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Original Research Article

VIRULENCE AND ANTIMICROBIAL RESISTANCE GENES OF *Escherichia coli* IN READY TO EAT SANDWICHES IN SHARKIA GOVERNORATE

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Abstract: Ready to eat food has been associated with some epidemics of foodborne illness all over the world. This study was designed to evaluate the microbial quality of ready to eat (RTE) sandwiches in Sharkia Governorate with special reference to virulence and antibiotic resistance genes of *Escherichia coli* (*E. coli*). One hundred and eighty RTE sandwiches containing meat (shawerma, kofta, sausage and hawawshi), chicken (chicken shawerma, pane, shish tawook, grilled chicken) and fish (grilled Tilapia nilotica, grilled *Mugel cephalus*, fried shrimp and fried fillet), fifteen of each were randomly collected from restaurants in Sharkia Governorate. Bacteriological examination revealed that the mean values of aerobic plate count (APC) ranged from 1.23×10^4 to 8.4×10^5 CFU/g and of total coliform count indicated by most probable number (MPN/g) ranged from 0.09×10^2 to 6.95×10^2. *E. coli* percentages ranged from 6.7% to 26.7%. Serotyping of *E. coli* strains revealed five serotypes (O_{153}: H_2, O_{78}, O_{127}: H_6, O_{91}: H_{21} and O_{26}: H_{11}) by different percentages, O_{26}: H_{11} was the most common one (31.6%) and O_{153}: H_2 was the lowest one (5.3%). All recorded isolates showed 100% antibiotic resistant to both erythromycin and amoxicillin – clavulanic acid. It was further found that *eae*A gene present in all isolated serotypes except O_{153}: H_2 while Shiga toxin (*Stx*1 and *Stx*2) were not detected at all, also found that resistant *E. coli* isolates to amoxicillin-clavulanic acid and erythromycin possessed bla_{TEM}, mph_A resistance genes (100%). Current results point to that RTE sandwiches in Sharkia Governorate are potential vehicles of antimicrobial-resistant *E. coli* among other possible foodborne pathogens with public health significance.

Key words: ready-to-eat; aerobic plate count; *E. coli*; coliform; resistance genes

Introduction

Ready-to-eat foods which prepared and sold on restaurants and public places act as a source of available, inexpensive and nutritional meals, also consider a source of income for the vendors (1). In spite of the commercial and nutritive value of this foods, the consumption of these foods suggested to increase the risk of foodborne illnesses as these foods may be contaminated from different sources (2). The aerobic plate count (APC) is an important factor for evaluation of microbial quality assessment in food products and is an indicator of the overall degree of microbial contamination of foods (3). Although most of *E. coli* are nonpat-

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hogenic but they are considered as indicator of faecal contamination in food and about 10 to 15% of intestinal coliforms are opportunistic and pathogenic serotypes (4) and cause a variety of lesions in immunocompro-mised hosts. The presence of specific microorganisms such as *E. coli* and or coliform in ready to eat food indicates that there are degrees of ignorance of the handlers to the proper hygienic practices (5)**.** Also the major sources of microbial contamination are the place of ready to eat (RTE) food preparation, utensils which used in cooking , raw materials, time and temperature of cooking in addition to the personal hygiene of workers (6)**.** Shiga toxin-producing *E. coli*. (STEC) are a rare but potentially fatal cause of gastroenteritis. They are associated with a wide spectrum of disease ranging from mild to bloody diarrhea, through to hemorrhagic colitis and hemolytic uremic syndrome (HUS) (7) but the *eae*A gene produces a 94-kDa outer membrane protein called intimin, which has been shown to be necessary but not sufficient to produce the attaching-and-effacing lesion. Improper handling considers one of the causes of foodborne diseases and that inadequate hand hygiene is a risk factor for food contamination (8)**.** Overuse of antibiotics act as a major factor for the development of antibiotic resistant bacteria which affect both the environment and human health (9). Antibiotics generally used for treatment of both human and animal diseases (10) and are used as prophylactic during animal growth. Foodborne transmission of pathogenic microorganisms has been recognized as a risk in the past few years and bacterial pathogens as *E. coli*, particularly antibiotic resistant strains, have long been dangerous zoonotic hazards (11). The resistance of Enterobacteriaceae to third-generation cephalosporin is mediated by TEM- and SHV-type L-lactamases. While, the most incriminated plasmid-borne beta-lactamases in amoxicillin-clavulanic acid resistance *E. coli* isolates is TEM type and OXA-1enzymes (12). Therefore, this study was conducted to evaluate the microbial quality of RTE sandwiches in El- Sharkia Governorate with special reference to virulence and antibiotic resistance genes of *E.* coli.

Material and methods

Collection of samples

A total 180 random samples of ready-to-eat (well done) sandwiches containing meat (shawerma, kofta, sausage and hawawshi), chicken (chicken shawerma, pane, shish tawook, grilled chicken) and fish (grilled Tilapia nilotica, grilled *Mugel cephalus*, fried shrimp and fried fillet) (15 of each) were collected from different restaurants in Sharkia Governorate. Each sample was kept in a separate sterile plastic bag, put in an icebox then transferred to the laboratory under complete aseptic conditions without undue delay for bacteriological examination (Examined within four hours from collection).

Preparation of samples

Twenty five grams of the meat products (sandwich core and in case of fish from dorsal muscle after removal of skin) samples were taken under aseptic condition to sterile stomacher bag then 225ml sterile 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, 1ml was transferred into separate sterile test tube containing 9ml sterile peptone water, from which tenth- fold serial dilutions were prepared (13). The prepared samples were subjected to the following bacteriological examination:

Determination of total aerobic plate count CFU/g and coliform count MPN/g

The total aerobic plate count CFU/g and coliform count MPN/g were determined according to International Commission of Microbiological Specification for Foods (ICMSF) (14) and Food and Drug Administration (FDA) (15), respectively.

Isolation and identification of E. coli

It was applied by using MacConkey broth as enriched broth and eosin methylene blue (EMB) as plating Media (16).

Antimicrobial susceptibility testing for E. coli

Antimicrobial susceptibility testing for *E. coli* was determined by a standard disk diffusion method using the Bauer et al. (17) disk diffusion technique on Mueller-Hinton agar according to guidelines of Clinical and Laboratory Standards Institute guidelines (18).

Serological identification of E. coli

Serological identification of *E. coli* was measured according to Kok et al. (19) by using rapid diagnostic *E. coli* antisera sets (DENKA SEIKEN Co., Japan) for diagnosis of the enteropathogenic types.

Molecular identification of E. coli virulence and antibiotic resistance genes

DNA extraction was carried out using QIAamp DNA Mini Kit. The screening for the presence of shiga toxins virulence genes were applied according to Dipineto et al. (20) by using the following primer F: 5'- ACA CTG GAT GAT CTC AGT GG -3' and R: 5'- CTG AAT CCC CCT CCA TTA TG -3', which amplify a fragment of 614 bp (*stx*1) and F: 5'- CCA TGA CAA CGG ACA GCA GTT -3', and R: 5'- CCT GTC AAC TGA GCA GCA CTT TG -3', which amplify a fragment of 779 bp (*stx*2). The *eae*A gene was screened according to Wang et al. (21) using the primers F: 5'- ATG CTT AGT GCT GGT TTA GG -3', and R: 5'- GCC TTC ATC ATT TCG CTT TC -3', which amplify a fragment of 248 bp. The antibiotic resistance genes as *mph*A was examined according to Nguyen et al. (22) using the primers F: 5'- GTG AGG AGG AGC TTC GCG AG -3', and R: 5'- TGC CGC AGG ACT CGG AGG TC -3', which amplify a fragment of 403 bp. The *bla*TEM was determined according to Mabilat and Courvalin (23) using the primers F: 5'- ATC AGC AAT AAA CCA GC -3', and R: 5'- CCC CGA AGA ACG TTT TC -3', which amplify a fragment of 516 bp. The PCR products were tested for positive amplification by agarose gel electrophoresis (24). For each PCR experiment, appropriate positive and negative controls.

Statistical analysis

The obtained data were statistically analyzed using analysis of variance (ANOVA) test and comparisons of means were performed according to Duncan Multiple Range test for comparison of Means using SPSS14.

Results

Data presented in Table (1) revealed that the mean values of total APC CFU/g of sausage, kofta, shawerma, and hawawshi meals were 1.5×10^5, 2.2×10^5, 3.7×10^5 and 8.4×10^5, respectively. While for shish tawook, chicken shawerma, pane and grilled chicken was 7×10^4, 8.9×10^4, 3.7×10^5 and 5.8×10^5, respectively and for fried shrimp, fried fillet, grilled T. nilotica and grilled *M. cephalus* was 1.23×10^4, 3.3×10^4, 5.9×10^4 and 1.1×10^5, respectively. As reveled in Table (1) the mean value of total coliform count (MPN/g) in kofta, shawerma, sausage and hawawshi meals were 0.39×10^2, 0.71×10^2, 0.75×10^2 and 6.95×10^2, respectively. While in shish tawook, chicken shawerma, pane and grilled chicken was 0.15×10^2, 0.20×10^2, 0.148×10^3, and 0.20×10^3, respectively. Also in fried shrimp, fried fillet, grilled T. nilotica and grilled *M. cephalus* was $0.0\ 9\times10^2$, 0.65×10^2, 0.39×10^3 and 0.39×10^3, respectively. Coliform incidence in Table (2) was 26.7%, 33.3% 33.3% and 40% in shish tawook, pane, chicken shawerma and grilled chicken, respectively; 13.3%, 20%, 33.3%, 40%, in sausage, shawerma, kofta and hawawshi, respectively and 20%, 33.3%, 40% and 40% in fried shrimp, fried fillet, grilled T. nilotica and grilled *M. cephalus*, respectively. While *E. coli* incidence was 6.7 %, 13.3 %, 20% and 26.7% in shish tawook, pane, chicken shawerma and grilled chicken, respectively 13.3%, 13.3% and 20% in kofta, shawerma and hawawshi, respectively and 6.7% in both grilled T. nilotica and *grilled M. cephalus*, while not detected in sausage, fried shrimp and fried fillet.

E. coli isolates revealed five different serotypes (Table 3), the most common one was O_{26} : H_{11} (31.6%) which isolated from two samples of both shawerma and grilled chicken and one sample in both hawawshi and chicken shawerma, followed by five O_{91}: H_{21} isolates

(26.3%) recorded from two samples of both pane and chicken shawerma and one sample of grilled *M. cephalus* ,then four O_{127}:H_6 isolates (21%) obtained from two samples of kofta and two samples of hawawshi, three O_{78} isolates (15.8%) reported from one sample of shish tawook and two samples of grilled chicken, and finally O_{153} : H_2 (5.3%) isolated from only one sample of grilled T. nilotica.

Data in Table (4) showed that all isolates were 100% sensitive to streptomycin, doxycycline, chloramphenicol, sulphamethe-xazol–trimethoprim, 89.5% were sensitive to both ciprofloxacin and gentamycin and 84.2% were sensitive to cefotaxime while 100% of isolated samples were resistant to both erythromycin and amoxicillin–clavulanic acid. Using further investigation (PCR) in Figure (1) for five representative serotypes isolates (kofta, chicken shawerma, hawashi, grilled chicken and grilled Tilapia nilotica) (A) showed that *eae*A gene was present in all isolated serotypes except O_{153}:H_2 (grilled Tilapia nilotica) while Shiga toxin genes (*stx1* and *stx*2) were absent from all. (B) showed that all resistant *E. coli* isolates to amoxicillin-clavulanic acid possessed bla_{TEM} resistance genes (100%), (C) showed that all resistant *E. coli* isolates to erythromycin possessed mph_A resistance genes (100%).

Table 1: Mean values of APC (CFU/g) and Coliform count (MPN/g) in the examined samples of ready to eat sandwiches (n=15)

Item		APC Mean ± SE	Coliform count Mean ± SE
Meat meals	Sausage	$1.5\times10^5 \pm 8.3\times10^{4ab}$	$0.75\times10^2 \pm 0.24\times10^{2b}$
	Kofta	$2.2\times10^5 \pm 1.1\times10^{5ab}$	$0.39\times10^2 \pm 0.09\times10^{2b}$
	Shawerma	$3.7\times10^5 \pm 1.3\times10^{5ab}$	$0.71\times10^2 \pm 0.21\times10^{2b}$
	Hawawshi	$8.4\times10^5 \pm 2.2\times10^{5a}$	$6.95\times10^2 \pm 1.48\times10^{2a}$
Chicken meals	Shish tawook	$7\times10^4 \pm 2.8\times10^{4b}$	$0.15\times10^2 \pm 0.04\times10^{2b}$
	Chicken shawerma	$8.9\times10^4 \pm 3.7\times10^{4b}$	$0.20\times10^2 \pm 0.09\times10^{2b}$
	Pane	$3.7\times10^5 \pm 1.8\times10^{5ab}$	$0.148\times10^3 \pm 0.32\times10^{2ab}$
	Grilled chicken	$5.8\times10^5 \pm 2.4\times10^{5ab}$	$0.20\times10^3 \pm 0.113\times10^{2ab}$
Fish meals	Fried shrimp	$1.2\times10^5 \pm 4.2\times10^{4ab}$	$0.09\times10^2 \pm 0.029\times10^{2b}$
	Fried fillet	$3.3\times10^4 \pm 1.4\times10^{4b}$	$0.65\times10^2 \pm 0.32\times10^{2ab}$
	Grilled T. nilotica	$5.9\times10^4 \pm 1.2\times10^{4b}$	$0.39\times10^3 \pm 0.14\times10^{3ab}$
	Grilled *M. cephalus*	$1.1\times10^5 \pm 6.6\times10^{4ab}$	$0.39\times10^3 \pm 0.14\times10^{3ab}$

SE= stander error. Means of the same column carrying different superscript letters were significantly different ($p<0.05$).

Table 2: Incidence of isolated bacteria from the examined samples of ready to eat sandwiches (n=15)

Item		Coliform		*E.coli*	
		NO	%	NO	%
Chicken meals	Shish tawook	4	26.7	1	6.7
	Pane	5	33.3	2	13.3
	Chicken shawerma	5	33.3	3	20
	Grilled chicken	6	40	4	26.7
Meat meals	Sausage	2	13.3	ND	ND
	Shawerma	3	20	2	13.3
	Kofta	5	33.3	2	13.3
	Hawawshi	6	40	3	20
Fish meals	Fried shrimp	3	20	ND	ND
	Fried fillet	5	33.3	ND	ND
	Grilled T. nilotica	6	40	1	6.7
	Grilled *M. cephalus*	6	40	1	6.7

ND = not detected.

Table 3: Incidence of serotypes of *E. coli* strains isolated from examined isolates: (n=19)

***E. coli* strains**		**O_{127}:H_6**		**O_{91}: H_{21}**		**O_{26} : H_{11}**		**O_{78}**		**O_{153} : H_2**		
		No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**Total**
Meat meals	Shawerma	-	-	-	-	2	10.5	-	-	-	-	2
	Kofta	2	10.5	-	-	-	-	-	-	-	-	2
	Hawawshi	2	10.5	-	--	1	5.3	-	-	-	-	3
Chicken meals	Shawerma	-	-	2	10.5	1	5.3	-	-	-	-	3
	Pane	-	-	2	10.5	-		-	-	-	-	2
	Shish tawook	-	-	-	-	-		1	5.3	-	-	1
	Grilled chicken	-	-	-	-	2	10.5	2	10.5	-	-	4
Fish meals	Grilled T. nilotica	-	-	-	-	-	-	-	-	1	5.3	1
	Grilled *M. cephalus*	-	-	1	5.3	-	-	-	-	-	-	1
Total		4	21	5	26.3	6	31.6	3	15.8	1	5.3	19

Table 4: Percentages of antimicrobial susceptibility of *E. coli* strains isolated from the examined isolates of ready-to-eat sandwiches (n = 19)

Antimicrobial agents	**Susceptible**		**Intermediate**		**Resistant**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Streptomycin (S)	19	100%	-	-	-	-
Ciprofloxacin (CIP)	17	89.5%	2	10.5%	-	-
Gentamycin (CN)	17	89.5%	2	10.5%	-	-
Erythromycin (E)	-	-	-	-	19	100%
Amoxicillin – clavulanic Acid(AMC)	-	-	-	-	19	100%
Doxycycline(DO)	19	100%	-	-	-	-
Chloramphenicol (C)	19	100%	-	-	-	-
Sulphamethexazol – trimethoprim(SXT)	19	100%	-	-	-	-
Cefotaxime (CTX)	16	84.2%	3	15.8%	-	-

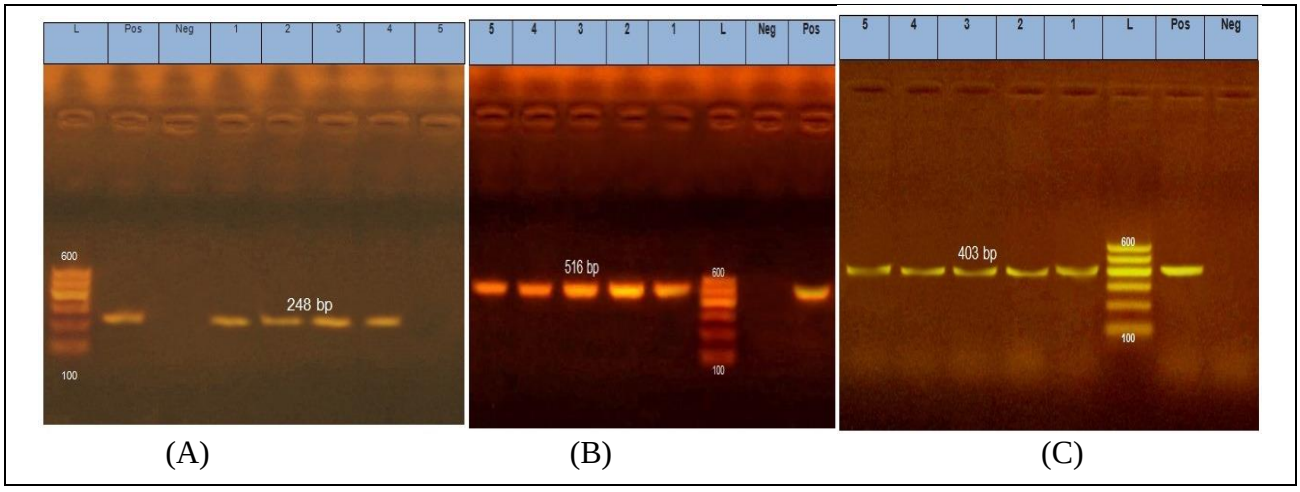

Figure 1: Agarose gel electrophoresis of PCR (A) *E. coli* virulence genes PCR in 1.5% agarose gel [L:100pb Ladder, 1: kofta (O_{127}:H_6); 2: chicken shawerma (O_{91}: H_{21}); 3: hawashi (O_{26} : H_{11}); 4: grilled chicken (O_{78}); 5: grilled Tilapia nilotica (O_{153}: H_2)] *eae*A (248 bp) (intimin gene) was +ve for sample number 1, 2, 3 and for 4, while negative in sample number 5. (B) bla_{TEM} (516 bp) resistance gene PCR in 1.5% agarose gel [L:100 bp Ladder, 1: kofta (O_{127}:H_6); 2: chicken shawerma (O_{91}: H_{21}); 3: hawashi (O_{26} : H_{11}); 4: grilled chicken (O_{78}); 5: grilled Tilapia nilotica (O_{153}: H_2)] +ve in all samples. (C) mph_A (403bp) resistance gene PCR in 1.5% agarose gel [L:100pb Ladder, 1: kofta (O_{127}:H_6); 2: chicken shawerma (O_{91}: H_{21}); 3: hawashi (O_{26} : H_{11}); 4: grilled chicken (O_{78}); 5: grilled Tilapia nilotica (O_{153}: H_2)] +ve in all samples

Discussion

This study revealed that, ready-to-eat sandwiches containing meat, chicken and fish had significant growth of microorganisms. But the microbial load of samples of certain products was higher than others to the extent that it may pose a threat to the health of regular consumers as some sandwiches are seasoned with peppers and with tahini (sesame seeds paste and oil) and served in a pita bread wrap as hawawshi. In addition, some restaurants use local mayonnaise to season the sandwiches, all this additives affect microbial quality of sandwiches. Aerobic plate count (APC) considered as important indicator for evaluation of sanitary condition of RTE sandwiches. Hawawshi was significantly higher contaminated ($P<0.05$) with APC, which attributed to the bad quality of ingredient introduced in processing or due to its coating with aluminum foil, which may consider as a source of contamination

The APC in hawawshi was lower than a study applied by Ibrahim (25) which was 21.2×10^6 CFU/g. The APC of kofta was $2.2x10^5$ CFU/g which is lower than Fahim et al. (26) who found that it was 8.51×10^5 CFU/g, while higher than a study applied by Sobieh (27) which was 1.83×10^4 CFU/g. The APC of chicken shawerma was lower than a study applied by Rafaie (28) who found that it was 2.46×10^7 CFU/g. Also APC of sausage was lower than that reported by Tudor et al. (29) who found that it was $1.2x10^4$ - $4.8x10^4$ CFU/g in meat products including sausage, while higher than El-Mossalami (30) which was $3.2x10^4$ CFU/g. Regarding to fish meals APC of grilled T. nilotica and grilled *M. cephalus* was lower than a study applied by Salim (31) which was 6.3×10^4 CFU/g in grilled T. nilotica and 3.7×10^5 CFU/g in grilled *M. cephalus*. The APC in fried shrimp was lower than Hassanin et al. (32) recorded 5.4×10^3 CFU/g in fried shrimp, also lower than Edris et al. (33) which was 2.78 CFU/g in breaded shrimp. APC in pane was higher than Ibrahim et al (34) who found that it was 7.35×10^4 CFU/g. As the high incidences of bacterial contamination are mainly due to the unsanitary and largely unhygienic nature of the food preparations and services areas as foods are good indicators of the state of environment in which they are prepared or served (35)**.** Total coliform count findings were lower than obtained by Rafaie et al. (28) who recorded $33.9x10^5$ CFU/g and $1.8x10^5$ CFU/g in shawerma and kofta samples, respectively. Also lower than that reported by Fahim et al. (26) which was 1.12×10^4 CFU/g in hawawshi sandwiches and Ibrahim et al. (34) who found that it was 1.18×10^3 CFU/g, 4.32×10^3 CFU/g, 9.97×10^3 CFU/g in RTE pane, shish tawook and shawerma, respectively. Also Hassanin et al. (32) recorded $2.4x10^2$ CFU/g in fried shrimp. On the other hand, it was higher than Edris et al. (33) who found that it was 1.59 CFU/g in breaded shrimp and Khater et al. (36) which was 2.92 CFU/g in RTE grilled kofta. Coliform bacteria were significant organisms in meat as indicator of fecal contamination and had the ability to grow well over wide range of temperature below 10˚C up to 46˚C (37). In the current study, coliform % was higher than that reported by Moustafa et al. (38) recorded in 20% of hawawshi samples and 10% of both shawerma and sausage. Lower than Salem et al. (39) isolate it from 76% of RTE chicken samples and 52% of RTE meat samples. *E. coli* % in this study was higher than that mentioned by EL-Shater et al. (40) record *E. coli* in 8% of shawerma samples and El-Dosoky et al. (41) isolate it from 10% of shawerma samples and Ismail (42) detected it in 17.3% of hawawshi. While, it was lower than resultes recorded by Khater et al. (36) which was 30% in kofta and Nimri et al. (43) which was 28.3% in shawerma. Similar results obtained by Hassanien et al. (32) isolate it from 8.6% of grilled *M. cebhalus* and Hosein et al. (44) reported that, all examined shrimp were free from *E. coli*. Absence of *E. coli* from fillet sandwiches, shrimp sandwiches and sausage sandwiches may be attributed to efficient heat treatment during cooking, high quality of ingredient introduced in processing, absence of other additives as salads or mayonnaise and application of good hygienic measures. Although, *E. coli* is readily inactivated above 55°C, the post cooking cross contamination

may occur as a result of contact of raw ingredient with cooked meat (45) or the hands of food handlers as mentioned by Awadallah et al. (46) or also due to eat chicken by mixing it with contaminated leafy vegetables and salads post-processing (47). In general, heat-treated foods must be free from *E. coli*. The presence of *E.coli* in the food is considered as indicator of fecal contamination beside they induce severe diarrhea in infants and young children as well as cases of food poisoning and gastroenteritis among consumers. Although most of *E.coli* are harmless, several are known to produce toxins that may cause diarrhea. The pathogenic *E. coli* can be grouped into enteropathogenic (EPEC), enterotoxogenic (ETEC), enterohaemorrhagic (EHEC), entero-aggregative (EAEC), enteroinvasive (EIEC) and Diffusely adherent *E. coli* (DAEC) (48). The pathogenic strains of *E. coli* were previously isolated from different ready-to-eat meat products by Soliman and El–Tabiy (49) who isolate O_{26} (13.3%) and O_{127} (6.7%) from kofta, Fahim et al. (26) isolate O_{111}: H_4 and O_{127}:H_6 strains from 10% and 5% of kofta respectively, O_{26}:H_{11}(5%), O_{55} : H_7(5%), O_{111} : H_4(5%) and O_{119}: H_4(10%) from sausage sandwiches. While O_{26}: H_{11} (10%), O_{55}:H_7 (5%), O_{86} (5%), O_{111}: H_4(5%) and O_{124} (5%) in hawawshi.

Results of antibiotic sensitivity test agree with Rao et al. (50) and Hemeg (51) who found that all isolates from ready to eat meat were 100% resistant to amoxicillin–clavulanic acid, but disagree with Nimri et al. (43) found 50% of *E. coli* isolates were resistant to tetracycline and streptomycin. The rate of antibiotic resistance in *E. coli* acts as an indicator of resistance transmission in bacterial populations and also as an indicator for the antimicrobials used in the treatment of slaughter animals and humans (52). *Eae*A gene was detected in 80% of examined isolates mean while shiga like toxin genes were not detected. Intimin gene (*eae*A) is an essential factor for the microbe to attach strongly to intestinal mucosal cells and initiate disease (48). On contrary, the finding of Nimri et al. (43) was 30% of *E. coli* isolates were positive for the *stx*1 gene. The results of *bla*$_{TEM}$ gene were nearly similar to findings of Paula et al. (53) who declared that *bla*$_{TEM}$ gene was detected in (34.3%) of deli meats. Zongo et al. (54) reported that *E.coli* isolates had low resistance with antibiotics of beta lactamin family in RTE food Yoon et al. (55) found that cephalosporin-resistant *E. coli*, was 8.7% in meat samples and 31.8% in chicken samples. The most common mechanism of resistance among enterobacteriaceae is the production of b-lactamases, chromosomally or plasmid encoded, which inactivate certain b-lactam antibiotics by hydrolyzing the b-lactam ring (56).

Conclusion

Our results indicate that RTE sandwiches in Sharkia serve as potential vehicles for the transmission of antimicrobial-resistant *E. coli* among other possible emerging foodborne pathogens, and are therefore a potential public health hazard. Therefore, using of high quality raw materials, efficient heat treatment, adequate cleaning and sanitization of utensils, day-by- day observance of proper personal, food handling of cooked food and lastly adequate education of food hygiene should be done. In addition, strict hygienic measures should be applied during preparation of ready to eat food to improve the quality of the product and to safeguard the consumers.

Conflict of interest

None of the authors have any conflict of interest to declare

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