



## Enterobacteriaceae in Meat Products Sold by Street vendors

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### ABSTRACT

Eighty random samples of beef burger, kofta, hawawshi and variety meat (20 of each) were collected from different street vendors in Cairo governorate to evaluate their value of Enterobacteriaceae. The mean values of Enterobacteriaceae counts in the examined samples (cfu/g) were  $2.67 \times 10^3 \pm 0.53 \times 10^2$  for beef burger,  $6.41 \times 10^3 \pm 1.72 \times 10^3$  for kofta,  $9.33 \times 10^3 \pm 2.16 \times 10^3$  for hawawshi and  $1.09 \times 10^4 \pm 0.25 \times 10^4$  for variety meat, respectively. The results declared that the values of coliform count/g in the examined samples of street vended meat products were  $7.12 \times 10^2 \pm 1.46 \times 10^2$  for beef burger,  $1.86 \times 10^3 \pm 0.59 \times 10^3$  for kofta,  $4.27 \times 10^3 \pm 0.92 \times 10^3$  for hawawshi and  $7.48 \times 10^3 \pm 2.10 \times 10^3$  for variety meat. Accurately, O26: H11, O55: H7, O91: H21, O103: H2, O111: H2, O113: H4, O124, O126: H21 and O127:H4 *E. coli* strains were isolated from such examined samples. Concerning salmonella organisms, *S. enteritidis* was isolated from beef burger (5%), hawawshi (5%), variety meat (10%) while not isolated from kofta, *S. Heidelberg* was isolated from kofta (5%), *S. Infantis* was isolated from hawawshi (5%), *S. Montevideo* and *S. Typhimurium* were isolated from variety meat (5%) for each.

**Keywords:** street vendors, meat products, *E. coli*.

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### 1. INTRODUCTION

Different terms have been used to describe such ready to eat foods. These include convenient, ready, instant and fast foods. Examples of such ready to eat foods include pastries, meat pie, sausage, rolls, burger, moin-moin, salad or coleslaw, fried meat and fried chicken (Caserani and Kinston, 1974) also, Ready to eat foods can be described as the status of foods being ready for immediate consumption at the point of sale, Ready to eat foods could be raw or cooked, hot or chilled and can be consumed without further heat treatment (Tsang, 2002). A general observation of our society shows a social pattern characterized by increased mobility, large numbers of itinerant workers and less family or home centered activities. This situation however has resulted in more ready to eat foods taken outside home. (Musa and Akande, 2002). on the other hand, Food borne illness caused by microbial contamination of foods is an

important international public health problem and is known to be a major cause of Diarrhea diseases especially in developing countries (Mensah, 1997). In these developing countries a major source of ready-to-eat foods are prepared and or sold at public places such as schools, market places and along the streets, all together termed Street Foods (Sfs). The SFs offer food at relatively cheaper cost and at easily accessible places. Furthermore, it offers the traditional meals and preparations of a number of them are quite laborious and time consuming. Thus, with the increase in the number of hours spent at work places by parents (especially mothers) and schools; the importance of SFs in the provision of nutritional requirements is increasingly becoming very important among all socio-economic groups (Amoah, 1992), At the same time, most of the people who patronize these foods are more interested in

its convenience than the question of its bacteriological quality and hygiene. The bacteriological quality of food indicates the amount of bacteria contaminants it has; a high level of contamination indicates low quality and more likely to transmit infection and the reverse is true (Anonymous, 1988). Thus concerns have been raised by the Food and Agricultural Organization (FAO) and others about these foods serving as a potential source of food poisoning outbreaks (Chakravarty and Canet, 2002). Three common conditions caused by *Salmonella* are gastroenteritis, enteric fever, and bacteremia (MayoClinic 3-5). *S. typhimurium*, *S. enteritidis*, and *S. Newport* are serotypes associated with human and animal gastroenteritis, *S. typhi* and the paratyphoid species are associated with human enteric fever, and *S. choleraesuis* is associated with bacteremia in pigs (Gray and Fedorka-Cray 57). In order to cause disease, the *Salmonella* bacteria, in general, are first ingested and then travel through the digestive system to reach the small intestine. Within the small intestine, they generate inflammation of the intestinal cells that leads to the gastroenteritis that is typical of salmonella (Slack and Snyder 297). The isolated enteric bacteria are known pathogens responsible for millions of cases of infectious gastrointestinal diseases and death each year. The microorganism encountered in this study correlated with earlier reports (Yeboah-Manu *et al.*, 2010). Their detection in the street food samples suggests the possibility that other intestinal pathogens like the enteropathogenic strain of *E. coli* (O157:H7), may also be present in the food samples (James, 2005). These diverse groups of pathogenic microorganisms are transmitted by fecal oral route, often by the ingestion of contaminated foods and water.

## 2. MATERIAL AND METHODS

### 2.1. Collection of samples

A total of 80 random samples of street vended meat products represented by beef burger, kofta, hawawshi and variety meat (20 of each) were collected in Cairo governorate, Egypt.

### 2.2. Bacteriological examination

The prepared samples were subjected to the following bacteriological examination

### 2.3. Preparation of samples

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. The collected samples were subjected to the bacteriological examinations to evaluate their quality. 25 grams of the sample, 225 ml of sterile peptone water were added and thoroughly mixed using sterile blender for 1.5 minutes, from which ten fold serial dilutions was prepared. Total Enterobacteriaceae count (Gork, 1976), Total coliform count ICMSF (1996) using Violet Red Bile agar medium were done, Screening for Enteropathogenic *Escherichia coli*: It was applied by using Macconkey broth as enriched borth and EMB as plating media, Serodiagnosis of *E. coli*: The isolates were serologically identified according to Kok *et al.* (1996) by using rapid diagnostic *E. coli* antisera sets (DENKA SEIKEN Co., Japan) for diagnosis of the Enteropathogenic types, Screening for Salmonellae (Rappaport *et al.*, 1956 and Harvey and Price, 1981) and Serological identification of Salmenollae (Kauffman, 1974), (DENKA SEIKEN Co., Japan).

## 3. RESULTS

The data shown in Table (1) revealed that enterobacteriaceae count ranged from  $1.0 \times 10^2$  to  $8.9 \times 10^3$  with mean value of  $2.67 \times 10^3 \pm 0.53 \times 10^2$  for beef burger ,  $1.8 \times 10^2$  to  $3.2 \times 10^4$  with mean value of  $6.41 \times 10^3 \pm 1.72 \times 10^3$  for kofta ,  $3.0 \times 10^2$  to  $5.1 \times 10^4$  with mean value of  $9.33 \times 10^3 \pm 2.16 \times 10^3$  for hawawshi and  $4.0 \times 10^2$  to

$6.0 \times 10^4$  with mean value of  $1.09 \times 10^4 \pm 0.25 \times 10^4$  for variety meat respectively.

From the results given in table (2), it is obvious that the values of coliform count/g in the examined samples of street vended meat products ranged from  $2.0 \times 10$  to  $3.5 \times 10^3$  with mean value of  $7.12 \times 10^2 \pm 1.46 \times 10^2$  for beef burger,  $5.0 \times 10$  to  $7.8 \times 10^3$  with mean value of  $1.86 \times 10^3 \pm 0.59 \times 10^3$  for kofta,  $6.0 \times 10$  to  $1.6 \times 10^4$  with mean value of  $4.27 \times 10^3 \pm 0.92 \times 10^3$  for hawawshi and  $9.0 \times 10$  to  $2.2 \times 10^4$  with mean value of  $7.48 \times 10^3 \pm 2.10 \times 10^3$  for variety meat.

Results achieved in table (3) showed that *Citrobacter diversus*, *Citrobacter freundii*, *Enterobacter aerogenes*, *Enterobacter*

agglomerans, *Enterobacter cloacae*, *Enterobacter hafniae*, *Klebsiella ozaenae*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Proteus vulgaris*, *Providencia rettgeri*, *Serratia liquefaciens* and *Serratia marcescens* were isolated with different values. Results achieved in table (4), showed that (20%), (25%), (35%) and (40%) of the examined samples of beef burger, kofta, hawawshi and variety meat were contaminated with *E.coli*. in this respect, O55: H7, O111: H2, O124, O127:H4, O26 : H11, O91 : H21, O126 : H21, O113 : H4 and O103: H2, were isolated from the examined samples with different values.

Table (1): mean value of Enterobacteriaceae count/g in the examined samples of street vended meat products (n=20)

Meat Products	+ve samples		Min	Max	Mean $\pm$ S.E*
	NO	%			
Beef burger	13	65	$1.0 \times 10^2$	$8.9 \times 10^3$	$2.67 \times 10^3 \pm 0.53 \times 10^2$
Kofta	14	70	$1.8 \times 10^2$	$3.2 \times 10^4$	$6.41 \times 10^3 \pm 1.72 \times 10^3$
Hawwashhi	16	80	$3.0 \times 10^2$	$5.1 \times 10^4$	$9.33 \times 10^3 \pm 2.16 \times 10^3$
Variety meat	19	95	$4.0 \times 10^2$	$6.0 \times 10^4$	$1.09 \times 10^4 \pm 0.25 \times 10^4$

S.E\*: standard error

Table (2): mean value of coliform count/g in the examined samples of street vended meat products (n=20).

Meat Products	+ve samples		Min	Max	Mean $\pm$ S.E*
	NO	%			
Beef burger	12	60	$2.0 \times 10$	$3.5 \times 10^3$	$7.12 \times 10^2 \pm 1.46 \times 10^2$
Kofta	14	70	$5.0 \times 10$	$7.8 \times 10^3$	$1.86 \times 10^3 \pm 0.59 \times 10^3$
Hawawshi	15	75	$6.0 \times 10$	$1.6 \times 10^4$	$4.27 \times 10^3 \pm 0.92 \times 10^3$
Variety meat	17	85	$9.0 \times 10$	$2.2 \times 10^4$	$7.48 \times 10^3 \pm 2.10 \times 10^3$

Table (3): Incidence of *E. coli* isolated from the examined samples of street vended meat products (n=20).

<i>E. coli</i> strains	Burger		kofta		hawawshi		variety meat		strain Characteristics
	no	%	no	%	no	%	no	%	
O26 : H11	-	-	1	5	2	10	2	10	EHEC
O55 : H7	1	5	-	-	-	-	1	5	EPEC
O91 : H21	-	-	1	5	-	-	-	-	EPEC
O103: H2	-	-	-	-	-	-	1	5	EHEC
O111 : H2	1	5	2	10	1	5	3	15	EHEC
O113 : H4	-	-	-	-	2	10	-	-	EPEC
O124	1	5	-	-	1	5	-	-	EIEC
O126 : H21	-	-	1	5	-	-	1	5	ETEC
O127:H4	1	5	-	-	1	5	-	-	ETEC
Total	4	20	5	25	7	35	8	40	

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

Table (4): Incidence of Salmonella organisms isolated from the examined samples of street vended meat products (n=20).

Salmonella strains	Burger		kofta		hawawshi		variety meat	
	no	%	no	%	no	%	no	%
<i>S. Enteritidis</i>	1	5	-	-	1	5	2	10
<i>S. Heidelberg</i>	-	-	1	5	-	-	-	-
<i>S. Infantis</i>	-	-	-	-	1	5	-	-
<i>S. Montevideo</i>	-	-	-	-	-	-	1	5
<i>S. Typhimurium</i>	-	-	1	5	-	-	1	5
Total	1	5	2	10	2	10	4	20

#### 4. DISCUSSION

The Enterobacteriaceae count is important for evaluation of hygienic condition of street vended meat products. Limits suggested for Enterobacteriaceae count in various foods are lower than  $10^4$  microbes /g. (center of food safety 2014). The current results were relatively agreeing to that obtained by El-Daly et al. (1987), Pivarov et al. (1988) & Elwi (1994) who found that the mean values of Enterobacteriaceae in kofta were  $45 \times 10^2$ /g, while higher findings were obtained by Hassan (1991), Daif (1996) & Hussein (1996) who found that the mean Enterobacteriaceae for kofta samples were  $1.9 \times 10^5$ /g. The current

results agree with those recorded by El-Rayes (2008) who recorded that the mean value of total coliform count in kofta was  $2.83 \times 10^3 \pm 0.74 \times 10^3$  /g . While, lower results were recorded by EL-Daly et al. (1987) who found that the mean values of coliform counts were  $1 \times 10^2$  /g, in examined cooked spiced minced meat (El-hawawshi) collected from different restaurants in Zagazig. However, higher findings were obtained by Rafaie and Moustafa (1990), Daif (1996) and Hussien (1996) who found that the mean value of coliforms count were  $1.8 \times 10^5$ /g for kofta sandwiches. Members of coliforms groups are referred as general indicator microorganisms to measure the potential presence of enteric pathogens in

foods, besides the measuring of fecal contamination of food products and the sanitary condition in the foods processing environment (FAO, 1992). The presence of these organisms in RTE food (sandwiches) depicts a deplorable state of poor hygiene and sanitary practices employed in the processing and packaging of this food product (Jay, 2005).

The possibility of food health problem by coliforms depends upon the number, types and the virulence of these pathogens whereas, the higher the number, the greater possibility of pathogenic organisms being present (FAO, 1992). The results of bacteriological examination of the street vended meat products samples revealed that the value of Enterobacteriaceae and coliform were highest in variety meat followed by hawawshi then kofta then beef burger. Isolation and identification of *E. coli* in the examined street vended meat products samples revealed that the incidence of *E. coli* was highest in variety meat followed by hawawshi then kofta then beef burger. Furthermore, O55: H7, O111: H2, O124 and O127:H4 (5% for each) were isolated from beef burger, O26: H11(5%), O91: H21(5%), O111: H2(10%) and O126: H21(5%) were isolated from kofta, O26: H11(10%), O111: H2(5%), O113: H4(10%), O124(5%) and O127:H4(5%) were isolated from hawawshi, O26: H11(10%), O55: H7(5%), O103: H2(5%), O111: H2(15%) and O126: H21(5%) were isolated from variety meat.

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