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BACTERIAL ASPECT OF COOKED MEAT AND EDIBLE OFFAL AT STREET VENDORS LEVEL

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A B S T R A C T

One hundred random samples of cooked head meat, liver, kofta and mixed offal (25 of each) were collected from street vendors level in Kalyobia, Giza and Cairo governorates. All collected samples were examined to determine their microbiological profiles. The obtained results indicated that the mean values of APC, Enterobacteriaceae and coliform counts in the examined samples of cooked meat products were $1.4 \times 10^7 \pm 0.5 \times 10^7$, $1.7 \times 10^4 \pm 0.43 \times 10^4$, $3.4 \times 10^5 \pm 0.17 \times 10^5$ CFU /g, for liver, $1.2 \times 10^7 \pm 0.4 \times 10^7$, $2.4 \times 10^4 \pm 0.52 \times 10^4$, $9.6 \times 10^5 \pm 0.37 \times 10^5$ CFU /g, for mixed offal, $1.5 \times 10^7 \pm 0.43 \times 10^7$, $1.5 \times 10^7 \pm 0.48 \times 10^7$, $2.6 \times 10^5 \pm 0.5 \times 10^5$ CFU /g for kofta, $5.4 \times 10^6 \pm 0.33 \times 10^6$, $2 \times 10^3 \pm 0.58 \times 10^3$, $1.4 \times 10^3 \pm 0.44 \times 10^3$ CFU /g, for head meat, respectively. The differences associated with the examined samples of cooked meat products were significant ($P < 0.05$) because of product type. Concerning Salmonella organisms, *S. entritidis* was isolated from (8%, 12%, 4%) of liver, mixed offal and kofta respectively. In addition, *S.typhimurium* was isolated from 8% and 4% of the examined samples of liver and kofta, retailed at low level of sanitation, respectively. While, all examined samples of cooked head meat products were free from *Salmonellae.* Finally, the significance of isolated bacteria in ready- to- eat meat products and possible sources of contamination as well as some recommendations to improve the quality of these products were discussed.

Key words: liver head meat, Kofta, Mixed offal, Bacterial aspect.

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1. INDRODUCTION

Street-vended foods are ready-to-eat foods prepared and sold by vendors on streets and similar public places. Street-vended food differs greatly between countries and cultures. They provide source of readily available, inexpensive and nutritional meals, while providing a source of income for the vendors [7]. In countries where street vended food is prevalent, there is commonly a lack of information on the incidence of foodborne diseases related to such foods. However, microbiological studies on street-vended foods in American, Asian and African countries have revealed high bacterial counts and high incidence of foodborne bacterial pathogens implicating in outbreaks of foodborne diseases. Street food vending in Egypt, as in other developing countries, has increased markedly due to increased unemployment and limited work opportunities. The most popular traditional street-vended foods include meals of animal origin comprising cooked meat / liver /mixed offal and kofta. The microbiological quality of these foods depends on the hygienic quality of their ingredients. Due to the nature of their preparation, personnel hygiene is very important for food quality. Poor personnel hygiene during production probably leads to the contamination of these foods with pathogenic microorganisms, especially Salmonellae and coliform bacteria [8]. Using

raw materials of poor microbial quality, inadequate personnel hygiene and a long period between production and consumption at room temperature lead to food of a potential risk to public health..Moreover, the unhygienic conditions under which street vended food were operated in addition to their lack of basic food safety training approximate those described earlier [2]. Enterobacteriaceae group has an epidemiological interest as some of its members are pathogenic and may result in serious infections and food poisoning. Moreover, the total number of Enterobacteriaceae can be taken as an indication of possible enteric contamination in the absence of coliforms [25]. Also, Enteropathogenic *E.coli* constitute public health hazards as it may give rise to severe diarrhea in infants and young children as well as food poisoning and gastroenteritis among adult consumers. Further , Salmonellosis is a worldwide problem responsible for food poisoning outbreaks in human beings without indication of decline despite the traditional food hygiene efforts. In Egypt, several food poisoning outbreaks were reported due to consumption of meat and meat products contaminated with different strains of Salmonella organisms [35]. In addition, no data concerning the incidence of food-borne diseases related to street foods, and no recent information on the quality and safety of street-vended foods in Egypt are available. Therefore, the aim of this work was planned out to study the bacterial load in cooked meat ,liver ,mixed offal ,and kofta samples collected from several street vendors at Kalyobia, Giza and Cairo governorate.

2. MATERIAL AND METHODS

2.1. Collection of samples:

A total of 100 random samples of , liver , mixed offal, kofta and cooked head meat (25 of each) were collected at street vendors level from Kalyobia, Giza and Cairo governorates 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 delaying and examined as quickly as possible. The collected samples were subjected to the bacteriological examination to evaluate their quality.

2.2. Preparation of food homogenate:

Twenty five grams of each samples were aseptically taken and mixed with 225 ml sterile peptone water (0.1%) by using a stomacher, then serial dilutions prepared up to 10^6 were applied. The following bacteriological examinationswere carried out for such samples.

2.3. Total aerobic count [3].

From each dilution one ml of the food homogenate was transferred, by using a sterile pipette into two separate sterile melted and tempered plates of plate count agar (45ºC). The inoculated plates were gently shaken in rotatory movement and lift till complete solidification of the agar. The plates were incubated for 24-48 hours at 37 ºC. The Aerobic Plate Count (APC) per gram was calculated on plates containing 30-300 colonies and each count was recorded separately.

2.4. Total Enterobacteriaceae count [12].

The same technique of the previous pour plate method was carried out using Violet Red Bile Glucose agar medium (VRBG). The plates were incubated at 37ºC for 24 hours. All purple colonies were then counted and the average number of colonies was determined. Hence, the Enterobacteriaceae count / g was calculated.

2.5.Total coliform count:

The procedures recommended by [16] were adapted. using Violet Red Bile agar

medium were done. The coliform count per gram was calculated.

2.6.Isolation of Salmonellae: [35].

a. Pre-enrichment broth:
   Twenty five grams of examined samples were homogenized in 225 ml of sterile peptone water and incubated at 37 ºC for 18 hours.
b. Enrichment broth:
   One ml of the original dilution was inoculated into 9 ml Rappaport Vassilidis broth tube, then the tube was incubated at 43°C for 24 hours [29].
c. Selective Plating:
   Xylose lysine desoxychoclate agar (X.L.D) was used. The suspected colonies were sub-cultured into nutrient agar plate and incubated at 37 ºC for 24 hours. However, the purified suspected colonies were selected and streaked into slope nutrient agar for further identification. The purified isolates were identified morphologically, biochemically and serologically.

2.7.Biochemical tests.

1- Motility test [4].
2- Citrate utilization test [32].
3- Gelatin hydrolysis test [4].
4- Indole production test [19].
5- Methyl Red Test [21].
6- Voges – Praskauer test [22].
7- Hydrogen sulphide production test [23].
8- Oxidation–Fermentation test [14].
9- Nitrate reduction test [4].
10- Fermentation of sugars [23].

2.8. Serological identification of Salmenollae:

Isolates proved biochemically to be *Salmonella* microorganisms were subjected to serological identification according to Kauffman white scheme [17].

2.9. Microscopical examination:

Film were prepared from the pure culture of isolated organism stained with Gram's stain and examined under oil emersion lens for gram negative bacilli with rounded end.

2.10. Statistical Analysis:

The obtained results were statistically evaluated by application of Analysis of Variance (ANOVA) test according to [9].

3. RESULTS

Table (1). Statistical analytical results of Aerobic Plate counts (APC) in the examined samples of cooked head meat and offal at street vendors level. (n= 25)

Organ	Min,	Max.	Mean ± S.E
1- Liver	3.2×10^5	8.2×10^8	$1.4 \times 10^7 \pm 0.5 \times 10^7$
2- Mixed Offals	1.4×10^6	6.1×10^8	$1.2 \times 10^7 \pm 0.4 \times 10^7$
3- Kofta	3.2×10^5	7.2×10^8	$1.5 \times 10^7 \pm 0.43 \times 10^7$
4- Head meat	1.6×10^6	8.1×10^7	$5.4 \times 10^6 \pm 0.33 \times 10^6$

Table (2): Statistical analytical results of total Enterobacteriacae counts in the examined samples of cooked head meat and offal at street vendors level. (n=25)

Organ	Min,	Max.	Mean ± S.E
1- Liver	5×10^4	7.6×10^6	$1.7 \times 10^4 \pm 0.43 \times 10^4$
2- Mixed Offals	4.5×10^3	8.1×10^5	$2.4 \times 10^4 \pm 0.52 \times 10^4$
3- Kofta	7.8×10^4	8.1×10^7	$1.5 \times 10^5 \pm 0.48 \times 10^5$
4- Head meat	2.4×10^2	8.1×10^4	$2 \times 10^3 \pm 0.58 \times 10^3$

++ Significance difference at ($P < 0.01$)

Table (3): Statistical analytical results of total Coliform counts in the examined samples of cooked head meat and offal at street vendors level (n= 25)

Organ	Min,	Max.	Mean ± S.E
1- Liver	2.1×10^3	4.6×10^6	$3.4 \times 10^5 \pm 0.17 \times 10^5$
2- Mixed Offals	6.1×10^3	6.31×10^5	$9.6 \times 10^5 \pm 0.37 \times 10^5$
3- Kofta	1.7×10^3	8.1×10^5	$2.6 \times 10^5 \pm 0.5 \times 10^5$
4- Head meat	2.8×10^2	8.1×10^4	$1.4 \times 10^3 \pm 0.44 \times 10^3$

+ Significance difference at ($P < 0.05$)

Table (4): Incidence of Salmonella isolated from the examined samples of cooked head meat and offal at street vendors level. (n= 25)

Organ / Serotype	Liver		Mixed Offals		Kofta		Head Meat	
	No	%	No	%	No	%	No	%
S. enteritidis	2	8	3	12	1	4	-	-
S. typhimurium	2	8	-	-	1	4	-	-
Total	4	8	3	6	2	4	-	-

4. DISCUSSION

It is evident from the results recorded in table (1) that the APC of the street vended cooked samples ranged from 3.2×10^5 to 8.2×10^8 CFU/g with an average of $1.4 \times 10^7 \pm 0.5 \times 10^7$ CFU/g for liver , 1.4×10^6 to 6.1×10^8 CFU/g with an average of $1.2 \times 10^7 \pm 0.4 \times 10^7$ CFU/g for mixed offal, 3.2×10^5 to 7.2×10^8 CFU/g with an average of $1.5 \times 10^7 \pm 0.43 \times 10^7$ CFU/g for kofta 1.6×10^6 to 8.1 x 10 CFU/g ^{7}with an average of $5.4 \times 10^6 \pm 0.33 \times 10^7$ CFU/g for head meat respectively. The obtained results were nearly similar to those reported by [11], who found that APC in the examined samples of cooked kofta samples was 1.39×10^7 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 [20]. Accordingly, the high bacterial count of some examined samples may be attributed to neglected sanitary measures during

processing, handling, serving of such products. The variation in bacterial count between different types of meat products could be attributed to differences of ingredients and steps involved in their formulation and preparation [13]. The three main routes by which microorganisms enter food, the foodstuff, food handlers and the environments [30]. Early preparation of large quantities of meat products and hold for hours without control can facilitate the growth of micro-organisms contaminating such products from numerous sources during handling, transport, processing, storage and serving [6]. The average of Enterobactreaceae counts of the street vended cooked samples were highly significant different ($P < 0.01$) as shown in table (2) the higher average of Enterobactreaceae count was recorded in cooked kofta samples ($1.5 \times 10^5 \pm 0.48 \times 10^5$CFU/g) and the lower one was in cooked head meat samples which was($2 \times 10^3 \pm 0.58 \times 10^3$CFU/g) . Moreover, the average of Enterobactreaceae count of cooked liver and mixed offal samples were $1.7 \times 10^4 \pm 0.43 \times 10^4$CFU/g $2.4 \times 10^4 \pm 0.52 \times 10^4$CFU/g ,respectively. The improper handling of raw meats in homes and food service establishment is one of the main reasons for food borne illness caused by consumption of cooked meat [27]. In addition, the factors associated with outbreaks may be attributed to inadequate temperature control, infected food handlers, contaminated raw ingredients, cross contamination & in adequate heat treatment [31]. Wherever Street food was probably the source of most diseases caused by bacteria and other microorganisms due to uncovered food, which manipulated by consumers in an areas infected by flies and others insects or using poor quality water for washing the material and equipment [1]. Regarding results illustrated in table (3) the total coliform count of the street vended cooked liver , mixed offal , kofta and head meat samples ranged from 2.1×10^3 to 4.6×10^6 CFU/g with an average of. $3.4 \times 10^5 \pm 0.17 \times 10^5$ CFU/g, 6.1×10^3 to 6.31×10^5 CFU/g with an average of $9.6 \times 10^5 \pm 0.37 \times 10^5$ CFU/g , 1.7×10^3 to 8.1×10^5 CFU/g with an average of $2.6 \times 10^5 \pm 0.5 \times 10^5$ CFU/g and 2.8×10^2 to 8.1×10^4 CFU/g with an average of $1.4 \times 10^3 \pm 0.44 \times 10^3$ CFU/g, respectively. The current results agree with those recorded by [15] who found that 64.8% of examined samples of ready-to-eat meat products contained coliforms. Coliforms were significant organisms in meat as indicator of fecal contamination and had ability to grow well over wide range of temperature below 10°C up to 46°C [10]. In addition, the presence of coliform bacteria in great numbers may be responsible for inferior quality of meat products resulting in economic losses and the possibility of presence of enteric pathogens, which constitute public health hazard [34]. Moreover, coliform group was used as indicator organisms to determine the undesirable microbial condition of food such as fecal contamination ,the presence of potential spoilage of food , as well as the sanitary condition of food production r storage Results given in table (4) revealed that the serotyping of *Salmonella*e isolated from examined samples of cooked meat and offal at street vendors level . Incidence of Salmonella entretidis was 8%, 12% and 4% for examined samples of liver, mixed offal and kofta and *Salmonella typhimurium* were 8% and 4% for examined samples of liver and kofta ,respectively. *Salmonella typhimurium* were not isolated from mixed offal samples. Also, Salmonella microorganisms failed to be isolated from all examined samples of head meat. The results obtained in this study agreed with those obtained by [33]. For long time, it is necessary to ingest 10^5 or more cells of *Salmonella* per gram of food to cause disease in man. However, studies in recent year found that as low as 3-10 cells / gm cause disease.

Salmonella typhimurium occur is more widely distributed than any other serovars, this organism cause severe outbreaks of salmonellosis in all kinds of animals and was frequently the cause of both sporadic cases and outbreaks of gastroenteritis in man all over the world [36]. Salmonellosis is a great problem and one of the most important food born disease. Mishandling in preparation of food of animal origin was the major reason for the outbreak of salmonellosis (e.g. 25 of 35 registered outbreaks in 1986 were related to food of animal origin) [28]. The number of human cases of salmonellosis increased due to serious hygienic deficiency in food technology during processing, production and storage of food as will as due to poor hygiene of personal working [18]. Salmonella organisms may be commonly carried by human and animal, when those bacteria are multiplied in the intestine they become pathogenic and causing intestinal disorder and slight or sever infection and may even cause death [24]. The symptoms of salmonellosis include diarrhea, nausea, vomiting, fever and abdominal cramps [5]. Low incidence of Salmonella isolation may be attributed to the fact that most pathogenic bacteria destroyed between 72°C to 83°C so the cooking method should be effectively applied to produce temperature sufficient to kill all these pathogens[26].

The obtained results in the present study indicated that cooked liver ,mixed offal, head meat and kofta samples collected from street vendors in Kalyobia, Giza and Cairo governorates were contaminated with high levels of total aerobic, Enterobactreaceae and coliform counts.. The presence of such microorganisms constitute a significant risk and render this type of food of low quality and unfit for consumption.

As conclusion, the quality and safety of street foods samples from street vendors in Kalyobia, Giza and Cairo governorates were unacceptable. Consequently, this study highlighted that the production of relatively safe street-vended foods with low bacterial counts may be possible provided if attention is paid to improve the environmental conditions, personal hygiene and sanitary facilities.

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الوجهة البكتيرية للحوم المطهية والاحشاء على مستوى الباعة الجائلين

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الملخص العربي

تعتبر الوجبات الغذائية السريعة المجهزة للأكل من اللحوم والأعضاء من أهم الأغذية التي يقبل عليها كثير من المستهلكين فى مصـر وذلك لقيمتها الغذائية العالية نتيجة احتوائها على نسـبة عالية من البروتين الحيواني ولطعمها الشـهي وسـهولة إعدادها علاوة على انخفاض ثمنها. لذا قامت الدراسة بفحص عدد مائة (100) عينة فى كل من الكبدة، الاحشاء، الكفتة ولحمة الراس. بواقع (25) عينة فى كل منتج والتي تم جمعها بطريقة عشوائية من الباعة الجائلين فى محافظة القليوبية والقاهرة والجيزة و ذلك لتحديد جودتها من الناحية البكتريولوجية. وقد دلت نتائج الدراسـة على أن متوسـط العدد الكلى للميكروبات الهوائية، الميكروبات المعوية، الميكروبات القولونية هو $1.4 \times 10^{7} \pm 0.5 \times 10^{7}$، $1.7 \times 10^{4} \pm 0.43 \times 10^{4}$، $3.4 \times 10^{5} + 0.17 \times 10^{5}$/جم فى عينات الكبدة المطهية ، $1.2 \times 10^{7} \pm 0.4 \times 10^{7}$ ، $2.4 \times 10^{4} \pm 0.52 \times 10^{4}$ ، $9.6 \times 10^{5} \pm 2.6 \times 10^{5}$ / جم فى عينات الاحشاء المطهية ، $1.5 \times 10^{7} \pm 0.43 \times 10^{7}$ ، $1.5 \times 10^{5} \pm 0.48 \times 10^{4}$ ، $5.4 \times 10^{6} \pm 0.33 \times 10^{6}$ ، $2 \times 10^{3} \pm 0.58 \times 10^{3}$ / جم فى عينات الكفتة المطهية و $0.37 \times 10^{5} \pm 0.5 \times 10^{5}$ ، $0.44 \times 10^{3} \pm 1.4 \times 10^{3}$/ جم فى عينات لحمة الراس المطهية ، علي الترتيب . وقد وجد أن الاختلافات بين العينات محل الدراسـة كانت معنوية كنتيجة للتباين. وبالنسـبة لميكروب السـالمونيلا، فقد تم عزل ميكروب *S.entritidis* من عينات الكبدة، الاعضـاء، الكفتة بنسـبة 8 %، 12 %، 4 % من كل منتج. كما تم عزل ميكروب *S. typhimunium* من 8 % و4 % من عينات الكبدة والكفتة. هذا ولم يتم عزل أي من ميكروبات السـالمونيلا من جميع العينات المأخوذة من لحمة الراس. وقد تم مناقشـة الأهمية الصـحية للميكروبات المعزولة من منتجات اللحوم الجاهزة للأكل مع تحديد المصـادر المختلفة لتلوثها مع وضع بعض التوصيات لتحسين جودة تلك المنتجات.

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