Research & Reviews: Journal of Food and Dairy Technology

e-ISSN:2321-6204
p-ISSN:2347-2359

Fecal Pollution and *Salmonella* spp. in Sandwiches of Meat Products vended in Great-Cairo

Moustafa A El-Shenawy*

Department of Food Science and Bacteriology, National Research Center, Egypt

Research Article

Received Date: 31/10/2016
Accepted Date: 23/11/2016
Published Date: 29/11/2016

***For Correspondence**

Moustafa A El-Shenawy, Department of Food Science and Bacteriology, National Research Center, Egypt, Tel: + 201222361622

E-mail: elshenawy_moustafa51@yahoo.com

Keywords: Ready-to-eat foods, Pathogens, Chromogenic media, Contaminated food, Meat, Salmonella, Enterobacteriaceae

ABSTRACT

A total of seventy Sandwiches of meat and meat products were randomly collected randomly from the street-vendors and food shops located in different places in Cairo. All samples were examined for the presence of *Salmonella spp.* and fecal pollution indicators using the conventional examination methods (classic selective media), chromogenic media, and rapid food-system kits.

Results indicated that 20-70% of the examined samples were fecal contaminated with populations ranged from $17x10^2$ to $36x10^2$ cfu/g. Moreover, 20-40% of the examined samples, depended on the type of sandwich and the method used for analysis, were found to be contaminated with *Salmonella spp.* with counts ranged from $7x10^2$ to $26x10^2$ cfu/g. Confirmation of Sixty-eight predominant isolates of *Salmonella spp* picked up from classic media and other ninety-six isolates picked up from the chromogenic media was done using the biochemical tests, rapid kits, Hi *Salmonella* identification kit and Hi *Salmonella* latex test kit. Results of the identification/confirmation demonstrated that chromogenic medium was the most efficient for isolation of *Salmonella spp* from the examined samples.

INTRODUCTION

The major concern for street foods is their microbiological safety. This because vending process is done in poor sanitation places. In some African countries Street foods have been found to be contaminated of public health concern pathogens such as fecal coliforms, *Staphylococcus aureus*, *Salmonella sp.*, *Bacillus cereus and Escherichia coli* [1].

For example a recent recall of processed meats products by a leading food processor in Trinidad, West Indies assured the need for safe and sanitary handling of street- foods. Some consumers may cut purchases of certain street-food items or avoid consuming them because of fearing from food borne pathogens [2]. Thus, they need to be informed always about their food and how it is prepared and handled particularly for fast meal and ready-to-eat foods.

Salmonella spp. cause one of the most important food borne disease in the world called *Salmonellosis* [3]. Enterobacteriaceae bacteria are a gram-negative bacilli that inhabitants normally the gastrointestinal tract of humans, birds and animals [4]. These organisms are a common indicator of fecal pollution and thus possible presence of other pathogens that cause wide diverse of infections. This family includes more than 70 genera but, *Escherichia coli, Klebsiella* species, and Enterobacter species were the most commonly reported by CDC's National Healthcare Safety Network (NHSN) surveillance system [5].

The pathogen can transmitted from animals/birds to humans, through meat, water, poultry and eggs [6]**.** *Salmonella* has a large number of serotypes that can cause different types of diseases in different hosts. Some serotypes such as (*S. typhi* and *S. gallinarum*) are host adapted, while others such as (*S. typhimurium* and *S. enteritidis*) may cause disease in a variety of hosts. This pathogen is able to invade cells, including cells from gut epithelium, but not exclusively them and thus cause the disease [7,8]**.**

Foodborne Salmonellosis continues to be a significant public health problem. Meat and its products have been associated with outbreaks caused by *Salmonella*, *Shigella* and *E.coli* O157:H7 [9]. Pathogenic bacteria may contaminate the carcasses during slaughter, and thus pathogenic bacteria may distributed during preparation/processing of meat and meat products materials [10]. In addition, human Salmonellosis has been recognized due to consumption of raw or improperly pasteurized milk and milk

e-ISSN:2321-6204
p-ISSN:2347-2359

products [11]. Although the heating kills the pathogens, the heated food may become re-contaminated by food handlers or from cross contamination with raw materials, during processing, marketing or through food service operations.

This work was done to examine sandwiches of meat and meat products, vended in Cairo streets, for the presence of *Salmonella spp.* and fecal pollution indicators using the conventional examination methods (classic selective media), chromogenic media, and rapid food-system kits.

RESULTS AND DISCUSSION

A total of seventy sandwiches of street-vended, meat products including ten samples each of hawawshi, kofta, burger, liver, sausages, luncheon and shawerma, were microbiologically investigated. Results indicate the incidence of Enterobacteriaceae, Coliform group and *Salmonella spp.* in different meat products using classic, chromogenic method and food system as shown in **Table 1.** Results revealed that, Enterobacteriaceae group bacteria were detected in 50, 60, 60, 60, 20, 70 and 40%, and ranged from $25x10^2$ to $50x10^2$ cfu/g for with an average count of ca 10^2 cfu/g of sausages, liver, kofta, burger, hawawshi, luncheon and shawerma sandwiches, respectively. These results are in harmony with Bezerra et al. [12] who reported that 31.4% of hamburgers examined harbored coliform group bacteria and thus were not valid for human consumption.

Also, **Table 1** showed that coliform group were detected in 30, 50, 40, 60, 20, 70 and 30%, with an average count of ca 10^2 cfu/g of sausages, liver, kofta, burger, hawawshi, luncheon and shawerma sandwiches respectively. The obtained results reveal the highest coliform contamination percentage was observed in luncheon sandwiches (70%) while, hawawshi sandwiches contained the lowest contamination (20%). This prove that coliforms bacteria group still considered strict indicators for assessing general hygienic status of food contact surfaces [13].

Therefore, high coliform fecal contamination as presented by Gari, et al. [14] and Bezerra, et al. [12] and shown by the obtained results emphasize the importance of food coliform testing as general hygienic indicator for food and food contact surfaces as reported by Jackson, et al. [13].

Salmonella spp., the most hazardous particular bacterium of Enterobacteriaceae group, was detected count cfu/g in the examined meat product. Using the classic selective medium, *Salmonella spp.* was isolated from 20, 30, 30, 20, 20, 20 and 30% for sausages, liver, kofta, burger, hawawshi, luncheon and shawerma sandwiches with in average count of ca 10^2 cfu/g respectively. Results in **Table 1** indicate that higher contamination percentages were observed in liver, kofta and shawerma sandwiches while, lower contamination percentage in other kinds of meat sandwiches.

In Trinidad and Tobago, CAREC [15] stated that, improper preparation and handling of foods at factories of processing as well as establishments are the main factors of *Salmonella* outbreaks and salmonellosis [16].

Table 1. Incidence of Enterobacteriaceae, Coliform group and *Salmonella spp.* in different meat products using classic, chromogenic method and food system.

Type/no. of samples	Enterobacteriaceae		Coliform group		*Salmonella spp.*			
					classic and chromogenic methods		Food System	
	Positive samples	Average count cfu/ml (mean)	Positive samples	Average count cfu/ml (mean)	Positive samples	Average count cfu/ml (mean)	Positive samples	%
Sausage sandwiches (10)	5(50%)*	$35x10^{2*}$	3(30%)*	$36x10^{2*}$	2(20%)* 3(30%)**	$15x10^{2*}$ $18x10^{2**}$	4	40%
Liver sandwiches (10)	6(60%)*	$50x10^{2*}$	5(50%)*	$34x10^{2*}$	3(30%)* 4(40%)**	$12x10^{2*}$ $20x10^{2**}$	5	50%
Kofta sandwiches (10)	6(60%)*	$46x10^{2*}$	4(40%)*	$34x10^{2*}$	3(30%)* 4(40%)**	$15x10^{2*}$ $23x10^{2**}$	6	60%
Burger sandwiches (10)	6(60%)*	$31x10^{2*}$	6(60%)*	$22x10^{2*}$	2(20%)* 4(40%)**	$10x10^{2*}$ $11x10^{2**}$	4	40%
Hawawshi sandwiches (10)	2(20%)*	$25x10^{2*}$	2(20%)*	$17x10^{2*}$	2(20%)* 3(30%)**	$7x10^{2*}$ $11x10^{2**}$	3	30%
Luncheon sandwiches (10)	7(70%)*	$45x10^{2*}$	7(70%)*	$33x10^{2*}$	2(20%)* 3(30%)**	$14x10^{2*}$ $26x10^{2**}$	4	40%
Shawerma sandwiches (10)	4(40%)*	$30x10^{2*}$	3(30%)*	$21x10^{2*}$	3(30%)* 3(30%)**	$11x10^{2*}$ $23x10^{2**}$	3	30%

*Classic method, ** Chromogenic method.

e-ISSN:2321-6204
p-ISSN:2347-2359

With regard to the food system method, rapid miniaturized biochemical kits for food microbiological testing, data in **Table 1** reveal that the Salmonella contamination percentages ranged from 30% to 60% due to the different types of meat products. Moreover, since, the highest contamination percentage was obtained for kofta sandwiches while, hawawshi and shawerma sandwiches contained lower contamination percentage.

In this regard, some authors reported that Food-Systems kits proved to be efficient, as a rapid microbiological test, but not for testing food poisoning incriminated foods or the ready to eat foods [17-19]. Our results are in accordance of theses researchers.

As a general conclusion, as shown from **Table 1**, chromogenic media gives higher results for positive samples than the traditional classic media. The same was true, when comparing the results of positive samples obtained by chromogenic media and the food system kits, as we found that the percent of positive samples detected by the food system kit were higher than those detected by the chromogenic media **Table 1**.

When taking into consideration that the food system kits allow the detection of the bacteria, depend on some biochemical reactions, however the chromogenic media detect the bacterial cell itself and allow isolation of the detected strains. This criterion may give more preference to the use of chromogenic media. Thus, using the chromogenic media used for detection *Salmonella spp.* may have several advantages such as low cost, lower processing time and less cross-contamination than the other used methods [20].

Sixty eight isolates were picked up from the selective agar media, of the positive examined samples, (classic methods, *Salmonella and Shigella* agar), and exposed for identification/confirmation as *Salmonella typhimurium,* sources and numbers of these isolates are presented in **Table 2**.

In the same time, (96) isolates picked up from the chromogenic media including HiChrome Salmonella Agar were subjected to the same purpose of confirmation /identification. Sources and numbers of these isolates are presented in **Table 2**. All the aforementioned isolates were identified according to their morphology, physiological and biochemical characteristics. However, only 20 *Salmonella spp.* isolates (8 from classic and 12 from chromogenic media) from Sausage sandwiches, were subjected for more confirmation and identification process using additional kits, Hi Salmonella identification kit and Hi Salmonella latex test kit. The obtained results confirm again, that chromogenic medium still to be the most efficient media for isolation of the investigated pathogens from meat products.

Table 2. Identification of *Salmonella spp.* isolated from meat product sandwiches using classic and chromogenic methods.

Type/no. of samples	No of samples (Positive samples)	*Listeria spp.* isolates	*Listeria monocytogenes* strain
Sausage sandwiches	10(2)*10(3)**	8*12**	3*7**
Liver sandwiches	10(3)*10(4)**	12*16**	4*9**
Kofta sandwiches	10(3)*10(4)**	12*16**	6*10**
Burger sandwiches	10(2)*10(4)**	8*16**	3*9**
Hawawshi sandwiches	10(2)*10(3)**	8*12**	3*8**
Luncheon sandwiches	10(2)*10(3)**	8*12**	4*7**
Shawerma sandwiches	10(3)*10(3)**	12*12**	3*7**
Total	70	68*96**	26*57**

The Egyptian guideline standards numbers 1114, 1688, 1972 and 3492 issued in 2005 as well as number 1473 issued in 2007, specified for meat products, stated that the examined products should be free from any pathogenic organisms.

According to these microbiological specifications of the Egyptian standards, most of the examined meat product sandwiches (75.7%) were found to be accepted, due to the presence of *Salmonella typhimurium*. However, only 24.3% of samples were found to be not accepted by these standards **(Table 3)**.

Table 3. Final assessment of meat product according to Egyptian standards for *Salmonella typhimurium.*

Rejected samples (%)	Accepted samples (%)	No. of samples	Meat product
2 (20%)	8 (80%)	10	Sausage sandwiches
3 (30%)	7 (70%)	10	Liver sandwiches
3 (30%)	7 (70%)	10	Kofta sandwiches
4 (40%)	8 (80%)	10	Burger sandwiches
2 (20%)	8 (80%)	10	Hawawshi sandwiches
2 (20%)	8 (80%)	10	Luncheon sandwiches
3 (30%)	7 (70%)	10	Shawerma sandwiches
17(24.3%)	53 (75.7%)	70	Total

Over all the obtained results of this study indicated that meat product sandwiches, sold in different location of Great-Cairo Governorate, showed high degree of coliform and Salmonella contamination and though they can poses a serious challenge to the consumer.

e-ISSN:2321-6204
p-ISSN:2347-2359

CONCLUSION

The obtained results may highlight the need of strict applying the badges issued by the Egyptian Public Health Authority of the Ministry of Health. Other issues such as the critical control points should be taken into consideration to prevent the cross contamination from the raw products to ready-to-eat food. Use of right / adequate time for cooking / preparing the final food product, avoid recontamination of the final food by surfaces previously contaminated with the raw meat, refrigeration and properly storage of the final food product may help to avoid contamination by such investigated pathogens. Also, street vendors should be monitoring regularly by food inspectors and media should play a role to educate both vendors and consumers on how to deal with food safety issues.

REFERENCES

1. Tomlins K and Johnson PN. Developing Food Safety Strategies and Procedures through Reduction of Food Hazards in Street-Vended Food to Improve Food Security for Consumers, Street Food Vendors and Input Suppliers. Crop Post Harvest Program, R8270 (ZB0339). Project Final Report, Natural Recourses Institute, United Kingdom. 2004.
2. Roberts, et al. Piecemeal Microautophagy of nucleus in Saccharomyces cerevisiae. Mol Biol Cell. 2003;14:129-141.
3. Malorny B, et al. Multicenter Validation of the Analytic Accuracy of Salmonella PCR: toward an international standard. Applied and Environmental Microbiology. 2003a;69:290-296.
4. Donnenberg. The Cpx envelope stress response both facilitates and inhibits elaboration of the enteropathogenic Escherichia coli bundle-forming pilus. Mol Microbiol. 2010;76:1095-1110.
5. Sievert, et al. Antimicrobial-resistant pathogens associated with healthcare-associated infections: summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2009-2010. Infect Control Hosp Epidemiol. 2013;34:1-14.
6. Riyaz-Ul-Hassan, et al. Real-time PCR-based rapid and culture-independent detection of Salmonella in dairy milk – addressing some core issues. Applied Microbiology. 2004;56:275-282.
7. Galán, et al. Molecular and Functional characterization of the Salmonella typhimurium invasion gene invA: Homology of InvA to members of a new protein family. J Bacteriol. 1992;17:4338-4349.
8. Chen and Griffiths. Detection of Salmonella and simultaneous detection of Salmonella and Shiga-like toxin-producing Escherichia coli using the magnetic capture hybridization polymerase chain reaction. Applied Microbiology. 2001;32:7-11.
9. CDC. Outbreaks of Salmonella Serotype Enteritidis Infection Associated with Eating Shell Eggs --- United States. 2002.
10. Borch and Arinder. Bacteriological safety issues in red meat and ready-to-eat meat products, as well as control measures. Meat Sci. 2002;62:381-390.
11. Mcewen BS, et al. Corticosteroid receptors in brain: relationship of receptors to effects in stress and aging. Annals of the New York Academy of Sciences. 1987;512:394-401.
12. Bezerra et al. Structural analysis of ConBr reveals molecular correlation between the carbohydrate recognition domain and endothelial NO synthase activation. Biochemical and Biophysical Research Communications. 2011;408:566-570.
13. Jackson et al. A Spitzer IRAC Census of the Asymptotic Giant Branch Populations in Local Group Dwarfs. II. IC 1613. The Astrophysical Journal. 2007;667:891-899.
14. Garin et al. Heparan sulfate-mediated binding of infectious dengue virus type 2 and yellow fever virus. Virology. 2002;292:162-168.
15. CAREC. 3rd World Water Forum: Regional Cooperation for Shared Water Resources Management. Kyoto, Japan. 2003.
16. Hedberg CW. Outbreaks of salmonellosis associated with eating uncooked tomatoes: implications for public health. Epidemiol. Infect. 1999;122:385-393.
17. El Kholy et al. Use of some agro-industrial by products in Nile Tilapia fish diets. 8th International Symposium on Tilapia in Aquaculture. 2008.
18. El Sadek et al. Assessment of Radiological Indices of Soil Samples from Northern Egypt through the Measurement of the Activity Concentrations of Natural Radionuclides. International Journal of Environmental Science and Toxicology Research. 2008;3:144-153.
19. Jacques-Antoine H, et al. Staphylococcus aureus and its food poisoning toxins: characterization and outbreak investigation. FEMS Microbiol Rev. 2011;36:815-836.
20. Fricker, et al. False-negative β-d-glucuronidase reactions in membrane lactose glucuronide agar medium used for the simultaneous detection of coliforms and Escherichia coli from water. Lett Appl Microbiol. 2008;47:539-542.