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Bacteriological examination of some ready to eat meat and chicken meals

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ABSTRACT

Sixty random samples of ready to eat chicken and meat meals including meat, chicken, beef kofta and chicken kofta (15 of each) were collected from different restaurants from Tanta city to evaluate their bacteriological quality. The mean values of Aerobic plate count (APC), Enterobacteriacae, coliform counts (CFU/g) were $6.03\times10^3 \pm 1.45$, $3.16\times10^3 \pm 0.72$, $7.43\times10^2 \pm 1.05$ for meat, $8.58\times10^3 \pm 1.65$, $6.53\times10^3 \pm 1.24$, $9.18\times10^2 \pm 2.07$ for chicken , $9.91\times10^3 \pm 2.18$, $5.25\times10^3 \pm 0.86$, $1.06\times10^3 \pm 0.19$ for beef kofta and $2.03\times10^4 \pm 0.43$, $9.14\times10^3 \pm 2.06$, $3.32\times10^3 \pm 0.45$ for chicken kofta, respectively. The results showed that 12 isolates of *E. coli* were identified from the examined ready to eat chicken and meat meals with different percentages as follow O_{26}:H_{11} EHEC (6.67%) & O_{111}:H_4 EHEC (6.67%) for meat, O_{26}:H_{11} EHEC (13.33%) & O_{124} EIEC (6.67%) for beef kofta, O_{78} EPEC (6.67%) & O_{127}:H_6 ETEC (6.67%) & O_{146}:H_{21} EPEC(6.67%) for chicken and O_{26}:H_{11} EHEC (13.33%) & O_{91}:H_{21} EHEC (6.67%) & O_{121}:H_7 EHEC (6.67%) for chicken kofta. Also, there were 6 isolates of salmonella from the examined meals were identified. Also, there were 21 *Staph. aureus* from examined samples represented as 20% from meat, 40% from beef kofta, 33.33% from chicken and 46.67% from chicken kofta. Thus, the results in this study concluding that all examined samples were contaminated with different bacteria as *E. coli*, salmonella and *Staph. aureus*, and the highest APC was in chicken kofta followed with beef kofta, chicken and meat.

1. INTRODUCTION

Ready to eat meat meals due to their high biological value, agreeable taste and easily serving. The meat meals have an excellent source of high-quality protein, vitamins and minerals (WHO, 1984; Mosupy et al., 1998). By using raw materials of poor microbial quality, bad personal hygiene and consumption at room temperature lead to contamination of food with pathogenic microorganisms, especially Salmonellae and coliforms, causing potential risk to public health (Kiipliilii et al., 2003).

Improper practices responsible for microbial food borne illness have been reported (Egan et al., 2007) and typically involve cross contamination of raw and cooked food ,poor cooking and storage at inappropriate temperature.

Staphylococcal food poisoning has rapid onset and its symptoms include nausea and violent vomiting with or without diarrhea (Argudin et al., 2010).

Salmonella species can persist on final raw products. Disease can result when these products are handled without good hygienic practices, not properly cooked and/or subjected to temperature abuse (Zhang et al., 2001). It is considered that the presence of Salmonella species in products makes it unsafe for human consumption (Agunos, 2007; Muth, 2009).

Escherichia coli is an important organism involved in food borne disease, it is considered as a good indicator of possible fecal contamination (Synge, 2000).

Therefore, the present study was planned out for determination of APC, Enterobacteriacae and coliforms counts, isolation and identification of *E. coli*, salmonella and *Staph. aureus* for ready to eat meat and chicken meals including meat, chicken, beef kofta and chicken kofta.

2. MATERIAL AND METHODS

2.1. Collection of samples

Sixty random samples of ready to eat chicken and meat meals including meat, chicken, beef kofta and chicken kofta (15 of each) were collected from different restaurants. 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 any delay for bacteriological examination.

2.2. Preparation of samples (ICMSF, 1996):

Samples were prepared by adding 25 grams of the sample to 225 ml of sterile peptone water then thoroughly mixed sterile blender for 2.5 minutes, from which tenth fold serial dilution was prepared. The prepared samples were subjected to the following bacteriological investigations:

2.2.1. Determination of aerobic plate count (ICMSF, 1996).

2.2.2. Determination of total Enterobacteriaceae count (Grok, 1976) by using Violet Red Bile Glucose agar.

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2.2.3. Determination of total coliform count (ICMSF ,1996) by using Violet Red Bile agar medium.

2.2.4. Isolation and identification of Enteropathogenic E. coli (ISO, 2001):

The isolation was applied by using MacConkey broth as enriched broth and Eosin Methylene blue (EMB) as plating media, then the isolated strains of *E. coli* were identified serologically by using rapid diagnostic *E. coli* antisera sets (DENKA SEIKEN Co., Japan) for diagnosis of the pathogenic types according to Kok et al. (1996).

2.2.5. *Isolation and identification of salmonellae* (ISO, 2002).

2.2.6. *Isolation and identification of S. aureus* (ICMSF, 1996).

3. RESULTS

The results of bacteriological examination of some ready to eat chicken and meat meals samples revealed that APC and coliform were highest in chicken kofta followed by beef kofta then chicken then meat. While, Enterobacteriaceae was highest in chicken kofta followed by chicken then beef kofta then meat (Table 1).

Isolation and identification of *E. coli* in the examined samples revealed that the incidence of *E.coli* was 26.67%in chicken, 20% in both of beef kofta and 13.33 in meat,12 isolates of *E.coli* represented as 13.33% from meat with serotypes O_{26}:H_{11} (6.67%) and O_{111}:H_4(6.67) 20% from beef kofta with serotypes O_{26}:H_{11}(13.33%)and O_{124} (6.67%). 20% from chicken with serotypes O_{78}(6.67%), O_{127}:H_6 (6.67%)and O_{146}:H_{21} (6.67%). 26.67% from chicken kofta with serotypes O_{26}:H_{11} (13.33%), O_{91}:H_{21} (6.67%) and O_{121}:H_7(6.67%) (Tables 5 & 6).

Table 1 Analytical results of Aerobic plate counts/g (APC) in the examined samples of ready to eat meat and chicken meals (n=15).

Meals	Min	Max	Mean ± S.E*
Meat meals:			
Meat	2.1×10^3	1.7×10^4	$6.03\times10^3 \pm 1.45\times10^3$
Kofta	4.6×10^3	2.9×10^4	$9.91\times10^3 \pm 2.18\times10^3$
Chicken meat meals:			
Chicken meat	3.5×10^3	3.9×10^4	$8.58\times10^3 \pm 1.65\times10^3$
Kofta	6.0×10^3	7.7×10^4	$2.03\times10^4 \pm 0.43\times10^4$

Table 2 Acceptability of the examined samples of cooked meat and chicken meals based on their APC (n=15).

Meals	APC /g	Accepted samples		Unaccepted samples	
		No.	%	No.	%
Meat meals *					
Meat	10^4	13	86.67	2	13.33
Kofta		11	73.33	4	26.67
Chicken meat meals **					
Chicken	10^4	12	80	3	20
Kofta		9	60	6	40

* Center for Food Safety (2014) for cooked meat meals. **EOS (2005) for heat treated poultry meat.

Table 3 Analytical results of Enterobacteriaceae counts/g in the examined samples of ready to eat meat and chicken meals (n=15).

Meals	Min	Max	Mean ± S.E*
Meat meals:			
Meat	2.2×10^2	8.1×10^3	$3.16\times10^3 \pm 0.72\times10^3$
Kofta	5.7×10^2	1.5×10^4	$5.25\times10^3 \pm 0.86\times10^3$
Chicken meat meals:			
Chicken	4.5×10^2	1.6×10^4	$6.53\times10^3 \pm 1.24\times10^3$
Kofta	7.8×10^2	2.8×10^4	$9.14\times10^3 \pm 2.06\times10^3$

Isolation and identification of salmonella in the examined samples revealed that the incidence of salmonella was equal in meat, beef kofta and chicken (6.67%) while in chicken kofta was the highest (20%). 6.67%from meat with serotype *S. Heidelberg.* 6.67% from beef kofta with serotype *S. Montevideo.* 6.67% from chicken with serotype *S. kentuckey*. 20%from chicken kofta with serotypes *S. anatum* (6.67%), *S. infantis* (6.67%) and *S. typhimurium* (6.67%) (Tables, 7 & 8).

Isolation and identification of *Staph. aureus* revealed that there are 21 isolates of *Staph. aureus* were isolated from examined samples represented as 20% from meat, 40% from beef kofta, 33.33% from chicken and 46.67% from chicken kofta (Tables 9) .

4. DISCUSSION

The total aerobic plate count is very important for evaluation of sanitary condition of ready to eat meat meals. Limits suggested for total aerobic bacterial count in various foods range from10^5 to 10^7 microbes/g (EEC, 2005).

It is evident from the results recorded in Table (1) that the APC/g of the examined samples of ready to eat chicken and meat meals ranged from 2.1×10^3 to 1.7×10^4 with an average of $6.03\times10^3 \pm 1.45\times10^3$ cfu/g for meat, 4.6×10^3 to 2.9×10^4 with an average $9.91\times10^3 \pm 2.18\times10^3$/(cfu/g) for meat kofta, $3.5\times10^3$to 3.9×10^4 with an average $8.58\times10^3 \pm 1.65\times10^3$ cfu/g for chicken and 6.0×10^3 to 7.7×10^4 with an average $2.03\times10^4 \pm 0.43\times10^4$ cfu/g for chicken kofta. The current results nearly similar to the results recorded by (Sobieh, 2014) found that the mean value of RTE kofta was 1.83×10^4 cfu/gm, while higher results was recorded by Shaltout et al. (2015a) who found that the mean value of APC of RTE kofta was 8.51×10^5cfu/g, also higher results was recorded by Shaltout et al. (2015b) found that the mean APC of RTE chicken meals was 1.9×10^4 cfu/g and in RTE meat meals was1.2×10^4 cfu/g. High incidence of APC may indicate that the cooking process was inadequate, or post cooking contamination had occurred, or the length of time and temperature control in storage or display facilities was inadequate to prevent bacterial contamination ,or that a combination of these factors was involved (Khater et al., 2013).

Results given in Table (2) revealed that the acceptability of the examined samples of cooked meat and chicken meals based on their APC was (86.67%) of meat samples were accepted samples but (13.33%) of meat samples were unaccepted, (73.33%) of beef kofta samples were accepted but (26.67%) of beef kofta samples were unaccepted,(80%) of chicken samples were accepted but (20%) of chicken samples were unaccepted and (60%) of chicken kofta were accepted but (40 %) of chicken kofta were unaccepted.

Results achieved in Table (3) showed that the mean values of total Enterobacteriaceae counts/g in the examined samples of Ready to eat chicken and meat meals were$3.16\times10^3 \pm 0.72\times10^3$ cfu/g for meat, $5.25\times10^3 \pm 0.86\times10^3$ cfu/g for meat kofta, ,$6.53\times10^3 \pm 1.24\times10^3$/ cfu/g for chicken and $9.14\times10^3 \pm 2.06\times10^3$ cfu/g for chicken kofta. The current results was nearly similar to recorded by Shaltout et al. (2015a), who found that the mean values of enterobacteriacae of RTE kofta was 7.15×10^3 cfu/g, while higher results recorded by Shaltout et al. (2013), who found the mean value of enterobacteriacae of street vended kofta samples was 1.5×10^7cfu/g.

From the results in Table (4), it is obvious that the mean values of total coliform counts cfu/g in the examined samples of ready to eat chicken and meat meals were $7.43\times10^2 \pm 1.05\times10^2$ cfu/g for meat, $1.06\times10^3 \pm$

0.19×10^2/(cfu/g) for meat kofta, $9.18\times10^2 \pm 2.07\times10^3$ cfu/g for chicken and $3.32\times10^3 \pm 0.45\times10^3$ cfu/g for chicken kofta. The current results was nearly similar to the results recorded by(Saad et al., 2011) who found that the mean values of coliform was $5.17\times10^2\pm1.2\times10^2$ cfu/g. while higher results was recorded by Hussien (1996), who found the mean value of coliform count of kofta sandwiches was 1.8×10^5 cfu/g.

The results in Tables (5&6) showed that there are 12 isolates of *E.coli* represented as 13.33% from meat with serotypes O_{26}:H_{11} (6.67%) and O_{111}:H_4 (6.67) 20% from beef kofta with serotypes O_{26}:H_{11} (13.33%)and O_{124} (6.67%). 20% from chicken with serotypes O_{78} (6.67%), O_{127}:H_6 (6.67%) and O_{146}:H_{21} (6.67%). 26.67% from chicken kofta with serotypes O_{26}:H_{11} (13.33%), O_{91}:H_{21} (6.67%) and O_{121}: H_7 (6.67%).

Tables (7&8) showed the incidence and serotyping of salmonella isolated from ready to eat meat and chicken meals is 6.67% from meat identified serologically as *S. heidelberg* $O_{4,5,12}$:$H_{r:1,2}$ 6.67% from beef kofta identified serologically as *S. montevideo* $O_{6,7,14}$:$H_{g,m,s:1,7,2}$ 6.67% from chicken identified serologically as *S. kentuckey* $O_{8,20}$:$H_{i:Z6}$ 20% from chicken kofta identified serologically as *S. anatum* $O_{1,9,12}$: $H_{g,m:1,7}$ (6.67%), *S. infantis* $O_{6,7,14}$:$H_{r:1,5}$ (6.67%) and *S. typhimurium* $O_{1,4,5,12}$: $H_{i:1,2}$(6.67%). Salmonella microorganisms were previously isolated from ready to eat meat meals by (Soliman et al., 2002) and Richardson and Stevens (2003). Also, salmonella failed to be isolated from ready to eat meat meals by Kirralla (2007). The symptoms of salmonellosis include diarrhea, nausea, vomiting, fever and abdominal cramps (Cui, 2004).

The results in Table (9) reported that *Staph. aureus* was isolated from 20% of meat, 40% of meat kofta,33.33%of chicken and 46.67% of chicken kofta. Such organism was isolated previously from ready to eat meat meals by (Soliman et al., 2002; Kirralla, 2007), who isolated *Staph. aureus* from cooked samples. The presence of *Staph. aureus* in ready to eat meat meals may be due to their contamination from food handlers, inadequate cleaned equipment or post processing contamination (Duffy et al., 2000).

Table 4 Analytical results of coliform counts/g in the examined samples of ready to eat meat and chicken meals (n=15)

Meals	Positive samples No.	%	Min	Max	Mean ± S.E*
Meat meals:					
Meat	7	46.67	1.0×10^2	2.3×10^3	$7.43\times10^2 \pm 1.05\times10^2$
Kofta	8	53.33	1.0×10^2	4.9×10^3	$1.06\times10^3 \pm 0.19\times10^2$
Chicken meat meals:					
Chicken	8	53.33	1.0×10^2	3.7×10^3	$9.18\times10^2 \pm 2.07\times10^3$
Kofta	9	60	1.0×10^2	7.0×10^3	$3.32\times10^3 \pm 0.45\times10^3$

Table 5 Incidence and serotyping of Enteropathogenic *E. coli* isolated from the examined samples of ready to eat meat meals (n=15).

Meat meals	Meat		Kofta		Strain Characteristics
E.coli strains	No.	%	No.	%	
O_{26} : H_{11}	1	6.67	2	13.33	EHEC
O_{111} : H_4	1	6.67	-	-	EHEC
O_{124}	-	-	1	6.67	EIEC
Total	2	13.33	3	20	

EIEC = Enteroinvasive *E. coli* EHEC= Enterohaemorrhagic *E. coli*

Table 6 Incidence and serotyping of Enteropathogenic *E. coli* isolated from the examined samples of ready to eat chicken meals (n=15).

Chicken meals	Chicken		Kofta		Strain Characteristics
E.coli strains	No.	%	No.	%	
O_{26} : H_{11}	-	-	2	13.33	EHEC
O_{78}	1	6.67	-	-	EPEC
O_{91} : H_{21}	-	-	1	6.67	EHEC
O_{121} : H_7	-	-	1	6.67	EHEC
O_{127} : H_6	1	6.67	-	-	ETEC
O_{146} : H_{21}	1	6.67	-	-	EPEC
Total	3	20	4	26.67	

EPEC = Enteropathogenic *E. coli* ETEC = Enterotoxigenic *E. coli* EHEC= Enterohaemorrhagic *E. coli*

Table 7 Incidence and serotyping of salmonellae isolated from the examined samples of ready to eat meat meals (n=15).

Salmonella serotypes	Meat	Kofta			Group	Antigenic Structure	
	No.	No.	No.	%		O	H
S. Heidelberg	1	6.67	-	-	B	4,5,12	r : 1, 2
S. Montevideo	-	-	1	6.67	C1	6, 7, 14	g, m, s: 1, 2, 7
Total	1	6.67	1	6.67			

Table 8 Incidence and serotyping of salmonellae isolated from the examined samples of ready to eat chicken meals (n=15).

Salmonella serotypes	Chicken	Kofta			Group	Antigenic Structure	
	No.	No.	No.	%		O	H
S. Anatum	-	-	1	6.67	D1	1,9,12	g,m : 1,7
S. Kentuckey	1	6.67	-	-	C3	8,20	i : Z6
S. Infantis	-	-	1	6.67	C1	6,7,14	r : 1,5
S. Typhimurium	-	-	1	6.67	B	1,4,5,12	i : 1,2
Total	1	6.67	3	20			

Table 9 Incidence of *Staphylococcus aureus* isolated from the examined samples of ready to eat meat and chicken meals

Samples	Meat meals	Positive samples	
		No.	%
Meat meals (n=15)	Meat	3	20
	Kofta	6	40
	Total (30)	9	30
Chicken meals (n=15)	Chicken	5	33.33
	Kofta	7	46.67
	Total (30)	12	40

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