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Assessment of food safety and hygienic practice of junk food in the restaurants of Al Qunfudhah in Saudi Arabia

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Abstract

Foodborne pathogens are becoming a globally formidable health problem and perceived as a major health concern in the Kingdom of Saudi Arabia (KSA). In our previous study 93 of *(E. coli, Serratia odorifera, Citrobacter werkmanii, Acinetobacer Baumannii, Klebsilla, Pseudomonas spp)* were isolated from fast food included Shawarma, Burger Chicken & Beef, Liver, Chicken fillet nuggets (Mesahab) and Fried Chicken (Borst) different restaurant in the Al Qunfudhah is administrative centers, located in the southwest of the Emirate of Makkah at a distance of 360 km. Kingdom of Saudi Arabia. Identification was based on conventional culture and antimicrobial susceptibility testing (AST) .The objective of the current study is to confirm identification of *(E. coli, Serratia odorifera, Citrobacter werkmanii , Acinetobacer Baumannii, Klebsilla, Pseudomonas spp)* for the BD phoenix automated microbiology system is intended for the rapid identification (ID) and antimicrobial susceptibility testing (AST) of clinically significant bacteria. The results revealed that mean value of E.coli counts Shawarma, Burger, Borst and Mesaheb were 6.23±0.48, 5.72±0.74, 6.15 ±0.48 and 5.59±0.64 log10 CFU g^{-1} respectively.The *Pseudomonas Flourescens* count of Burger was statistically significant when compared with Shawarma ,Borst and Mesaheb ($p < 0.05$). This result indicated that most of the fast food samples examined in the study did not meet any bacteriological quality standard as recommended by The New South Wales (NSW) Food Authority to be <5.0 log10 CFU g–1 and, therefore, it poses potential risks to consumers. Also, the hygiene practices in the fast food were evaluated using a questionnaire format and critical points were identified.

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Introduction

The busy and hectic life schedule has opened the way for the fast food industry in most parts of the world. The traditional or conventional way of cooking is over and the fast food joints are visible everywhere. The broad spectrum of food-borne infections has changed over time; well-established pathogens are being controlled, and new ones are emerging. New pathogens may emerge because of changing ecology or changing technology that connects a potential pathogen to the food chain. Food borne illness of microbial origin is not only a national problem but is a major international health problem associated with street foods (WHO 2009).

In ready to eat sample is one of the most liked and eaten sandwiches sold in fast food restaurants in Saudi Arabia. Although fast food restaurants are often viewed as a ready-cooked food to go is as old as cities themselves, unique variations are historical in various cultures. Food borne diseases remain a major public health problem across the globe. The problem is more severe in developing countries because of lack of personal hygiene and food safety measures. As much as 70% of diarrheal diseases in developing countries are believed to be of foodborne origin (Farooq and Saqlain, 2013).

Different terms can be used to describe ready-to-eat foods. These include convenient, ready, instant and fast foods. An example of such ready- to-eat food includes; pastries, meat pie, sausage rolls, burger, doughnut, shawarma, salads or coleslaw, milk and milk products.

Ready-to-eat (RTE) foods are processed foodstuffs which have gained popularity in recent times because they can be ingested without further thermal treatments (Rodriquez *et al*., 2010) . RTE poultry and meat products are highly demanded due to their high biological value, reasonable price, agreeable taste and easily serving.

The importance of food as a vehicle for the transmission of several diseases has been documented, especially in developing countries where hygienic standards are not strictly followed or enforced**.** The fact that very few illnesses can be linked to food with certainty makes it difficult to estimate the burden of foodborne diseases, and these links are often made only during outbreak situations (Odu and Akano, 2012).

More than 250 different foodborne diseases have been described; most of these diseases are caused by a variety of pathogenic bacteria, parasites, and viruses that can be foodborne and can cause food poisoning (Centers for Disease Control and Prevention, 2012). Most foods become contaminated due to poor sanitation during food preparation, packaging, storage, and serving (McCown & Grzeszak 2010).

Food contamination occurs during production, processing, or inappropriate handling of food even at home. Ingestion of food contaminated with certain bacteria, viruses, parasites or any of their toxins will lead to food poisoning (Addis and Sisay, 2015). Symptoms of food poisoning such as vomiting, nausea, cramps, diarrhea with or without blood, abdominal pain, or fever might appear after hours or even few days after consuming contaminated food. They are often mild and a person can recover alone at home but some people need to refer to the hospital. Risks of getting an infection are higher in infants or children since they don't have a well-developed immune system, and in old people as the response of their immune system becomes anemic (Centers for Disease Control and Prevention, 2012 & Abdalhamid *et al.,* 2013). The objectives of this study were to determine the presence of pathogenic bacteria in shawarma, Burger, Borst and Mesahab sandwiches served to the public in Al-Qunfudah Governorate, KSA. This study carried out to give information about the methods of prevention of diseases due to food borne pathogens and how to control it.

Materials and methods

Bacteriological analysis

Food samples were collected from 7 administrative centers, selected food outlets in AlQunfudhah is

administratively divided into 10 administrative centers, located in the southwest of the Emirate Makkah at a distance of 360 km. Kingdom of Saudi Arabia.

People around here buy food from at least one of these selected out-lets during various times of the day. These sites were chosen because they are very popular among students, workers, shoppers and passers-by. Restaurants and cafeterias**.**

A total of 93 samples of fast food (Shawarma, Burger, Borst and Mesahab) were obtained. Samples were delivered to the laboratory in ice box and tested within 24 hr.

Preparation of samples

Each sample was placed in a separate clean sterile plastic bag. Samples were immediately kept in an ice box until analysis in the lab. Samples were prepared according to the technique that recommended by the (ICMSF, 1978). as follows: From each shawarma sample 25 g was aseptically weighed and homogenized in 225 ml of sterile water**.** Serial dilutions were carried out using sterile distilled water as diluents. From each dilution, 1 ml was plated using the pour plate methods of (Swanson, *et al.,* 1992).

Sample Preparation, Culture and Bacterial Count

Samples were processed, studied- and viable bacterial counts were done according to (Roland *et al.*, 2012) with some modifications. Twenty-five grams of each sample were homogenized by blending in 225 ml of sterile buffered peptone water. One milliliter of the homogenate was introduced into 9 ml of the buffered peptone water in a test tube, labelled 1:10 (10^{-1}) dilution and serially diluted to five other test tubes labelled 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}. The procedure was repeated for each sample and the blender was carefully cleansed and disinfected in between sampling to prevent any cross contamination. One hundred microliters of each of the diluted samples were plated on nutrient agar (Scharlau, Spain). The plates were then incubated aerobically for 24 h at 37°C. All discrete colonies were counted and expressed in colony forming units per gram (CFU g^{-1}).

Isolation and identification

Bacterial colonies were analyzed by colony pigmentation and Gram staining characteristics. Pure cultures were obtained by streaking a portion of an isolated colony on nutrient agar and incubated aerobically at 37 °C for 24 h.

Intended use BD phoenix

The BD phoenix automated microbiology system is intended for the rapid identification (ID) and antimicrobial susceptibility testing (AST) of clinically significant bacteria. The BD phoenix system provides rapid results for most aerobic and facultative anaerobic Gram -positive bacteria as well as most aerobic and facultative anaerobic gram -negative bacteria of human origin.

Statistical analysis

Means of data obtained for sensory evaluation of samples were evaluated using Duncan's multiple range test to identify significant differences at the 0.05 probability ($p \leq 0.05$) using the statistical analysis system "SAS" (SAS Institute Inc., 1999).

Results and discussions

Study of ready to eat fast food (RTE) samples

Microbiological analysis of fast food samples

It was surprising to find the presence of bacteria in fast food based on the study conducted on samples collected from 5 zones select outlets.

The mean bacterial counts in the fast food samples were expressed as colony-forming unit per gram ($\log_{10}$ CFU g^{-1}). Foods were classified as acceptable if the bacterial counts were less than or equal to 5 $\log_{10}$ CFU g^{-1}. The mean value of E.coli counts Shawarma, Burger, Borst and Mesaheb were 6.23±0.48, 5.72±0.74, 6.15 ±0.48 and 5.59±0.64 $\log_{10}$ CFU g^{-1} respectively (table 1,2,3,4). The *Pseudomonas Flourescens* count of Burger was statistically significant when compared with Shawarma, Borst and Mesaheb ($p < 0.05$).

Table 1. Identification ID of pathogenic bacteria (log cfu/ml) with BD phoenix at fast food (shawarma).

N	Sample Collection	No. of examined sample	E.coli	*Serratia odorifera*	Citrobacter werkmanii	Pseudomonas Flourescens	Acinetobacer Baumannii	Klebsilla
A	Restaurants	2	N.D	N.D	6.22	N.D	5.11	N.D
	Cafeteria	6	6.83	N.D	6.51	5.30	N.D	5.11
B	Restaurants	4	5.91	N.D	4.81	N.D	4.53	6.34
	Cafeteria	5	5.66	N.D	5.83	5.41	5.92	5.86
C	Restaurants	1	N.D	5.44	5.94	N.D	5.43	N.D
	Cafeteria	2	5.98	6.91	5.87	6.19	6.16	6.32
D	Restaurants	4	6.54	6.47	N.D	N.D	6.53	6.77
	Cafeteria	2	6.56					6.93
E	Restaurants	4	5.93	6.17	6.76	N.D	6.41	5.39
	Cafeteria	2	6.74	6.35	N.D	6.33	6.62	6.11
	Total	32						
	Range	1-6	5.66-6.83	5.44-6.91	4.81-6.76	5.30- 633	4.53-6.62	5.11-6.93
	Means		6.23	6.26	5.99	5.80	5.83	6.19
	±SD		0.48	0.53	0.62	0.52	0.74	0.56

N.D: Not detect.

Table 2. Identification ID of pathogenic bacteria (log cfu/ml) with BD phoenix at fast food (Burger).

N	Sample Collection	No. of examined sample	E.coli	*Serratia odorifera*	Citrobacter werkmanii	Pseudomonas Flourescens	Acinetobacer Baumannii	Klebsilla
A	Restaurants	1	N.D	N.D	N.D	N.D	N.D	N.D
	Cafeteria	5	6.99	N.D	6.26	N.D	6.61	6.32
B	Restaurants	2	N.D	N.D	N.D	N.D	6.52	6.91
	Cafeteria	2	6.23	N.D	4.11	N.D	4.22	N.D
C	Restaurants	2	N.D	N.D	N.D	N.D	N.D	N.D
	Cafeteria	2	6.54	N.D	N.D	6.25	6.11	6.14
D	Restaurants	3	5.37	N.D	N.D	5.98	5.39	N.D
	Cafeteria	1	5.17	6.76	6.39	----	----	----
E	Restaurants	2	N.D	2.83	N.D	N.D	N.D	N.D
	Cafeteria	---	----	----	-----	----	----	---
	Total	20						
	Range	1-5	5.17-6.99	2.83-6.76	4.11-6.39	5.98-6.25	5.39-6.61	6.14-6.91
	Mean		5.72	3.26	5.58	6.11	5.77	6.45
	±SD		0.74	1.31	0.75	0.19	0.99	0.40

The contamination levels in this study of all the samples had mean bacterial counts $\geq$ 5.0 $\log^{10}$ CFU g^{-1}. New South Wales Food Authority, (2012) recommends the standard limit for bacterial count of fully cooked ready-to-eat foods to be <5.0 $\log_{10}$ CFU g^{-1}.Hence, most of the samples in this study are not of good quality according to NSW standard. These findings authenticate previous works (Ebeed, *et al.,* 2015). It is found that, highest bacterial load are found in the samples collected from those vendors who use polluted water for food preparation and reside in places without toilet facilities. Unhygienic surroundings like lack of sewage, improper waste disposal systems, inadequate water supply attract house flies which further increases food contamination (Chumber *et al.* 2007). Food items are generally prepared much before the time of selling and stored at room temperature that is suitable for multiplication of these pathogens could be another factor contributing to observance of high bacterial

load in these food samples. Viability of these organisms for a long period in these samples is an additional factor to contamination of these fast foods, as in many cases the vendors store the left out items at room temperature for selling in the next day. Occurrence of high bacterial load in fast foods as observed in this investigation corroborates with the findings of several others (Tambeker *et al.* 2009; Das *et al.* 2010; Das *et al.* 2011) It is also observed that serving in bare hands, without head caps, preservation of food in room temperature, ignorance about food sanitation, use of poor quality of raw materials and improper storage at room temperature are the main factors of food contamination. Most of the samples were observed to be coliform positive that resembles with several other investigations (Hassanin, & Amin 2014) from different parts of the country.

Table 3. Identification ID of pathogenic bacteria (log cfu/ml) with BD phoenix at fast food (Borst).

N	Sample Collection	No. of examined sample	E.coli	*Serratia odorifera*	Citrobacter werkmanii	Pseudomonas Flourescens	Acinetobacer Baumannii	Klebsilla
A	Restaurants	5	N.D	N.D	N.D	N.D	N.D	N.D
	Cafeteria	3	5.61	N.D	5.13	5.61	5.41	N.D
B	Restaurants	4	6.71	6.19	5.48	N.D	5.98	6.41
	Cafeteria	2	5.54	----	----	5.73	----	----
C	Restaurants	3	6.32	6.15	5.31	6.52	5.44	6.78
	Cafeteria	1	6.17	---	5.68	-----	-----	5.66
D	Restaurants	3	6.55	N.D	N.D	5.23	N.D	N.D
	Cafeteria	--	----	----	---	----	----	----
E	Restaurants	2	N.D	3.83	N.D	4.42	6.45	N.D
	Cafeteria	---	----	----	-----	----	----	---
	Total	23						
	Range	1-5	5.54-6.71	3.83-6.19	5.13-5.68	4.42-6.52	5.41-6.45	5.66-6.78
	Mean		6.15	5.39	5.35	5.52	5.82	6.28
	±SD		0.48	1.35	0.27	0.86	0.51	0.57

Table 4. Identification ID of pathogenic bacteria (log cfu/ml) with BD phoenix at fast food (Mesaheb).

N	Sample Collection	No. of examined sample	E.coli	*Serratia odorifera*	Citrobacter werkmanii	Pseudomonas Flourescens	Acinetobacer Baumannii	Klebsilla
A	Restaurants	2	N.D	N.D	N.D	N.D	N.D	N.D
	Cafeteria	2	6.11	N.D	5.22	4.63	5.13	4.53
B	Restaurants	3	5.34	N.D	N.D	5.72	N.D	4.86
	Cafeteria	2	6.18	----	----	6.75	----	----
C	Restaurants	2	6.32	6.15	5.31	4.52	5.44	4.78
	Cafeteria	1	5.51	---	5.66	6.19	-----	----
D	Restaurants	3	4.55	N.D	N.D	5.23	N.D	N.D
	Cafeteria	--	----	----	---	----	----	----
E	Restaurants	2	N.D	2.83	N.D	N.D	3.45	N.D
	Cafeteria	1	5.17	----	5.34	----	5.62	---
	Total	18						
	Rang	1-3	4.55-6.32	2.83-6.15	5.22-5.66	4.52-6.75	3.45-5.62	4.53-4.86
	Mean		5.59	4.49	5.38	5.50	4.91	4.72
	±SD		0.64	2.34	0.19	0.88	0.99	0.17

The hygienic conditions of the selected restaurants and cafeteria of fast food like Shawarma, Burger, Borst and mesaheb (in the study were assessed using a questionnaire based on the HACCP system). Generally, most of restaurants and cafeteria in this study were not applying Good Manufacture Practice (GMP), which explains the presence of many critical control points as evident from the analysis of the obtained results and presented in Tables (5-10).

The location of the restaurants and cafeteria can be considered a critical point as 77.9% were located in environmentally polluted areas which pose the hazards of industrial contamination (Swai and

Schooman, 2013). Also, several critical points were apparent from the restaurants and cafeteria design, the most prevalent ones were the absence of air filtration (93.2%) absence of resistant glass windows (74.4%). The absence of protective maintenance of equipment (92.7%) and controlling the cooling system (80.6%) and water analysis (97.4%) characterize most of the studied restaurants and cafeteria.

Table 5. Prevailed hazards from the Restaurants and Cafeteria location, and surroundings.

Item	Present %	Not present %
Garbage	15.7	84.3
Adequate drainage and sewage disposal	81.7	18.3
Protection against scrap metal, pests , birds and Animals	87.9	12.1
Location, environmental polluted areas	77.9	22.1

Table 6. Prevailed hazards from the Restaurants and Cafeteria design.

Item	Applied %	Not Applied %
Good storage of packaging materials	56.7	43.3
Cleaning of walls and ceiling	73.6	26.4
Air purification	6.8	93.2
Resistant glass windows	25.6	74.4
Good storage of raw materials	64.2	35.8
Good lighting	85.3	14.7
Suitable distance bet. Pips and walls	21.5	78.5
Suitable paths	25.6	74.4
Suitable floor drainage	78.2	21.8
Soft walls	29.7	70.3
Available hygiene records	10.7	89.3
Pest control records	21.6	78.4
Special place for eating and smoking	11.8	88.2

Source: Data of the questionnaire.

In nearly all restaurants and cafeteria (70.6%) wearing of glories was not practiced and inspection of workers for visible injuries and infection was not practiced in 87.6%. Generally, the quality control of raw material and processing steps and end products were not practiced in 80.7 and 82.1% and 82.1% respectively of the restaurants and cafeteria (Ebeed, 2015). High percentages of the personnel were not aware with several points related to GMP and legislation (Table 10) which are necessary information for workers in the field.

Table 7. Prevailed hazards from the operating conditions in the Restaurants and Cafeteria.

Item	Applied%	Not Applied %
Equipment maintenance	7.3	92.7
Cooling system and instruments of temperature	19.4	80.6
Program for water analyses	2.6	97.4

Table 8. Hazards from personnel in the Restaurants and Cafeteria.

Item	Applied%	Not Applied %
Hand washing before and after bathroom	79.8	20.2
Cleaning of the uniform	61.8	38.2
Wearing of gloves and head caps	78.3	21.7
Wearing of glories	29.4	70.6
Following the infection and wounds of laborers	12.4	87.6
Sufficient and adequate lockers (one per person)	55.6	44.4

It is apparent from the obtained results that several critical points were found in the small restaurants and cafeteria, which can be used to develop an HACCP system which a should be adopted in order to improve the quality and hygiene of produced fast food.

Table 9. Application of quality control measurement.

Item	Applied%	Not Applied %
Quality control of raw materials	19.3	80.7
Presence of quality control plan	17.9	82.1
System follow up	17.9	82.1
Quality control of end product	17.9	82.1

Source: Data of the questionnaire.

Table 10. Awareness of the GMP in the Restaurants and Cafeteria.

Item	Applied%	Not Applied %
Good storage of raw and intermediate materials	18.7	81.3
Records for amount and kind of wastes generated inside the lab	5.1	94.9
Following air disseminated out of the plant	5.1	94.9
Getting rid of wastes near lines of production	67.8	32.2
Aware of new legislation about environment Protection	18.2	81.8
Electrical UV-light insect control units suspended in food handling areas in any stage of production, must be of safety type and protected to prevent contamination of food in case of breakage	29.6	70.4
Equipment must be positioned at least 50 cm. away from the wall and off the floor	5.1	94.9
Easy to clean surface, which does not pose a foreign hazard e.g. Walls should be finished with a continuous, bonded surface and protected from damage. Corners, joints between cladding sheets or ceramic tiles must be sealed with a suitable impervious sealing	48.6	51.4

Source: Data of the questionnaire.

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