safe food for hospitalized patients and the detrimental effect that contaminated food could have on their recovery have been emphasized (Kandela, 1999). Patients receiving foods from a single kitchen with poor food handling practices could suffer a foodborne infection, which could result in an outbreak involving the whole hospital (Ayliffe, 1992). Outbreaks of foodborne infections in hospitals are preventable, but facilitated by several factors; these include staff carriers, poor hygiene conditions in the kitchens, carelessness, and lack of training of food handlers. The particular danger of contaminated food in hospitals is that such food is given to consumers in poor health (Custovic and Ibrahimagic, 2005). Improper practices responsible for microbial foodborne illnesses have been well documented by (Egan et al. 2007) and typically involve cross-contamination of raw and cooked food, inadequate cooking, and storage at inappropriate temperatures. Food handlers may also be asymptomatic carriers of food poisoning organisms. There is general agreement that good overall level of knowledge of food safety among food handlers and the effective application of such knowledge in food handling practices are essential in ensuring the consistent production of safe food in restaurant operations (Bolton et al., 2008). The level of Enterobacteriaceae as well as aerobic bacterial count in poultry carcasses can be routinely used as indicators of improper hygiene during processing and incorrect storage conditions, which can lead to proliferation of pathogens (Robert et al., 1995 and Zweifel et al., 2005). The presence of fecal *coliform* in meat generally indicates direct and indirect contamination of fecal origin, improper handling and storage (Charlebois et al., 1991). In addition, *E. coli* was associated with human and animal infections causing suppurative lesions, neonatal septicemia and meningitis (Collins et al., 1991). Moreover, *Staphylococcus aureus* is one of the most food poisoning microorganisms due to production of toxins Therefore, the aim of the present study was to evaluate the microbiological status of boiled and fried beef and chicken meats at hospital restaurant to investigate their microbiological status.

2. MATERIALS AND METHODS

2.1. Collection of Samples:

A grand total of 80 random samples of cooked beef and chicken meat (40 of each) represented by boiled beef (20), fried beef (20), boiled chicken meat (20) and fried chicken meat (20) sample weight 100gram were collected from a governmental hospital at various times in Kalyobia governorate, Egypt. Each sample was kept in a separated sterile plastic bag and preserved in an ice box then transferred to the laboratory under complete aseptic conditions without undue delay and then subjected to following examination.

2.2. Preparation of Samples:

The samples were prepared according to the technique recommended by ICMSF (1996) as follows: 10 grams of the examined sample, 90 ml of sterile peptone water were added and thoroughly homogenized using sterile blender for 1.5 minutes, from which ten fold serial dilutions, was prepared.

2.3. The prepared samples were subjected to the following examination:

Determination of aerobic plate count: According to (ICMSF, 1996). Determination of Enterobacteriaceae count: According to (Gork, 1976). Determination of coliform count: According to (ICMSF (1996). Identification of Enterobacteriacea*:* according to Cowan and Steel (1974). Screening for Enteropathogenic *Escherichia coli*: According to (ICMSF, 1996) and (Kok et al. (1996). Determination of total Staphylococci count: According to (ICMSF, 1996), (MacFaddin, 2000) and *(*Bailey and Scott, 1978 and APHA, 1984) and (Lachia et al., 1971).

3. RESULTS

It is evident from the result recorded in table (1) that APC in the examined samples varied from3.6x 10^3 to 4.5x10^5 with an average of 5.07x10^4 ± 1.12x10^4 /(cfu/g) for boiled beef, 7.9x10^2 to 1.7x10^5 with an average of 8.31x10^3 ± 2.05x10^3 /(cfu/g) for fried beef , 7.1x10^3 to 6.9x10^5 with an average of 9.64x10^4 ± 2.25x10^4/(cfu/g) for boiled chicken meat and 1.04x10^3 to 3.5x10^5 with an average of 7.18x10^4 ± 1.44x10^4 /(cfu/g) for fried chicken meat. The difference between the examined samples of beef and chicken meat were highly significant (*P*<0.01). Also, high significant difference (*P*<0.01) appeared between boiling and frying as cooking method. It is evident from the result recorded in table(2) that the higher average of Enterobacteriaceae counts/g was recorded in the examined boiled beef samples (7.48×10^4± 1.29×10^4 cfu/g) and the lower one was in the examined fried beef samples which was (3.95×10^3± 0.62×10^3

cfu/g). Moreover, the average of Enterobacteriaceae counts/g of examined boiled and fried chicken meat samples were $2.21\times10^4\pm 0.38\times10^4$ and $8.73\times10^3\pm 1.96\times10^3$ cfu/g, respectively. In other words, there is a highly significant difference of Enterobacteriaceae between the examined meat (beef and chicken) *(P< 0.01)*. From the results given in Table (3), it is obvious that the total coliform counts/(cfu/g) in the examined samples of boiled and fried beef and chicken meat at hospital restaurant ranged from 5.3×10^2 to 1.7×10^4 cfu/g with an average of $5.67\times10^3\pm 0.87\times10^3$ cfu/g for boiled beef meat , 1.0×10^2 to 8.5×10^3 cfu/g with an average of $2.01\times10^3\pm 0.33\times10^3$ cfu/g for fried beef meat, 2.1×10^3 to 4.8×10^4 cfu/g with an average of $1.06\times10^4\pm 0.17\times10^4$ cfu/g for boiled chicken meat and 4.0×10^2 to 1.9×10^4 cfu/g with an average of $6.40\times10^3\pm 1.23\times10^3$ cfu/g for fried chicken meat. In other words, there is significant difference of coliform count between the examined meat (beef and chicken) *(P<0.01)*. Table (4) indicated that the mean values of total staphylococcal count/(cfu/g) in the examined samples of boiled and fried beef and chicken meat at hospital restaurant were $3.27\times10^3\pm 0.46\times10^3$/(cfu/g) for boiled beef meat, $9.58\times10^3\pm 2.08\times10^3$/(cfu/g) for fried beef meat, $4.42\times10^3\pm 0.75\times10^4$/(cfu/g) for boiled chicken meat and $2.10\times10^3\pm 0.32\times10^3$/(cfu/g) for fried chicken meat. Results indicated that the differences of total staphylococcal count between the examined samples of meat (beef and chicken) were highly significant (*P*<0.01).

Table (5) declared that the incidence and serotyping of Enteropathogenic *E.coli* isolated from the examined samples of boiled and fried beef and chicken meat at hospital were O26: H11 EHEC(5%), O111: H4 EHEC (5%), O114: H21 EPEC (5%) for boiled beef meat, O26: H11 EHEC(5%), O125: H18 ETEC (5%) for fried beef meat but in fried chicken meat O1: H7 EPEC(5%), O78 EPEC (5%), O125: H18 ETEC(5%) was isolated. From boiled chicken meat O1: H7 EPEC (5%), O78 EPEC (10%), O114: H21 EPEC (5%) and O124 EIEC (5%) were isolated.

Table (1): Statistical analytical results of Aerobic plate counts/g (APC) in the examined samples of boiled and fried meat at hospital restaurant (n=20).

Food Item	Beef			Chicken meat ++		
Cooking Method	Min	Max	Mean ± S.E*	Min	Max	Mean ± S.E*
Boiling ++	3.6×10^3	4.5×10^5	$5.07\times10^4\pm 1.12\times10^4$	7.1×10^3	6.9×10^5	$9.64\times10^4\pm 2.25\times10^4$
Frying	7.9×10^2	1.7×10^5	$8.31\times10^3\pm 2.05\times10^3$	1.4×10^3	3.5×10^5	$7.18\times10^4\pm 1.44\times10^4$

S.E* = standard error of mean. t- Test indicated high significant differences (*P*<0.01) either between the examined food items or cooking methods

Table (2): Statistical analytical results of Enterobacteriacae counts/g in the examined samples of boiled and fried meat at hospital restaurant (n=20).

Food Item	Beef			Chicken meat ++		
Cooking Method	Min	Max	Mean ± S.E*	Min	Max	Mean ± S.E*
Boiling ++	8.4×10^2	2.9×10^4	$7.48\times10^4\pm 1.29\times10^4$	4.3×10^3	1.1×10^5	$2.21\times10^4\pm 0.38\times10^4$
Frying	3.0×10^2	1.5×10^4	$3.95\times10^3\pm 0.62\times10^3$	9.0×10^2	5.7×10^4	$8.73\times10^3\pm 1.96\times10^3$

Table (3): Statistical analytical results of total coliform counts/g in the examined samples of boiled and fried meat at hospital restaurant (n=20).

Food Item	Beef			Chicken meat ++		
Cooking Method	Min	Max	Mean ± S.E*	Min	Max	Mean ± S.E*
Boiling ++	5.3×10^2	1.7×10^4	$5.67\times10^3\pm 0.87\times10^3$	2.1×10^3	4.8×10^4	$1.06\times10^4\pm 0.17\times10^4$
Frying	1.0×10^2	8.5×10^3	$2.01\times10^3\pm 0.33\times10^3$	4.0×10^2	1.9×10^4	$6.40\times10^3\pm 1.23\times10^3$

Table (4): Statistical analytical results of total Staphylococci counts/g in the examined samples of boiled and fried meat at hospital restaurant (n=20).

Food Item	Beef			Chicken meat ++		
Cooking Method	Min	Max	Mean ± S.E*	Min	Max	Mean ± S.E*
Boiling ++	1.0×10^2	7.0×10^3	$3.27\times10^3\pm 0.46\times10^3$	3.0×10^2	1.0×10^4	$4.42\times10^3\pm 0.75\times10^4$
Frying	1.0×10^2	2.0×10^3	$9.58\times10^3\pm 2.08\times10^3$	1.0×10^2	5.0×10^3	$2.10\times10^3\pm 0.32\times10^3$

Table (5): Incidence and serotyping of *Enteropathogenic E.coli* isolated from the examined samples of boiled and fried meat at hospital restaurant (n=20).

Food Item	Boiled beef		Fried beef		Boiled chicken meat		Fried chicken meat		Strain Characteristics
E.coli strains	No.	%	No.	%	No.	%	No.	%	
O1 : H7	-	-	-	-	1	5	1	5	EPEC
O26 : H11	1	5	1	5	-	-	-	-	EHEC
O78	-	-	-	-	2	10	1	5	EPEC
O111 : H4	1	5	-	-	-	-	-	-	EHEC
O114 : H21	1	-	-	-	1	5	-	-	EPEC
O124	-	-	-	-	1	5	-	-	EIEC
O125 : H18	-	-	1	5	-	-	1	5	ETEC
Total	3	15	2	10	5	25	3	5	

Enteropathogenic *E. coli* (EPEC). Enterotoxogenic *E. coli* (ETEC). Enterheamorrhagic *E. coli* (EHEC). Enteroinvasive *E. coli* (EIEC)

4. DISSCUSION

It is evident from the result recorded in table (1) that the total APC in examined samples nearly similar to that obtained by El-Mehrath (2005) who mentioned that the mean value of aerobic plate count in boiled beef meat were 1.3 x10^3 cfu/g. In fried meat, the mean APC values were 1.6 x10^3 cfu/g. Ali (2011) mentioned that the mean value of aerobic plate count fried beef burger was 6.33 x 10^4 ± 1.84 x 10^4cfu/g for cooked beef. On the other hand, the total APC in examined samples nearly similar to that obtained by Arab (2010) who mentioned that the mean value of aerobic plate count in fried chicken pane were 6.3 x 10^4 $\pm$0.35 x 10^4 cfu/g for cooked chicken meat. Higher APC in duck meat obtained by Daif (1996) who found that the mean value of APC was 1 x 10^8 in examined ready to eat cooked meat. While Zaki, R., et al. (2012) who mentioned that the mean value of aerobic plate count in fried chicken sandwiches was 1.3x10^6±1.2x10^6 CFU/g. The obtained results may be explained as cooking cannot destroy all microorganisms, therefore, the holding of cooked foods at ambient temperature for several hours is the primary contributory factor for the growth and multiplication of such organisms (Bryan et al., 1997). The spoilage bacteria can multiply very quickly if the cooked food is stored at room temperature (WHO, 2003). Enterobacteriaceae may be superior to the coliforms as indicators of sanitation (GMPs) because they have collectively greater resistance to the environment than the coliforms and can be colonized in an inadequate sanitation and are sensitive to sanitizers. Thus, the Enterobacteriaceae are useful for monitoring sanitation in food manufacturing plants (Kornacki and Johnson 2001). As well as the Enterobacteriaceae counts are used as a hygiene indicator of foods of animal origin (Arthur et al., 2004 and Crowley et al., 2005). Nearly similar results were obtained by Ali (2011) who found the average number of Enterobacteriaceae in fried beef burger was $1.13 \times 10^3 \pm 0.25 \times 10^3$cfu/g. for cooked beef. Also Ali (2011) found the average number of Enterobacteriaceae in fried chicken meat were $9.81 \times 10^3 \pm 2.66 \times 10^3$/ (cfu/g) for cooked chicken. Higher total Enterobacteriacae count was obtained by Al-Tawab (2004) who found the average number of Enterobacteriaceae in$1.6 \times 10^7 \pm 2.5 \times 10^6$in Kofta. The high Enterobacteriaceae counts are an indication of potential microbial contamination during processing, distribution and storage. Their presence in large numbers in food indicates inadequate processing/or recontamination due to cross contamination by raw materials, dirty equipment or unhygienic handling (Ikeme, 1990). As well as presence of Enterobacteriaceae in the food is an indication of improper hygienic measures during the entire sequence of processing (Gill and Landers, 2004). Enterobacteriaceae have an epidemiological importance as some of their members are pathogenic and may cause serious infections and food poisoning outbreaks to human being. Furthermore, the Enterobacteriaceae count can be taken as indicator of possible enteric contamination in the absence of coliform organisms (Mosupye and Van Holy, 2000). The current results were nearly similar with those obtained by El-Taher-Amna (2009) who found that the mean values of total coliform counts were $3.48 \times 10^3 \pm 0.63 \times 10^3$,$2.81 \times 10^3 \pm 0.47 \times 10^3$ and $4.85 \times 10^3 \pm 0.77 \times 10^3$/ (cfu/g) in cooked meat, kofta and fried chicken meat at university student restaurant.

Higher *coliform* count obtained by Al-Tawwab (2004) who found that the mean values of total coliform counts were $3.5 \times 10^7 \pm 6.4 \times 10^6$ in kofta. High *coliform* count indicated poor hygienic quality of meat. The contamination with coliforms may occur during slaughtering, cutting or dressing of carcasses, soiled hands, shopping blocks or knives used for handling and cutting or contaminated water considered as an source of coliforms in meat (Yadav et al., 2006). The presence of *Staphylococcus aureus* in a food indicates its contamination from food handlers & in adequately cleaned equipment (ICMSF, 1996). Nearly similar results were obtained by Arab (2010) who examined the bacteriological quality of cooked meat found that the mean count of the mean staphylococci counts were $1.86 \times 10^3 \pm 0.64 \times 10^3$ / g. Ali (2011) examined the bacteriological quality of fried beef burger found that the mean count of the mean staphylococci counts were $1.85 \times 10^3 \pm 0.42 \times 10^3$/(cfu/g). Higher count obtained by Farag (2009) found Staphylococcus count were 5.9% more than permissible limit. Presence of *E. coli* in meat indicates a general lack of cleanness during slaughtering, evisceration, dressing, transportation and handling of meat (ICMSF, 1996c). As well as, *E. coli* may be used as an indicator microorganism because it provides an estimate of fecal contamination and poor sanitation during processing (Eisel et al., 1997). Moreover, the incidence of serologically identified *E. coli* as Enteropathogenic *E. coli* (*E. coli* $O_1:H_7$, *E. coli* O_{78} and *E. coli* $O_{114}: H_{21}$), Enterotoxogenic *E. coli* (*E. coli* $O_{125}:H_{18}$) Enteroheamorrhagic *E.* coli (*E. coli* $O_{26}:H_{11}$

and *E. coli* O_{111}:H_4) and Enteroinvasive *E. coli* (*E. coli* O_{124}). Nearly similar results were obtained by Ali (2011). Higher results obtained by EL-Abbasy (2010). The presence of *E. coli* in high numbers indicates the presence of organisms originating from faecal pollution. This is due to improper slaughtering techniques, contaminated surfaces and/or handling of the meat by infected food handlers (Nel et al., 2004). In addition, the presence of these pathogens can be due to contamination taking place during the meat processing at slaughter house or due to the poor handling of the retailers of meat (Kagambèga et al., 2011).

5. CONCLUSION

The achieved results in the current study allow to conclude that boiled and fried beef and chicken meat at hospital restaurant were contaminated with different types of microorganisms due to many causes mainly bad hygiene. Furthermore, the examined samples of chicken meat were more contaminated with the highest level of microorganisms because such products may receive more handling during preparation as well as addition of spices which act as a source of contamination and during processing (scalding) which consider big source of contamination. Also fried beef meat less contaminated than boiled beef meat mainly due to that fried meat firstly boiled then fried so expose to high temperatures for long time which kill most food poisoning microorganism on the other hand my contaminated by some types of bacteria not present in boiled one through cross contamination and bad personnel hygiene. On opposite side fried chicken meat highly contaminated than boiled one as it fried only which expose to lower temperature than that of boiling. This can be controlled by applying Hygienic measures during slaughtering, struggling as well as efficient bleeding should be considered. All meat and poultry establishments develop and implement a system of preventive control designed to improve the safety of their products, known as HACCP (Hazard Analysis and Critical Control Points).

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