Bacteriological aspect of meat and poultry meat meals.

Fatin S. Hassanien[1], Mohamed, A. H. El-Shater[2], Rabab R. Abd El-Fatah[3]

[1] Department of Food Hygiene, Faculty of Veterinary Medicine, Benha University. [2]Animal Health Research Institute, Dokki, Giza,. [3]Animal Health Research Institute, Benha.

A B S T R A C T

Ninety random samples were collected from different restaurants in Benha city to evaluate their bacteriological quality. The mean values of APC, coliform, staphylococcus counts (cfu /g) were 2.69x 10^5 ± 0.47x10^5, 5.54x10^3 ± 0.96x10^3& 2.31 x 10^3± 0.49 x 10^3 for beef kofta,7.34x10^4 ± 1.22x10^4, 1.73x10^3± 0.51x10^3&1.57 x 10^3± 0.36x $10^3$for beef burger, 3.16x 10^4± 0.60 x 10^4 , 1.01 x 10^3±0.27 x 10^3& 6.29 x 10^2± 1.14x10^2 for beef shawerma, 6.23 x 10^5± 1.14x10^5, 8.52x10^3± 2.04x10^3& 4.64 x 10^3± 0.85 x 10^3 for chicken kofta,3.58 x 10^5± 0.72 x 10^5, 2.39 x 10^3± 0.61 x 10^3& 2.73 x 10^3± 0.52 x 10^3 for chicken burger and 5.91x10^4 ± 1.08x10^4 , 1.81x10^3 ± 0.35x10^3 & 9.42x10^3 ± 2.23x10^3 for chicken shawerma, respectively. The results declared that 18isolates of *E.coli* were identified from examined ready to eat meat and poultry meat meals with varying percentages. Accurately, O_{26}: H_{11}, O_{111} :H_4, O_{114} :H_{21} ,O_{128} :H_2 ,O_{124} ,O_{127} :H_6,O_1 :H_7, O_{78}, O_{125} :H_{18}, $O_{78,}$ O_{119}: H_4 *E.coli* strains were serologically identified from such examined samples. Also,47 isolates of coagulase positive *St.aureus* were isolated from the examined ready to eat meat and poultry meat meals represented as 60% from beef kofta, 46.67% from beef burger, 40% from beef shawerma, 60% from chicken koft , 53.33% from chicken burger, 53.33% from chicken shawerma samples.

Keywords: Poultry meat, *E. coli*, Meat products, *S. aureus*.

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1. INTRODUCTION

Ready – to – eat meat products are highly demanded due to their high biological value, reasonable price, agreeable taste and easily serving. Meat products are considered as excellent sources of high quality protein, minerals and vitamins (WHO, 1984 and Mosupy et al., 1998). Ready prepared foods are fried and usually held at room temperature for considerable period of time and later reheated without reaching the prescribed temperature. Usually, the poor quality raw materials of the meat products for street vendors as well as lack of necessary facilities to hold food within the recommended temperature, thus the existing microorganisms reach high levels sufficient to produce food borne diseases (Primo et al., 1993).

Using raw materials of poor microbial quality, inadequate personel hygiene and a long period between production and consumption at room temperature lead to contamination of food with pathogenic microorganisms, especially Salmonellae and coliform, posing potential risk to public health (Kiipliilii et al., 2003) as food infection or intoxication among consumers. Cooked poultry products may become a hazard when cross contamination from raw to cooked product occurred which is a major problem. The growth of food poisoning bacteria introduced in this way is not restricted by the competing organisms normally found in the raw product. Several

foodborne illness with known etiological agents occurred where 6% were attributed to *E. coli* and 5% to *Staphylococcus aureus* (Simone et al., 1997). *S.aureus* plays a great role in bacterial contamination of cooked meat because workers during preparation and processing may touch cooked meat that is usually eaten without sufficient cooking or heating (Soliman, 1988). Therefore, the present study was carried out for determination of APC, coliform & *Staphylococcus* counts, isolation and identification of *St.aureus, E. coli* for ready to eat meat and poultry meat meals including beef kofta, beef burger, beef shawerm, chicken kofta, chicken burger, and chicken shawerma.

2. MATERIAL AND METHODS

2.1. Collection of samples

A grand total of 90 random samples of ready to eat meat and poultry meat meals including beef kofta, beef burger, beef shawerma, chicken kofta, chicken burger, and chicken shawerma (15 of each) were collected from different restaurants in Benha city. Each sample was kept in a separate sterile plastic bag, put in an ice box then transferred to the laboratory under complete aseptic conditions without undue delay for bacteriological examination.

2.2. Preparation of samples (APHA, 1992)

Twenty five grams of the samples were taken under aseptic condition to sterile stomacher bag then 225 ml sterile 0.1% peptone water were added, the contents were homogenized at Stomacher for 2 minutes, the mixture was allowed to settled, for 5 minutes at room temperature. The contents were transferred into sterile flask, thoroughly mixed, 1 ml was transferred into separate sterile test tube containing 9 ml sterile 0.1% peptone water, from which tenth- fold serial dilutions were prepared.

2.3. Bacteriological examination

The prepared samples were subjected to the following bacteriological examination: Determination of Aerobic Plate Count (FDA, 2001). Coliform count using Violet Red Bile agar medium (ICMSF, 1996). Isolation of *E.coli* (ISO, 2001): It was applied by using Macconkey broth as enriched borth and EMB as plating media. Serological Identification: The isolated strains of *E.coli* were identified serologically by using diagnostic sera "Welcome *E.coli*" agglutinating sera for diagnosis of the pathogenic types according to (Varnam-Evans, 1991). Determination of Staphylococci count using Mannitol agarplates(ICMSF, 1996). Isolation of *St. aureus* using Baired Parker agar (ICMSF, 1996).

3. RESULTS

The results of bacteriological examination of the ready to eat meat and poultry meat meals samples revealed that APC and coliform were highest in chicken kofta followed by chicken burger then beef kofta then beef burger then chicken shawerma then beef shawerma. While, staphylococcal count was highest in chicken shawerma followed bychicken kofta, chicken burger then beef kofta, beef burger and beef shawerma. In which, 47 isolates of coagulase positive *St.aureus* were isolated from the examined ready to eat meat and poultry meat meals represented as 60% from beef kofta , 46.67% from beef burger, 40% from beef shawerma, 60% from chicken koft, 53.33% from chicken burger, 53.33% from chicken shawerma samples.

Isolation and identification of *E. coli* in the examined the ready to eat meat and poultry meat meals samples revealed that the incidence of *E. coli* was highest in beef burger then chicken kofta then chicken burger then beef shawerma then chicken shawerma , 18 isolates of *E.coli* represented as 33.33% from the beef kofta with serotypes O_{26} : H_{11} (6.67%), O_{111}:H_4 (13.33%), O_{114}:H_{21} (6.67%) and O_{128}:H_2 (6.67%). 26.67% from beef burger with serotype O_{26}:H_{11} (13.33%), O_{111}:H_4 (6.67%) & O_{124} (6.67%). 13.33% beef shawerma,

with serotypes O111:H4 (6.67%) &O_{127}:H_6 (6.67%). 20% from chicken kofta with serotypes O_1:H_7 (6.67%), O_{78} (6.67%) & O_{125}:H_{18} (6.67%). 20% from chicken burger with serotypes, O_{78} (13.33%) & O_{127}:H_6 (6.67%) & 6.67% from chicken shawerma with serotypes O_{119}:H_4 (6.67%) only.

Table 1: Statistical analytical results of Aerobic plate counts (APC) (cfu/g) in the examined samples of ready to eat meat and chicken meat products (n=15).

product	Min.	Max.	Mean ± S.E*
Meat products:			
kofta	6.1×10^3	1.4×10^6	$2.69\times10^5 \pm 0.47\times10^5$
burger	3.2×10^3	3.7×10^5	$7.34\times10^4 \pm 1.22\times10^4$
Meat shawerma	1.5×10^3	8.8×10^4	$3.16\times10^4 \pm 0.60\times10^5$
Chicken meat products:			
kofta	2.4×10^4	1.5×10^6	$6.23\times10^5 \pm 1.14\times10^5$
burger	5.1×10^3	9.2×10^5	$3.58\times10^5 \pm 0.72\times10^5$
shawerma	4.0×10^3	1.7×10^5	$5.91\times10^4 \pm 1.08\times10^4$

S.E* = standard error of mean

Table 2**:** Statistical analytical results of total coliform counts (cfu/g) in the examined samples of ready to eat meat and chicken meat products (n=15).

product	+ve Samples		Min.	Max.	Mean ± S.E*
	No	%			
Meat products:					
kofta	13	93.33	1.0×10^2	9.8×10^3	$5.45\times10^3 \pm 0.96\times10^3$
burger	11	73.33	1.0×10^2	4.8×10^3	$1.73\times10^3 \pm 0.51\times10^3$
Meat shawerma	9	60.00	1.0×10^2	4.0×10^3	$1.01\times10^3 \pm 0.27\times10^3$
Chicken meat products:					
kofta	14	86.67	2.0×10^2	3.4×10^4	$8.52\times10^3 \pm 2.04\times10^3$
burger	11	73.33	1.0×10^2	6.8×10^3	$2.39\times10^3 \pm 0.61\times10^3$
shawerma	10	66.67	1.0×10^2	5.0×10^3	$1.81\times10^3 \pm 0.35\times10^3$

S.E* = standard error of mean.

Table 3: Incidence and serotyping of Enteropathogenic *E.coli* isolated from the examined samples of ready to eat meat products (n=15).

*E.coli*strains	Kofta		Burger		Shawerma		Strain Characteristics
	No.	%	No.	%	No.	%	
O_{26} : H_{11}	1	6.67	2	13.33	-	-	EHEC
O_{111} : H_4	2	13.33	1	6.67	1	6.67	EHEC
O_{114} : H_{21}	1	6.67	-	-	-	-	EPEC
O_{124}	-	-	1	6.67	-	-	EIEC
O_{127} : H_6	-	-	-	-	1	6.67	ETEC
O_{128} : H_2	1	6.67	-	-	-	-	ETEC
Total	5	33.33	4	26.67	2	13.33	

EPEC = Enteropathogenic*E.coli*ETEC = Enterotoxigenic*E.coli,* EIEC = Enteroinvasive*E.coli*EHEC= Enterohaemorrhagic *E.coli.*

Table 4: Incidence and serotyping of Enteropathogenic *E.coli* isolated from the examined samples of ready to eat chicken meat products (n=15).

E. coli strains	Kofta		Burger		Shawerma		Strain Characteristics
	No.	%	No.	%	No.	%	
O_1 : H_7	1	6.67	-	-	-	-	EPEC
O_{78}	1	6.67	2	13.33	-	-	EPEC
O_{125} : H_{18}	1	6.67	-	-	-	-	ETEC
O_{119} : H_4	-	-	-	-	1	6.67	EPEC
O_{127} : H_6	-	-	1	6.67	-	-	ETEC
Total	3	20.00	3	20.00	1	6.67	

Table (5) Statistical analytical results of total Staphylococci counts (cfu/g) in the examined samples of ready to eat meat and chicken meat products (n=15).

product	+ve Samples No	%	Min	Max	Mean ± S.E*
Meat products:					
kofta	12	80.00	1.0×10^2	5.0×10^3	$2.31\times10^3 \pm 0.49\times10^3$
burger	11	73.33	1.0×10^2	4.0×10^3	$1.57\times10^3 \pm 0.36\times10^3$
Meat shawerma	10	66.67	1.0×10^2	9.0×10^2	$6.29\times10^2 \pm 1.14\times10^2$
Chicken meat products:					
kofta	12	80.00	1.0×10^2	8.0×10^3	$4.64\times10^3 \pm 0.85\times10^3$
burger	12	80.00	2.0×10^2	5.0×10^3	$2.73\times10^3 \pm 0.52\times10^3$
shawerma	11	73.33	1.0×10^2	2.0×10^3	$9.42\times10^3 \pm 2.23\times10^3$

S.E* = standard error of mean.

Table 6: Incidence of Gram positive cocci isolated from the examined samples of ready to eat meat products (n=15).

product	+ve Samples No	%
Meat products:		
kofta	9	60.00
burger	7	46.67
Meat shawerma	6	40.00
Chicken meat products:		
kofta	9	60.00
burger	8	53.33
shawerma	8	53.33

4. DISCUSSION

The total aerobic plate count is important for evaluation of sanitary condition of ready to eat meat and poultry meat products. Limits suggested for total aerobic bacterial count in various foods range from 10^5 to 10^7 microbes /g. (EEC, 2005). The data shown in Table (1) revealed that, the mean value of APC/g in the examined samples $2.69\times10^5\pm0.47\times10^5$ for beef kofta, $7.34\times10^4\pm1.22\times10^4$ for beef burger, $3.16\times10^4\pm0.60\times10^4$ for beef shawerma, $6.23\times10^5\pm1.14\times10^5$ for chicken kofta, $3.58\times10^5\pm 0.72 \times 10^5$ for chicken burger and $5.91\times10^4\pm1.08\times10^4$ for chicken shawerma, respectively. These results were lower than those suggested by by El-Taher-Amna (2009) who found that APC in the examined samples of cooked kofta was 5.38×10^4(cfu/g). Nearly similar results were obtained by by EEC 2005, Tolba (1994), who found that APC in the examined samples of kofta was $2.9\times10^5 \pm 1.9\times10^5$/g. Meanwhile, higher figures were recorded by Hussein (1996), Rafaie and Mostafa (1990) who Found that the mean APC in the examined samples of shawerma collected from various fast food restaurants was 2.46×10^7(cfu/g). Although, the aerobic plate counts of any food articles are not a sure indicative of their safety for consumption, yet it is of supreme importance in judging the hygienic condition under which food has been produced, handled and stored (Levine, 1987). Accordingly the high bacterial count of some examined samples may be attributed to neglected sanitary measures during their processing, handling, serving of such products. The variation in bacterial count between different types of meat products could be attributed to difference of ingredients and steps involved in their formulation and preparation (Hefnawy and Youssef, 1984).

Data presented in Table (2) showed that the mean values of coliform count (cfu/g) in the examined samples were $5.45\times10^3\pm 0.96\times10^3$ for beef kofta, $1.73\times10^3\pm 0.51\times10^3$ for beef burger, $1.01\times10^3\pm 6.27\times10^3$for beef shawerma, $8.52\times10^3\pm 2.04\times10^3$ for chicken kofta, $2.39\times10^3\pm 0.61\times10^3$ for chicken burger and $1.81\times10^3\pm 0.35\times10^3$ for chicken shawerma. The current results agree with those recorded by El-Rayes (2008) and Yassien (1992) who found that the mean value of coliform was 3.8×10^3/g in the examined cooked meat samples. While, lower results were recorded by Elwi (1994), Saad et al. (2011)

who found that the mean value of coliform was $5.17\times10^2\pm 1.2\times10^2$/g in the examined samples of grilled beef kofta. However, higher findings were obtained by Rafaie and Moustafa (1990) who found that the mean value of coliform was 33.9×10^5/g for shawerma samples, Hussien (1996) who found that the mean value of coliform count was 1.8×10^5 for kofta sandwiches. The high incidence of coliforms in the examined ready-to-eat sandwiches indicates inadequate processing or post processing contamination (most probably from workers, dirty instrument, machinery and other contact surfaces), or from raw ingredients before processing which drive their contamination from various sources as human contact, polluted water, soil and manure, The presence of coliforms indicates a probable faecal sources of contamination (Thatcher and Clark, 1975; ICMSF, 1978 and NAS, 1985). The results in tables (3&4) revealed that, 18 isolates of *E.coli* were isolated from examined samples represented as 33.33% from the beef kofta with serotypes O_{26} : H_{11} (6.67%), O_{111}:H_4 (13.33%), O_{114}:H_{21} (6.67%) & O_{128}:H_2 (6.67%), 26.67% from beef burger with serotype O_{26}:H_{11}(13.33%), O_{111}:H_4 (6.67%) & O_{124}(6.67%), 13.33% beef shawerma, with serotypes O_{111}:H_4 (6.67%) & O_{127}:H_6 (6.67%) , 20% from chicken kofta with serotypes O_1:H_7(6.67%), O_{78}(6.67%) & O_{125}:H_{18} (6.67%), 20% from chicken burger with serotypes, O_{78}(13.33%) & O_{127}:H_6 (6.67%) & 6.67% from chicken shawerma with serotypes O_{119}:H_4(6.67%) only. Such Enteropathogenic E.coli were previously isolated from different ready-to-eat meat products by Yassien (1992), Soliman and El-Tabiy (2006) and El-Rayes (2008) who achieved that the incidence of serologically identified *E-coli* isolated from the examined samples of kofta were 5 isolates . In general, EPEC strains are the major cause for many infantile diarrhea, in typical cases, symptoms appear within 12 to 36 hours. Clinically, EPEC illness is characterized by fever, nausea, vomition and watery stools, which occasionally contain mucous, but without gross blood (Toledo et al., 1983).Certain serotypes of *E.coli* play an important role as human pathogens, which give rise to gastroenteritis outbreaks, severe diarrhea in infants, coli-bacillosis in adults, meningitis, enteritis (Youssef et al., 1992). The obtained results in Table (5) revealed that, the mean value of *Staphylococcus* count (cfu/g) $2.31\times10^3\pm 0.49\times10^3$ for beef kofta, $1.57\times10^3\pm 0.36\times10^3$/for beef burger, $6.29\times10^2\pm 1.14\times10^2$for beef shawerma, $4.64\times10^3\pm 0.85\times10^3$ for chicken kofta, $2.73\times10^3\pm 0.52\times10^3$ for chicken burger and $9.42\times10^3\pm2.23\times10^3$ for chicken shawerma. Nearly similar results obtained by Nasser (1988); Yassien El-Essawy (1990) and Moussa et al. (1992) who found that the mean values of *St-aureus* count (cfu/g) was 5.8×10^4 in the examined samples of ready to eat meat . While Mohamed (2000) failed to detect and isolate *S. aureus* from any of the examined samples of heat treated meat products, also lower result recorded by Zaki (2003) & Abd Allah and Hassan (2000) who found that the mean value of staphylococci count was 1.2×10^2(cfu/g) in the examined samples of cooked shawerma. However, higher findings were obtained by Kirralla (2007) & Al-Tawwab (2004) who found that the mean value of staphylococcus aureus count was $3.1\times10^6\pm4.9\times10^5$, $5\times10^4\pm 6.7\times10^3$ in the examined samples of kofta and shawerma, respectively. The results obtained in tables (6, 7) revealed that 47 isolates of coagulase positive *St.aureus* were isolated from the examined ready to eat meat and poultry meat meals represented as 60% from beef kofta, 46.67% from beef burger, 40% from beef shawerma, 60% from chicken koft ,53.33% from chicken burger, 53.33% from chicken shawerma samples . Such organism was previously isolated from ready-to-eat meat products by Soliman et al. (2002) & Kirralla (2007) who isolate *S. aureus* from cooked meat samples. The presence of *S. aureus* in a food indicates its contamination from food handlers and inadequately cleaned equipments (ICMSF, 1996). Finally, the present study proved that ready to eat meat

and poultry meat meals constitute public health hazard. The presence of negligible percentages of aerobic bacteria, *Enterobacteriaceae*, coliforms, *E.coli*, Staphylococci mainly Coagulase Positive *S. aureus* was due to the post-cooking contamination with bad handling, added spices and during packaging.

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