



(RESEARCH ARTICLE)



The microbiological quality of food in hospitals kitchen in Khartoum State, Sudan

Hilwa Hamid Bajin Salam ^{1,*}, Ekram Adam Eldoom ², Fatima Fadul Ali ² and Abeer Magthop Mohammed ²

¹ Ministry of Health, Department of Nutrition, Khartoum, Sudan.

² Khartoum North, Faculty of Public Health, Alzaiem Alazhari University, Sudan.

Magna Scientia Advanced Biology and Pharmacy, 2021, 03(01), 049–057

Publication history: Received on 05 July 2021; revised on 18 August 2021; accepted on 20 August 2021

Article DOI: <https://doi.org/10.30574/msabp.2021.3.1.0033>

Abstract

An interventional research was conducted in the kitchens of Khartoum state hospitals 2021 on the impact of microbial quality in (12) hospital. Samples taken from meals, hands, environment, surfaces, equipment, and utensils before and after interventions and measuring results. Questionnaires were filled out with interview with nutrition supervisor about kitchens. The data was statistically analyzed by using the Statistic Package for Social Sciences (SPSS) program version 25; the Paired Samples T Test and Chi-Square Test was used and there is an improvement at the level of indication 0.000 at the level (0.05). The results showed that the lack of quality of kitchens in buildings, equipment, utensils, hand facilities and no periodic inspection for raw materials. The study concluded that taken samples has an effective impact on microbial quality. The study recommended that the ministry of health and hospitals to commitment to take samples periodically.

Keywords: Bacteria; Examination; Impact; Common

1. Introduction

Kitchens should be part of a structured and organized department that provides nutritional assistance by preparing high quality meals with standards of food safety [1].

The measurement of the safety of foods has relied on evaluation of the microbiological quality of foods [2, 3].

Bacterial counts in prepared food or water is a key factor in assessing the quality and safety of food, and can reveal the hygiene level adopted by food handlers in the course of preparation of such foods [4].

In a recent review, *E. coli*, *Shigella*, *Salmonella* and *Campylobacter* spp. are the most commonly reported causes of gastrointestinal disease and all have been associated with foodborne disease [5, 6].

However, in developing countries, monitoring the microbial safety of foods is not routine practiced, due to a lack of infrastructure and effective food safety regulations and standards [7]. Hence, there is a great wanted for taken samples.

This study is aimed to determine the microbial contamination of food in the hospital kitchens pre and post intervention.

* Corresponding author: Hilwa Hamid Bajin Salam
Ministry of Health, Department of Nutrition, Khartoum, Sudan.

2. Material and methods

The study area is hospital kitchens in Khartoum state that have (51) governmental hospital, only (35) hospital have kitchens that prepare food for patients and health workers through food handlers. The kitchen operates full-time and serves food for breakfast, lunch and dinner (breakfast selected for sample). Only twelve (12) hospitals selected.

Listing all hospital kitchens in Khartoum state hospitals that obtained from the ministry of health. Then stratified according to their localities Khartoum, Omdurman and Bahri. A stratified random sampling was selected hospitals. Twelve (12) hospitals participated in the study, 41.7% (5) Khartoum locality (Ibn Senna, Dermal, Abdalalfadual Almaz, AL academy, Turkish), 33.3% (4) Omdurman locality (Mohamed Alamin Hamid, Omdurman teaching, Aboanga, Abosed), and 25% (3) Bahri locality (Bahri teaching, Alshohada and Omdwaban). The data was collected using different methods. Firstly, interview, and microbiological examination that designed to collect primary data from the selected sample and then secondary data was collected using available published information in books, journals, reports, internet and studies in different sources. Face-to-face interviews with supervisors in the hospital kitchens selected in Khartoum state. The interviews were in this study to identify awareness of the interviewees toward food hygiene practices. The interviews take place within the food premises and each interview approximately 10-to15 minute. The questionnaire include (31) questions such as general information about the food premises such as the number of bed, estimated number of meals distributed, the number of food services staff, the Hazard Analysis Critical Control Point (HACCP) system implementation status.

3. Microbiological Examination

It is frequently necessary to conduct a microbiological examination of food to determine its quality. This may be necessary to estimate enumeration of *Escherichia coli* (*E. coli*), total aerobic mesophilic bacteria and total plate counts (APC) in food [8].

Food samples was prepared, cultured in their respective media and incubated. The microorganisms is identify and their counts and compare to standard values of microbiological counts [9, 10].

The hands of food handlers, equipment, utensils, environment and surfaces was swabbed using sterile cotton smears moistened with sterile normal saline solution. The samples were transported as soon as possible to the laboratory using an insulated icebox containing an ice pack. The sample was culture in suitable media.

A plate was incubated under aerobic condition at 37°C for 24- 48 h. After the incubation, isolated species is identifying using Gram stain, colony morphology and appropriate biochemical tests [11].

4. Ethical Considerations

The research approval was obtained from the university and was obtained from the Khartoum state ministry of health research department that have authorizing data collection from hospitals.

The interviewee was asked to participate in the study voluntarily. The interviewees have right to withdraw at any time without any deprivation from research benefit. Confidentiality was guaranteed by not indicating interviewee names in data collection tool. Each participant was informed about the objective of the study and privacy during interview was ensured. The interview was done in their rest time without any interruption to their work.

5. Results and discussion

5.1. 1/The-building conditions of the hospitals kitchens

Table 1 Hospitals kitchen characteristic (n=12)

Statement	No
Beds	269
Meals /day	1813
Staff	190

The numbers of beds (269), and meals distributed daily (1813) meals and these meals throughout (41) Dietitians, (54) Nutrition counseling, (30) cooks, (54) services and (11) workers.

Table 2 The hospital kitchens (n=12)

Statement	Yes		No	
	Frequency	%	Frequency	%
Adequate ventilation	6	50.0	6	50.0
Adequate lights	8	66.7	4	33.3
Washing hand	2	16.7	12	83.3
Room change	3	25.0	9	75.0
Food storage procedure	3	25.0	9	75.5
Any procedure for personal hygiene	3	25.0	9	75.0
HACCP system	0	0.0	12	100.0
Food hygiene operating procedure	0	0.0	12	100.0
Continuing education courses on HACCP	0	0.0	12	100.0
Continuing education courses on food hygiene	0	0.0	12	100.0
Use critical control point's tree	0	0.0	12	100.0
Clean and disinfect surfaces and equipment	8	66.7	4	33.3
Check foods temperature	1	8.3	11	91.7
Inspection of raw materials	5	41.7	7	58.3
Microbiological testing of the kitchen	0	0.0	12	100.0
Microbiological testing of the food	0	0.0	12	100.0
Microbiological testing of the surfaces	0	0.0	12	100.0
Microbiological testing of the equipment	0	0.0	12	100.0
Microbiological testing of the utensils	0	0.0	12	100.0
All workers have medical certificate	10	83.3	2	16.7
Every six months	9	75.0	3	25.0
Every year	1	8.3	11	91.7
Other (specify)	0	0.0	0.0	0.0
Release any food handlers if ill	12	100.0	0	0.0
Diarrhea	3	25.0	0	0
Fever	5	41.7	0	0
Other (specify)	4	33.3	0	0
Very poor condition	5	41.7	0	0
Poor condition	3	25.0	0	0
Average condition	2	16.7	0	0
Good condition	1	8.3	0	0
Very good condition	1	8.3	0	0

Data presented in Table (2) shows that an adequate ventilation in 6(50%), an adequate lights 8(66.7%), only two hospitals (16.7%) had washing hand facility and three hospitals had food storage and personal hygiene procedure (25.0%) These results agree with the study that conducted in Kenya by Nyamari, 2013, which aimed to identify gaps with regard to status of the hospital kitchen, status and storage of equipment, some aspects of personal hygiene and sanitation and vector control [12].

5.2. Microbiological Analysis

Table 3 The bacteria count in Environment and Surfaces

Hospitals	No of sample	Environment		No of sample	Surfaces	
		Before	After		Before	After
A	1	>300	200	1	>300	80
B	1	>300	53	1	>300	>300
C	1	>300	165	1	>300	>300
D	1	>300	225	1	>300	>300
E	1	>300	74	1	>300	>300
F	1	>300	165	1	>300	>300
G	1	>300	68	1	>300	39
H	1	>300	74	1	>300	>300
I	1	>300	70	1	<30	110
J	1	>300	>300	1	>300	163
K	1	>300	>300	1	>300	0
L	1	>300	220	1	>300	150

All 12(100%) none of the hospitals adopted any educational courses on HACCP trainings or food hygiene for food handlers and not used critical control point's tree. This finding agree with the study that conducted in Kenya by Wandolo, 2016 which aimed to carry out a comparative study of training on food safety and hygiene in TVET and University Hospitality schools and their impact on hygiene practices in the hospitality industry[13]. The HACCP prerequisites were not used in most of the institutions. In several studies, food service workers that received training had better hygiene scores and safe food handling practices than those that did not receive training. Eight (66.7 %) of the hospitals had clean and disinfect surfaces and equipment and four (33.3%) had not clean and disinfect. only one hospitals kitchen had check foods temperature (8.3%) that done through observation. Foods were not to be in the danger zone (between 5^{0c} and 60^{0c}) longer than necessary. If food is not chilled or frozen during storage; and heated to temperatures between 70 and 80 before consumption, then there are high chances of growth and subsequent ingestion of pathogens and for this reason needed to check foods temperature. Five (41.7 %) of the hospitals had inspection of raw materials and seven (58.3%) had not inspection and this indicated to some hospitals were not aware about used it in their kitchens. Only one hospitals kitchen had check foods temperature (8.3%). The routine inspections wanted to prevent foodborne illness by ensuring safe food handling and preparation. This study finding that the hospital kitchens were not inspected often. (100%) none of the hospitals had any microbiological testing for their kitchens Microbiological testing is very important to reduce foodborne illness and the most studies suggested taking samples from kitchens to microbial quality testing. Across sectional descriptive study conducted in Sudan by Omer, 2017 to determine the status of food safety and hygiene in 16 hospitals the results confirm that the microbial tasting was vital issues in hospitals kitchens [14]. The table shows that 10 (83.3%) of the hospitals kitchens had medical certificate and two (16.7%) had no certificate. Nine (75.0 %) of the hospitals check certificate every six months and one (8.3%) every year. The data presented that all (100%) of the hospitals release food handlers when ill. The five (41.7%) fever, four (33.3%) any other symptoms and three (25.0%) diarrhea. Five (41.7 %) of the hospitals kitchen had very poor food safety practice and one (25.0%) had poor practice in kitchens.

Table 4 The bacteria count in Food Handlers and Meals

Hospitals	No of sample	Food Handlers		No of sample	Meals	
		Before	After		Before	After
A	4/4	>300	100	3/3	>300	77
B	2/2	>300	165	3/2	>300	172
C	2/2	>300	250	1/1	>300	62
D	2/2	>300	297	3/2	>300	>300
E	4/4	>300	>300	2/2	>300	80
F	10/10	>300	>300	3/1	>300	165
G	8/8	>300	>300	2/2	<30	>300
H	4/4	>300	183	4/2	>300	<30
I	3/3	<30	233	2/4	>300	194
J	11/11	>300	165	5/3	>300	>300
K	3/3	>300	0	5/4	39	0
L	3/3	>300	0	4/2	>300	0
Total	56/56			34/28		

Table 5 The bacteria count in Equipment

Hospitals	No of sample	Refrigerator		No of sample	Refrigerator home		No of sample	Cooker	
		Before	After		Before	After		Before	After
A	1	>300	150	1	>300	250	1	>300	124
B	1	<30	>300	1	>300	>300	1	>300	>300
C	1	>300	>300	1	>300	>300	1	>300	>300
D	1	>300	>300	1	>300	>300	1	>300	>300
E	1	>300	>300	1	>300	>300	1	>300	>300
F	1	>300	>300	1	>300	123	1	>300	>300
G	1	>300	>300	1	>300	>300	1	>300	>300
H	1	>300	>300	1	>300	>300	1	>300	120
I	1	>300	225	1	>300	>300	1	>300	>300
J	1	0	0	1	0	0	1	>300	>300
K	1	>300	0	1	>300	0	1	>300	0
L	1	>300	124	1	>300	134	1	>300	>300

Table 6 The bacteria count in Utensils

Hospitals	No of sample	Bola		Cutting board		Spoons		Plates		Knives		Dollop		Distribution container		Package	
		Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
A	1	>300	158	>300	175	>300	185	>300	132	>300	12	>300	150	>300	145	>300	98
B	1	>300	>300	>300	>300	>300	>300	>300	242	>300	>300	>300	>300	>300	<30	>300	259
C	1	>300	>300	>300	>300	>300	<30	>300	>300	>300	85	>300	>300	>300	>300	>300	>300
D	1	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	75	>300	>300	>300	>300
E	1	>300	<30	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
F	1	>300	>300	>300	>300	>300	>300	>300	>300	>300	237	>300	>300	>300	>300	>300	>300
G	1	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
H	1	>300	120	>300	68	>300	230	>300	>300	>300	165	>300	>300	>300	>300	>300	182
I	1	>300	>300	168	<30	>300	240	>300	>300	>300	<30	>300	>300	>300	<30	>300	<30
J	1	>300	>300	>300	>300	>300	>300	>300	>300	>300	183	>300	>300	>300	109	>300	0
K	1	>300	0	>300	180	172	0	151	32	89	<30	>300	0	>300	89	>300	0
L	1	>300	>300	>300	120	>300	230	>300	290	>300	75	>300	150	>300	0	>300	28

Table 7 The most commonly bacteria in food handlers and meals

Sample	<i>Pseudomonas</i>		<i>Campylobacter</i>		<i>Staphylococcus</i>		<i>Salmonella</i>		<i>Kleibsella</i>		<i>Proteus</i>		<i>Enteriobacteria</i>		<i>Fungi</i>	
	before	after	Before	after	before	after	before	after	before	after	before	after	before	after	before	after
Meals	9	0	0	0	5	1	8	1	5	3	8	8	0	2	0	0
Food Handlers	8	3	0	0	6	3	9	1	7	6	7	7	0	4	0	0
Total	17	3	0	0	11	4	17	2	12	9	15	15	0	6	0	0

Table 8 The most commonly bacteria in environment and surfaces

Sample	<i>Pseudomonas</i>		<i>Camplybacteria</i>		<i>Staphylococcus</i>		<i>Salmonella</i>		<i>Kleibsella</i>		<i>Proteus</i>		<i>Enteriobacteria</i>		<i>Fungi</i>	
	before	after	before	after	before	after	before	after	before	after	before	after	before	after	before	after
Environment	11	2	0	0	7	7	9	4	5	4	0	3	0	4	12	7
Surfaces	9	2	0	0	4	0	5	1	1	2	6	8	1	3	0	0
Total	20	4	0	0	11	7	14	5	6	6	6	11	1	7	12	7

Table 9 The most commonly bacteria in equipment

Sample	<i>Pseudomonas</i>		<i>Camplybacteria</i>		<i>Staphylococcus</i>		<i>Salmonella</i>		<i>Kleibsella</i>		<i>Proteus</i>		<i>Enteriobacteria</i>		<i>Fungi</i>	
	before	after	Before	after	before	after	before	after	before	after	before	after	before	after	before	after
Refrigerator	8	2	0	0	3	2	7	0	2	1	5	8	1	4	7	0
Refrigerator home	8	2	0	0	1	2	4	0	3	0	7	7	0	1	0	0
Cooker	11	1	1	0	5	3	6	0	0	1	5	8	0	2	0	0
Total	27	5	1	0	9	7	17	0	5	2	17	23	1	7	7	0

Table 10 The most commonly bacteria in utensils

Sample	<i>Pseudomanus</i>		<i>Camplybacteria</i>		<i>Staphylococcus</i>		<i>Salmonella</i>		<i>Kleibsella</i>		<i>Proteus</i>		<i>Enteriobacteria</i>		<i>Fungi</i>	
	before	after	before	after	before	after	before	after	before	after	before	after	before	after	before	after
Bola	8	1	0	0	5	2	2	0	2	1	5	7	0	3	0	0
Cutting board	8	0	0	1	5	2	5	0	3	2	5	6	0	5	0	0
Spoons	9	1	0	0	4	0	4	1	2	2	8	7	0	3	0	0
Plates	10	0	0	0	5	1	7	1	2	2	6	6	0	5	0	0
Knives	8	0	0	0	5	1	6	0	3	5	7	8	0	4	0	0
Distribution container	9	2	0	1	4	3	6	0	2	3	4	7	0	0	0	0
Dollop	9	0	0	0	4	1	6	1	3	2	5	7	0	3	0	0
Total	61	4	0	2	32	10	36	3	17	17	40	48	0	23	0	0

The APC involved 264 samples that taken from 12 hospitals kitchens before and after intervention the environment (12-12), surfaces (12-12), utensils (96-96), equipment (36-36), food handlers (56-56) and meals (34-28). Six (50%) of the hospitals kitchens had improvements in surfaces after intervention. Nine (75%) of the hospitals kitchens had improvement in food handlers and meals after intervention. Only five (42%) of the hospitals kitchens had improvement in refrigerator after intervention and there were no change in cooker.

There were improvement in hospitals kitchens A, E, H, and k in bola, A, H, I, K and L in cutting board, A, C, H, I, K and L in spoons, A, B, K and L plates, A, C, F, H, I, J, K and L in knives, A, D, K and L, A, B, I, K, and L in distribution container and A, B, H, I, J, K and L in package after intervention. The most pathogenic bacteria were found *Pseudomonas.spp*, *Staphylococcus*, *Proteus.spp*, *Klebsiella.spp*, *Enterobacteria.spp* *Salmonella*, *Camplybacteria.spp* and *Fungi*.

Proteus.spp and *Enterobacteria.spp* were high level in utensils and preventive from germs through wash hand and disinfected after toilet. In our study only two hospitals had washing hand facility. To designated places for handwashing with soap and water in or near the latrine and food preparation and cooking areas. This can help new practices to become part of the daily routine. Studies have shown that compliance of handwashing is higher when soap and water is immediately available.

The bacteriological quality of meals, food handlers, environment, surfaces, utensils and equipment improved after training intervention.

These results agree with the study that conducted in the Clinical Centre Niš, Serbia, 2013 to evaluate the effects of food hygiene training of food handlers on sanitary-hygienic conditions in hospital kitchens, based on microbiological analysis of smears taken in hospital kitchens. 1,076 smears in the central kitchen and 4,025 smears in distributive kitchens were taken from hands and work clothes, work surfaces, equipment, and kitchen utensils and microbiological analysis of smears. The results confirmed that food hygiene training improved hygiene and is an important component for the prevention of nosocomial infection [15].

6. Conclusion

The finding of this study indicated to improve the microbiological quality in hospitals kitchens to reduce the foodborne diseases before and after training intervention in Khartoum state of the hospitals kitchens. The result of the building condition had very poor food safety practice and kitchens hygiene. Not had adequate lighting and ventilation, only two hospitals had washing hand facility and three hospitals had food storage and personal hygiene procedure. Not all the hospitals adopted any educational courses on prerequisites of food safety and HACCP training before and addition not used critical control point's tree. Eight of the hospitals had clean and disinfect surfaces and equipment and four not had. Only one hospitals kitchen had check foods temperature. Only five of the hospitals had inspection of raw materials and seven not had inspection. Not all the hospitals had any microbiological testing for their kitchens. Ten of the hospitals kitchens had medical certificate and two not had certificate and nine of the hospitals check every six months and only one every year. All of the hospitals release food handlers when ill with fever, diarrhea or any other symptoms.

The most pathogenic bacteria were found *Pseudomonas*, *Staphylococcus*, *Proteus*, *Klebsiella*, *Enterobacteria*, *Salmonella*, *Camplybacteria* and *Fungi*. The bacteriological quality of meals, food handlers, environment, surfaces, utensils and equipment improved after training interventions.

Recommendation

The study was recommended the Ministry of Health to design kitchens with standardization. Further exploratory studies need to be taken to understand the reasons for *Proteus* and *Enterobacteria* in kitchens for all hospitals (Governmental and private).

Compliance with ethical standards

Acknowledgments

We express our heartfelt thanks to supervisors for their devotion, guidance and prompt response to my calls for attention. A special gratitude goes to all heads of departments in hospitals kitchen for their support during data collection.

Disclosure of conflict of interest

No disclosure of conflict of interest.

Statement of informed consent

The research approval was obtained from the university and was obtained from the Khartoum state ministry of health research department that have authorizing data collection from hospitals.

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