University of Khartoum
Faculty of Public & Environmental Health
Department of Food Hygiene and Safety

Food contamination in Khartoum Teaching Hospital Catering Services

By: Mona Abd Elgadir Ahmed Aboagla

Supervisor : Dr. Tawfig Eltigani Mohamed

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Dedication

To my husband
To my sisters, brothers and friends.
Who helped me through the period of my study
To my supervisor who played a great role in completing this study.
Acknowledgement

I am most grateful to the merciful Allah for health, patience and assistance, which he has given to me to complete this research.

Special thanks go to my supervisor Dr. Tawfig El Tigani for his advice and encouragement during this study.

A lot of thanks also to the nutritionists, cooks and lab technicians who helped me to achieve this result.
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Abstract

The study was conducted in Khartoum Teaching Hospital to assess the effect of hospital catering system in cooked food and identify the sources of contamination and the level of contamination in food when staying in the ward for a long time before being eaten.

The predominant bacteria isolated from 65 samples were *staphylococcus* in addition to *Escherichia coli* isolated from the sources of contamination.

There is increase in bacterial isolated from samples after food distribution in the ward, which reflects the level of food contamination after food stays in the ward for a long time.

The investigation of food followed by the investigation of equipments, utensils and food workers (by swap examinations) represents the main sources of the food contamination that 12 out of 25 samples are +ve (the percentage is 48%).

The results show that bacteria isolated from those samples were an indication to the poor hygienic practices of catering system in the targeted hospital.

So, food must be given to the patient immediately to avoid any multiplication of microorganism.

Equipment must be cleaned before and after food preparation.
oneksi البحث

تمت هذه الدراسة بمستشفى الخرطوم التعليمي لتقييم مدى تأثير نظام خدمات تغذية المرضى في تلوث الأطعمة المقدمة داخل عنبر المستشفى وتحديد مصادر تلوث الأغذية بواسطة المعالمين ببطيء الأطعمة وتوزيعها على المرضى وأدوات ومعدات التوزيع والطهي ومستوى تلوث الأطعمة عن طريق وضعها لفترة طويلة داخل العنبر قبل تناولها.

معظم البكتيريا التي تم عزلها من ٨٥ عينة هي العنقيدة إضافة إلى العصبيَّة التي تم عزلها من عينات أخذت من مصادر التلوث.

في هذه الدراسة اتضح أن هناك زيادة في عدد البكتيريا عندما يوضع الطعام داخل العنبر لفترة طويلة، مما يوضح مستوى تلوث الأطعمة داخل العنبر عندما يوضع لفترة طويلة قبل الأكل بعد توزيعه للمرضى.

من هذه النتائج التي أجريت على تحليل العينات للأطعمة الطازجة تبعها تحليل عينات من العاملين (مسحة من أيدي العاملين ومعينات العمل في توزيع وطهي الأطعمة) يعتبر أن هناك مؤشر واضح للمصادر الأساسية لتلوث الأطعمة داخل المستشفى والتي تمثل ٤٠% من ٥٠ عينة تم تحليلها.

يتبين من كل النتائج وأنواع البكتيريا التي تم عزلها من تحليل العينات أن هناك مؤشر على ضعف صحة نظام الأطعمة المقدمة للمرضى في المستشفى المعنى.

لذا يجب تقديم الطعام فورًا للمرضى حتى لا تزيد المايكروبات بداخله.

يجب غسل الأكياس قبل وبعد توزيع الأطعمة.
1. Introduction

Food is defined as any substance or liquid which provides the body for:
- Health and energy.
- Growth.
- To regulate the body processes these materials are known as nutrients, mainly protein, fats, carbohydrates, vitamins, minerals and water.
(Ceserain Kinton, 1984)

Hospital catering becomes nationalized and the feeding of patients becomes the responsibilities of catering officers instead of nursing staff. ((Butter worth – Heinemann 1997))
During catering system food is frequently widely come in contact with human hands (foods handlers), equipment and utensils before food being catered. This may cause the problem of poor standard catering operations in hospitals. Catering system method has an effect in patients who are usually more susceptible to food born infections and suffer more serious consequences than a healthy person.

Today hospitals comprise a large group of institutions whose food services are important as to merit special consideration.

Regardless the sources of support. The food service in these institutions are unique and complex, requiring staff well qualified to improve the health of the patients to restore them to normal activity by maintain well nourished personal (West et al 1977).

The diet served plays a major role in treatment of diseases and prevention of complications of disease related to diet e.g. Diabetes mellitus, cancer, hypertension, etc. (Aberennothy, 1983).

This research study covered hospital catering problems associated with food contamination in Khartoum Teaching Hospital which includes about 25 wards, 3 Kitchens an admitted all types of diseases and surgery.
The research deals with cooked food contamination and other sources of contamination like food handling, utensils and different equipments.

Justification:

The general concept of the Sudanese communities agrees that hospitals catering services are in adequate in quality and is not accepted by either the patients or their co-patients. This defect could be attributed to reasons such as, policies of ministry of health, hospitals manager, or any other reasons for instance the diet. Therapy units for the target.

Hospitals were initiated in the early 50th. At that time the kitchen design was built by optimal characteristics to meet the catering standards (ventilation, light, surfaces etc). But since that time these kitchens were not repaired or reconstructed, that make it unsuitable to meet the catering needs.

Objectives:
The general objectives of this study are:
1\ To study out if these is a direct effect of catering system on the food hygiene in the targeted hospital.
2\ To assess the causes of food contamination in the targeted hospital.

The specific objectives of this study:
1\ To study out the factors that promote the stability of the catering system.
2\ To reflect the possible hazards and diseases expected.
2. Literature Review

A very wide consideration must be given to the food on hospital catering, which must include:
1. Food preparation, handling and preservation.
2. Nutritional value.
3. Food hygiene.

2.1. Nutrition: it is defined as the constitutional to the body in suitable amounts, which include water, protein, fat, carbohydrate and vitamins (Robinson Lawler, 1982).

2.2. Nutritional composition of diets and the human body different requirements:

The quantities of the various nutrients that people consume vary widely, and the nutrients amounts present in different foods also vary a great deal.

The total daily intake of protein, fat, and carbohydrate amounts to about 500 grams (Slightly more than 1 pound). In contrast, the typical daily mineral intake totals to about 20 grams, and the daily vitamins intake total less than 300 milligrams. Although each day we require nearly a gram of some minerals, such as calcium and phosphorus, we need only a few milligrams or less of other minerals (contemporary nutrition).

2.3. Hospital routine:

2.3.1 Hospital routine can contribute to the lack of adequate nourishment include:

1. Highly restricted diets remaining on order and unsupplemented too long.

2. Un-served meals because of interference of medical procedures and clinical tests.

3. Un-monitored lack of patient appetite (Williams, 1994).

2.3.2. Organization of hospital catering service:

In many hospitals catering services are organized as follows; catering mangers plan menus, obtain supplies and supervise the preparation, cooking and service of food to the patient.

They also control the provision of the catering facilities for the doctors, nurses and other hospital employees.
• Assistant catering managers, assist and deputys for the catering managers all or part of their duties, they may be responsible for as small hospitals.
• Catering supervisor has similar responsibility as do catering managers but this grade is only used in very small health service establishments (Yvonne, John, 1998).

2.4. The menus:
Menus used in various hospitals may be on acyclic nature, being repeated by month or season (Gentili, Sullivan, 1990).

2.4.1. Menu supplies:
When considering foods for a menu it is sound policy to think of any foods in season, as they are usually plentiful, of good quality and reasonable prices.

2.4.2. Repetition of ingredients:
Never repeat the basic ingredients on one menu.

2.4.3. Price of menu:
The proposed charge per head is obviously an important factor to consider when selecting food for any menu (Ceserani Kinton, 1989).

2.5. The food hygiene regulations:
These regulations should be known and complied with by all people involved in the handling of food.

2.5.1. Equipments and personal hygiene:
* All parts of the person liable to come into contact with food must be kept as clean as possible.
* All clothing must be kept as clean as possible.
* Spitting is forbidden.
* Smoking and the use of snuff are forbidden in a food room or where there is food.
* As when a person is aware that he is suffering from or is carrier of such infections as typhoid, salmonella etc he must notify his employer, who must notify the medical office of health.

2.5.2. Washing facilities:
- Hand basins and an adequate supply of hot water must be provided.
- Supplies of soap, nail-brushes and clean towels or warm air machines must be available by the hand basins.

2.5.3. Other premises:
First aids: must be provided in a readily accessible position.
Light and ventilation: food rooms must be suitably lighted and ventilated.
Refuse: refuse must not be allowed to accumulate in a food room by placing it in proper bags.
Buildings: the structure of food rooms must be kept in good repair to enable them to be cleaned and to prevent entry of rats, mice etc ...

2.5.4. Food temperature:
Certain foods must be kept at temperature below 10°C or at not less than 62.8°C.
These foods include meat, fish, egg products and milk and milk product.
Storage: foods should not be placed in a yard or lower than 0.5 meter (18 inches) unless properly protected (Cesecani, Kinton, 1984).

2.5.5. Water management:
Provision of healthy water resources is crucial, water stored in artificial reservoirs should always be considered suspect as it may become contaminated even when covered (Cesecani Kinton, 1984).
These contaminated water can increase the transmission of some infective agents whether bacteria, viruses or protozoal cyst (Hobson, 1979).

2.5.6. Clothing in the kitchen:
Personnel working in kitchen should wear suitable clothing, feet wear, gloves, hair hats.
Suitable clothing must be protective, washable, suitable in color, light in weight, comfortable, strong and absorbent (Ceserani Kinton, 1984).

2.6. Food hygiene:
Is all conditions and measures necessary to ensure the safety and suitability of food at stages of the food chain (Joint FAO, WHO, 1997).
2.6.1. Food safety:
Assures that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended goal (Joint, FAO/WHO, 1997).
2.6.2. Hazard:
Is a biological chemical or physical agent, or condition of food with the potential to cause an adverse health effect (Joint FAO/WHO, 1997).
2.6.3. Contamination:
Is the introduction or occurrence of a contamination or a contaminant in food or food environment (Joint – FAO/WHO, 1997).
2.6.4. Contaminant:
Is any biological or chemical agent in foreign matter, or other substances not intentionally added to food, which may compromise food safety or suitability (Joint FAO-Who, 1997).
2.6.5. Handling:
Means the processes from the field up to the mouth, i.e. (preparation, manufacturing, packaging, distribution, offering sale, delivery or storage of any food) (Joint-FAO/WHO, 1997).
2.6.6. Food handler:
Is any person who directly deals with food, food equipments and utensils or food contact surfaces and is therefore expected to comply with food hygiene requirements (Joint-FAO/WHO, 1997).
2.6.7. Food sanitation:
Are all measures necessary for ensuring the safety, whole sameness and soundness of food at all stages from its growth, production or manufacturing until its final consumption (Bailey, 1977 cited).
2.6.8. Disinfection:
Is the reduction of the number of microorganisms in the environment, to a level that does not compromise food safety or suitability, by means of chemical agents and/or physical method (Joint-FAO/WHO, 1997).
2.7. Hospitals catering:

The hospital catering became nationalized and the feeding of patients become the responsibilities of catering officers instead of the nursing staff.

The problem areas in the catering operations in hospitals include the poor standards of food, lack of nutritional value contained in the food due to the poor production methods, lack of choices, and the inability to cope with the consumer needs.

The unfortunate effect with the consumer (i.e. patients) took longer to recover (Platt Report, 1963).

Consideration needs to be given to the fact that the catering service is perhaps their only source of food. The nutritional value, hygiene and food presentation must all be of the lightest standards to aid the recovery of the patients (Butter Worth, 1997).

Hospital catering classified as welfare catering, the objective being to assist the nursing staff to get the patient well as soon as possible. It is recognized that the provision of an adequate diet is just as much a part of the patients treatment as careful nursing and skilled medical attention (Yvonne, 1998).

Hospital patient may be unusually susceptible to food born infections and suffer more serious consequence than healthy person. Because of this high risk its important that high standards of catering hygiene are maintained and the following control measures should be considered as being of value:

- Adequate cooking to destroy the causative organisms or some toxins in naturally contaminated food example the raw meat and to some extent vegetables.
- Good separation of naturally contaminated foods those already cooked.
- Storage at a temperature which will prevent the multiplication of micro-organisms.
- High standards of catering and personal hygiene promoted through adequate training (Ayliffe, Collins, 1982).

2.8. The major food hazards are:

1- Microbial contamination: it is the public health significance may result from existence in processing plant
of insanitary condition or malpractice resulting in pollution of final product therefore food-borne diseases and food poisoning will be acquired as well as what was mentioned before in the introduction.

2- Pesticide residues and vet. Drugs: the misuse of these chemicals can lead to food hazards.

3- Food additives and promoters: should under grand name and their chemical nature are determined. They should be authorized restricted use of additives in finished foods should be directed to colors whether they are permitted or even they are miss-used.

4- Environmental contaminations: like dust, motor vehicle transformers leaking, polychlorinated biphenyl (PCBS) compound and heavy metals now become environmental sources of food hazards.

5- Mycotoxins: wastage and garbage disposal process caused problems in all food plants. The plant location and municipal facilities available determined how great is the problem and how much is the burden of waste disposal.

2.9. **Organisms causing infections and their sources:**

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<th>Source</th>
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<tr>
<td>Campylobacterium</td>
<td>Row, undercooked poultry, beef, lamb; unpasteruized milk</td>
</tr>
<tr>
<td>Cryptosporidium “parasite”</td>
<td>Contaminated water, uncooked food</td>
</tr>
<tr>
<td>Hepatitis &quot;A&quot; virus</td>
<td>Undercooked or raw shell fish</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>Row meat, sea food, milk, soft cheese, coleslaw</td>
</tr>
<tr>
<td>Salmonella species (nontyphoid type)</td>
<td>Raw or undercooked eggs, milk and other dairy products, meat and shrimp (cross-contamination)</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>Meats and meat products stored at 120° – 130°F</td>
</tr>
<tr>
<td>Shigella species</td>
<td>Egg salad, vegetables</td>
</tr>
<tr>
<td>Organism</td>
<td>Source</td>
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<tr>
<td>Enteropathogenic Escherichiacoli enterotoxigenic E-coli enteronemorrhagic E-coli</td>
<td>Contaminated water, undercooked beef, imported soft cheeses, fruits and vegetables.</td>
</tr>
<tr>
<td>Trichinella spiralis</td>
<td>Raw or undercooked pork or wild game (e.g. bear).</td>
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<tr>
<td>Bacillus cereus (bacterium)</td>
<td>Fried rice, pork, beef, chicken vanilla sauce</td>
</tr>
<tr>
<td>Clostridium botulinum (toxin)</td>
<td>Canned corn, peppers, green bean, soups, beets, asparagus, mushrooms, ripe olives, spinach, fish, meats (i.e. foods in anaerobic environment of low acidity).</td>
</tr>
<tr>
<td>Clostridium perfringens (bacterium)</td>
<td>“cafeeteria germ” foods served or stored at room temperature or not cooled properly, including meals, poultry, refried beans and gravies.</td>
</tr>
<tr>
<td>Mushroom toxin</td>
<td>Mushrooms</td>
</tr>
<tr>
<td>Staphylococcus--aureus (bacterium)</td>
<td>Toxin produced in meats, poultry, egg products; tuna potato, and macroni, salads; cream filled pastries.</td>
</tr>
<tr>
<td>Vibro cholerae 01 and 013g vcholerae</td>
<td>Shellfish</td>
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<tr>
<td>Tetrodoxin</td>
<td>Buffer fish</td>
</tr>
<tr>
<td>Ciguatera</td>
<td>Fish (amberjack, barracuda, grouper- snapper)</td>
</tr>
<tr>
<td>Paralytic component</td>
<td>Shell fish (clams, mussels, oysters, scallops, other mollusks).</td>
</tr>
<tr>
<td>Hypersensitivity reaction (scombrid poisoning)</td>
<td>Fish (blue fish, bonit, mackerel, mahimahs, tuna)</td>
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(www.postgradmed.com)
2.10. Hospital Catering Management in Developing Countries
Example "in Japan":

As the domain of medicine consists of medical science, medical care and public health that of nutrition consists of nutritional science and practical nutrition care. In Japan during 20th century, food and nutrition have always been considered under the rules and principles of nutrition with focus on the practical (nutritional activity) were directed to menu planning and cooking in the catering system in hospital.

In hospital, under the in-patient treatment-period meal system, there is general menu and the special menu. The general menu is based on the recommended dietary allowance RDAs and served as part of hospital catering service. The level of RDA necessary for each patient is added up in order to obtain the average level serves as the basis for the choice of foods to be provided to the patients, the "model food intake" is then set up, and from that the menu is planned, the food cooked, and finally served. Among the developing countries (dietary supply).

2.11. Prevention of food borne illness:
Contamination of food with E-coli can be minimized, or prevented if workers practice good personal hygiene and wash their hands after defecation.
Out break will be prevented if foods are stored. So as to prevent bacterial multiplication and if foods are heat processed by time temperature exposures that assure destruction of vegetative bacteria (Frank and Hank. 1979).
In the sanitary control of food production and handling these is necessity considerable grouping for bacteriological indices of pollution and potential danger to health. Knowledge of the food product, which permits an explanation of the source of contamination, is fully as important as knowledge of identity of the coli forms organisms’ detected init. This principle is elementary. (John and William 1980) Bar wart (1981) reported that so as to control and to keep the microbial load on or in food as low as possible, it is important to know the main source of contamination.
Four basic systems are used in food control of micro organisms: Prevent contamination, remove contamination, inhibit growth and finally destroy contamination. (George 1981). In order to establish workable food control system, a national government must:

- To enforce food control legislation.
- To set regulation to enforce that legislation.
- Create an agency to control the enforcement.
- Establish food inspection and analysis staff within the agency or agencies concerned.
- Provide physical facilities including a food cab oratory. (F.A.O) (1986).

Betty (1974) reported that prevention of food poisoning be ensured by:
Education and care of food handler and
Personal hygiene;
Good cooling and preparation.
Animal care, vigilance of important food, care of equipment and
cleanliness.

WHO (1997) reported that HACCP was to assess hazards and establish control system that focuses on prevention.
It aims to enhance food safety through out the food chain from producer to final consumer.
Managers of food handling establishment had the primary responsibility for preventing condition that could lead to outbreak of food borne diseases (Jacob, 1989; Harry and William, 1982).

F.A.O (1998) established standard operating procedures (SOPs), which ensure the product from safe sources: water used is potable, food contact, surface and utensils should be in good sanitary condition, un-cleaned and non sanitized surfaces of equipment and utensils should not contact raw food or cooked ready to eat food.

Marques (203) conducted other study in the state of para (Brazil), using microbiology analysis of samples taken from equipment and utensils and employees hands to examined the result indicated that utensils an equipment presented with 100%
contamination of fecal coli forms, as well and workers hands is 70% contamination.

2.12. Previous study:
Marques (203) conducted other study in the state of para (Brazil), using microbiological analysis of samples taken from equipment an utensils and employees hands to examined the result indicated that utensils and equipment presented with 100% contamination of fecal coli forms, as well as workers hands is 70% contamination.
Marques de (203), hygiene and sanitary conditions of a hospital diet is the state of para.

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3. Materials and Methods

Study area is Khartoum Teaching Hospital, particularly in the ward, kitchen, dietetic units, workers, equipments and utensils.

Khartoum Teaching Hospital has about 50 food serves personnel, distributed between food cookers, assistant cookers and food services.

Sample sizes are 65, they were taken randomly from cooked food and utensils, equipment, workers hands as sources of contamination.

3.1. Sources of food samples:

A total of 40 samples were collected randomly from cooked food from kitchen and ward of Khartoum Teaching Hospital.

Samples for sources of food contamination:

A total of 25 swaps samples were taken from utensils, equipment and food services hands.

3.2. Sampling procedure:

The food samples collected during the day were placed in sterilize bottles and closed immediately and also swaps samples were taken to the laboratory for bacteriological examination.

3.3. Collection of blood and serum:

Blood and sera used for enrichment of media were collected from healthy animals (sheep and horses) in sterile heparinzed and plan vacationers respectively. For serum to be collected. The blood usually is kept at 4c° until separation of serum that was then aseptically withdrawn using sterile Pasteur's pipette, Sera were in activated at 56c° in water bath for 30 minute before being used.

3.4. Sterilization:

The glass were used (bottle, swabs, Petri dish, test tubes, flasks pipettes, were sterilized at 170c° for one hour using hot air over (merchant and packer, 1967).
Different laboratory media, solutions, and test tubes were sterilized by autoclaving at 115°C - 120°C for 10 – 20 minutes and 15 ip pressure/sqin (Cowan and Steel, 1985).

3.5. Preparation of culture media:
Different culture media were prepared according to instructions of the manufacture or as recommended by (cowans and steel 1985).

The PH of different prepared media was adjusted using 1% NaOH and NHCL. Every step of media preparation was conducted under special condition

3.6. Preservation of culture media:
All prepared culture media were preserved at 4°C until they were used.

3.7. Media for isolation of bacteria:
3.7.1. Blood agar medium:
Twenty three grams of lab. Lemco agar (oxoid, cm.17) were suspended in one liter of distilled water. It was heated to dissolve completely using electronic boiler and then sterilized.

The medium was then cooled to 50°C in water bath and 5% of sterile sheep blood was added and mixed well. The mixture was distributed in to sterile dishes and left to solidify.

3.7.2. MacConkey's agar medium:
Fifty grams of MacConkey's agar (Merk, 4565) were added to one liter of distilled water. It was then dissolved by heating, sterilized before distributed in to sterile Petridishes and left to solidify.

3.7.3. Nutrient agar medium:
Thirty seven grams of nutrient agar (Merk, 1881) were mixed with one liter distilled water. It was dissolved by heating. Sterilized, poured in sterile Petri dishes and left to solidify.

3.8. Media for biochemical tests:
3.8.1. 40 % bile agar:
Forty grams of bile salt were added to one liter of melted nutrient agar. They were mixed sterilized and cooled to 55°C. Fifty ml. of equine serum were added, mixed well and distributed in sterile Petridishes.
3.8.2. Starch agar:
Ten (10) grams of starch were suspended in 50 ml of distilled water and added to one liter of melted nutrient agar. They were well mixed sterilized and distributed in sterile Petridishes.

3.8.3. Casien agar medium:
500 ml of litmus milk (50 gram litmus milk dissolved in 500 ml of distilled water) were prepared, sterilized, cooled to 50c° and added to 500 ml of sterile nutrient agar. They were mixed and poured in Petri dishes.

3.8.4. Citrate medium:
Three grams of sodium citrate, 0.2 gram of glucose, 0.5 gram yeast extract, 1 gram of k₂HPO₄, 5 grams of sodium chloride and 20 grams of agar were suspended in one liter of distilled water. The suspended solids were dissolved by heating. Filtered and adjusted to PH 6.8 – 6.9. Six ml of 0.2 % phenol red solution were added and the medium was distributed in to test tubes. The test tubes were sterilized and placed in slope position where they left to solidify.

3.8.5. Urea medium:
Fifteen grams of urea base (oxide, CM.67) were dissolved in one liter of distilled water and adjusted to PH 6.8. It was sterilized and cooled to 50c°. 100 ml of 20% urea was added to the medium and distributed in sterile containers.

3.8.6. Blood telluride agar:
One liter of brain- heart infusion agar medium was sterilized and cooled at 50c° in water bath. 16 ml of 0.0 3% sterile potassium telluride and 50 ml of sterile blood were then added to the medium, mixed well and distributed in sterile Petri dishes.

3.8.7. Methyl red and vogues proskauer (MR. and VP) medium:
Five grams from each of peptone and k₂HPO₄ were added to one liter of distilled water it was dissolved by heating, filtered and adjusted to PH 7.5. Five grams of glucose were then added to one medium and distributed in to 1.5 ml volume tubes which were then sterilized.
3.8.8. Peptone water:
Ten grams of peptone and 5 grams of NaCL were added to one liter of distilled water and heated to dissolve. It was adjusted to PH 8-8-4, boiled for 10 minutes and filtered. The medium was readjusted to PH 7.2 – 7.0 and sterilized.

3.8.9. Phenol red, peptone water for sugar fermentation:
Fifteen grams of dehydrated phenol red peptone water (oxoid cm .63) were suspended in 900 ml of distilled water, dissolved by heating and sterilized by autoclaving at 121c° for 15 minutes.

To 900 ml. phenol red peptone water added 10 grams of appropriate sugar in 90 ml. distilled water, sterilized by tyndilization and distributed aseptically in sterile test tubes containing inverted Durham's tube.
The sugar complied included:
1- Glucose.
2- Lactose.
3- Maltose.
4- Mannitol.
5- Salicin
6- Arabinose.
7- Trehalose
8- Xylose.

3.8.10. Arginine broth:
Five grams of peptone, 5 grams yeast extract, 2 grams k2HPO4, 0.5 grams glucose and 3 grams of arginine monohydrate were suspended in one liter of distilled water. They were then heated to dissolve, adjusted to PH 7.5 and filtered. The medium was distributed in bottles and sterilized.

3.8.11. Nitrate broth:
One gram of potassium nitrate and 13 grams of nutrient broth (oxoid, CM.1) were dissolved in one liter of distilled water. It was then distributed in tubes containing inverted Durham's tubes and sterilized.
3.8.12. Nutrient broth for Indol:
Thirteen grams of nutrient broth powder were dissolved in one liter of distilled water. The medium was then distributed in bijou. Bottles and sterilized.

3.8.13. MacConkey's broth purple:
One tablet of MacConkey broth purple (oxide, CM.6a) was added to 10 ml. of distilled water in a tube containing inverted Durham's tubes.

3.9. Medium for preservation of isolates:
Bacteria isolated were preserved in blood agar slants which were prepared by addition of 7% sheep blood to one liter of sterile nutrient agar cooled to 50°C. The medium was dispensed in 5 ml. volume in sterile Bijou. Bottles, and left in slope position to solidify.

3.10. Indicators:
Bromothymol blue:
0.2 gram of bromothymol blue was dissolved in 100 ml. of distilled water.

3.11. Reagents:
3.11.1. Acid mercuric chloride:
Twelve grams HgCl₂ were mixed in 80 ml. of distilled water and 10ml of concentration HCL was added and shaked well.

3.11.2. Hydrogen peroxide 3%:
This was obtained from local pharmacies.

3.11.3 Oxidase test reagent:
One gram of tetramethyl phenylene diamine dihydrochloride was dissolved in 100 ml. of distilled water.

3.11.4. Nitrate reagent:
1- Solution A:
Four grams of sulphatic acid were dissolved in 500ml. of 5N. acetic acid by gentle heating.
2- Solution B:
Two and half grams of α-naphthylamine were dissolved in 500 ml. of 5N – acetic acid by gentle heating.
3.12. Solutions:
3.12.1. Methyl red solution:
   0.04 gram of methyl red was dissolved in 40ml of ethyl alcohol and diluted by distilled water to 100 volumes.
3.12.2. α-Naphthol solution:
   Five grams of α naphthol were dissolved in 100m of ethanol.
3.12.3. 40 % potassium hydroxide:
   Forty grams of potassium hydroxide were dissolved in 100 ml of distilled water.

3.13 Culture Method:
3.13.1. Primary isolation:
   Blood agar media and Mannitol salt agar, Baird, parker media, MacConkey's agar, staphylococcus media were inoculated by transferring a loopfull of sample on the service of each plate and streaked to obtain discrete colonies and inoculated at 37°C for 24 hr, and then inoculated plates were incubated under aerobic condition for 3 days.

3.13.2. Examination of inoculated culture media:
   Culture media were examined by the naked eye for the growth of the organisms.
   Colony morphology, haemolysis, change in colour and consistency were observed. The presence of any organism was identified as to be light, moderate, heavy.

3.13.3. Purification of isolates:
   Recovered bacteria were purified by picking a single colony that was then streaked on to blood agar plates.

3.14. Primary identification:
3.14.1. Staining method:
   A drop of distilled water was placed on a clean slide. A single colony was taken, emulsified in the water and then spreaded.
   The smear was dried, fixed by heating and stained by Gram's or ziehl. Nelson stains.

3.14.2. Staining technique:
   Gram's and ziehl- Nelsen; stain were done according to (Cowan, Steal, 1985).
3.15. Preservation of isolated bacteria:

Primary identified bacteria were inoculated in blood agar slants, incubated overnight at 27°C to allow growth and then preserved at 4°C.

3.16. Identification of bacterial genera:

The genera of the recovered bacteria were identified after cowan (1985) through primary tests that include.

3.16.1. Gram’s stain:

3.16.2. Acid – Fastness:

3.16.3. Aerobic growth:

3.16.4. Motility:

Motility medium was inoculated by stabbing the isolated bacteria with straight wire loop. The medium were then incubated up to 3 days together with uninoculated media as a control. The growth of no motile organism was confined to the stab, while the motile one was distributed out the stab.

3.16.5. Catalase activity:

On a clean slide a drop of 3 % H₂O₂ was placed. Performed as described by (Cowan, Steal, 1985) from suspected bacteria growth on nutrient agar was emulsified and added to the drop of H₂O₂. Positive reaction was indicated by gas fermentation.

3.16.6. Oxidase tests:

A colony of the tested organism was smeared with glass rod across filter paper saturated with 1% tetramethyl- p-phenylene diamine dihydrochloride. A positive result was shown by the development of purple colour.

3.16.7. Oxidation fermentation (O.F) test:

Two tubes of O.F. medium were stabbed by the organism under test with straight loop. To one of the tubes, a layer of paraffin oil was added. The two tubes were incubated for 48 hours with tubes as a control. Development of yellowish colour in the 2 inoculated tubes indicated fermentation. Where as oxidation reaction was indicated by the development of yellow colour in the open tube only.
3. 17. Identification of bacteria species:

3.17.1. Arginine hydrolysis:
Arginine broth medium was inoculated with the tested organism and incubated overnight with un inoculated Arginine medium as a control. A positive reaction was indicated by change of colour to brown after addition of 0.25 ml of Nessler's reagent.

3.17.2. Aesculin hydrolysis:
Aesculin broth was inoculated with the tested organism, incubated with uninoculated aesculin broth as a control and observed for 7 days for blackening of the medium.

3.17.3. Coagulase test:
Single colony of the tested organism from 24hr growth on blood agar was transferred to one ml. of human plasma which was diluted (1:6) by physiological normal saline.

It was then incubated at 37° in water bath with uninoculated tube as a control and observed after 1, 2, 4, 8 and 14 hr. A positive reaction was shown by definite clot formation.

3.17.4. (MR- VP) reaction:
Mr. VP broth medium was inoculated with the organism to be tested and incubated for 48hr. with uninoculated tube as a control. Two drops of methyl red reagent were added change of medium color to red indicated a positive result for MR. After completion of MR test, 0.6ml of 50% α-naphthol solution and 0.2 ml of 4% KOH were added to the medium, shaked and placed in aslope position. Appositive reaction of VP was indicated by appearance of red colour.

3.17.5. Bile tolerance:
The tested organism was streaked on 40% bile agar plate and incubated for 48hrs. Growth of bacteria indicated their bile tolerance.

3.17.6. Nitrate reduction:
Nitrate broth medium was inoculated with organism under test and incubated for 24hr with uninoculated medium as a control one ml of solution "A" was added and followed by one ml of solution "B" Nitrate reduction was indicated by the development of red colour. Zink powder was then added to
negative tubes to confirm the presence of unreduced nitrate by the appearance of red colour.

3.17.7. Indol test:
The nutrient broth was inoculated with the tested organism and incubated for 48hrs with uninoculated tubes as a control. 0.5 ml of Kovacs reagent was then added to the medium and shacked. A positive reaction was indicated by the appearance of red colour in the reagent layer.

3.17.8. Hydrogen sulphide production:
Kligler iron agar media were inoculated with the organism to be tested by stabbing the butt and drawing and over the surface, incubated with the uninoculated media as a control and observed daily for up to 7 days.

3.17.9. Urease activity:
Urea medium was inoculated with the tested organism and incubated for 24hrs with uninoculated urea media as a control. Development of pink colour in the medium indicated urease activity.

3.17.10. Starch hydrolysis:
Starch agar was inoculated with tested organism, incubated for 24hrs and flooded with lugol's iodine solution. A clear colorless zone around the colony indicated positive reaction.

3.17.11. Digestion of casein:
Plate of casein agar were inoculated with the organism to be test and incubated for 24hrs. Clear zone around the colony indicated casein digestion. A positive reaction was confirmed by addition of acid mercuric chloride that decreases the false positive clearance zone.

3.17.12. Citrate utilization:
Citrate medium was inoculated with tested organism by stabbing the butt of the medium and drawing over the slope surface using straight wire loop. The inoculated medium was incubated with uninoculated one, and observed daily for up to 7 days. Development of purple colour over the surface indicated citrate utilization.
3.17.13. Production of acid and gas from carbohydrate:

Phenol red of Peptone water containing various sugars were inoculated with the tested organism and inoculated with an uninoculated media as a control.

Change in colour indicated positive reaction. The produced gas was trapped in the inverted Durham's tube.
4. Results and discussion

The following are the results of the laboratory analysis of the different samples that had been taken randomly from Khartoum Teaching Hospital for this study.

The selected samples either the cooked food materials, non food materials (utensils & equipment) and the human materials had been analyzed through series of experiments to obtain the following results, to confirm certain results, some of these experiments had been repeated, For more explanations,

A- Food Materials:

Table No. 1

type of cooked food samples, sample numbers and sources:

<table>
<thead>
<tr>
<th>Sample Sources</th>
<th>Type of cooked food</th>
<th>No of sample</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wards</td>
<td>Kwash milk lentil vegetable soup foul minced meet custard thine boridge Tamia juile cheece</td>
<td>20</td>
<td>50%</td>
</tr>
<tr>
<td>Kitchen</td>
<td>Jam foul lentil cheece juice thine boridg minced meet salad custard vegetable soup</td>
<td>20</td>
<td>50%</td>
</tr>
</tbody>
</table>

The above table shows that about 50% of food samples were collected directly from the kitchen and about 50% had been taken from the ward of Khartoum Teaching Hospital.
Table No (2): The overall prevalence rates of bacteria isolated from different sources of cooked food samples

<table>
<thead>
<tr>
<th>Sample sources</th>
<th>No of sample</th>
<th>No of positive isolate</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wards</td>
<td>20</td>
<td>21</td>
<td>58.3%</td>
</tr>
<tr>
<td>Kitchen</td>
<td>20</td>
<td>15</td>
<td>41.7%</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>36</td>
<td>100%</td>
</tr>
</tbody>
</table>

The above table shows the overall prevalence rates of bacteria isolated from different sources of cooked food samples according to laboratory results, which obtained when samples were cultured on MacConkey agar and blood agar, nutrient agar for purification of the isolates according to the biochemical reactions. Then, different types of bacteria were detected. Ward samples gave the highest numbers of isolated (58.3%) bacteria in contrast with samples taken from kitchen (41.7%). This high prevalence rate of isolates from ward samples was reflected to the poor hygiene during food distributions, which allow more contamination.

Table No (3): Types of bacteria isolated from different cooked food samples

<table>
<thead>
<tr>
<th>No of samples</th>
<th>Total of isolates</th>
<th>Types of bacteria</th>
<th>No of isolates</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>36</td>
<td>Saureus</td>
<td>20</td>
<td>55.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aerococcus viridans</td>
<td>1</td>
<td>2.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sepidermidis</td>
<td>7</td>
<td>19.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Micrococcus Varians</td>
<td>5</td>
<td>13.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Corynobacterium muriun</td>
<td>3</td>
<td>8.3%</td>
</tr>
</tbody>
</table>

The above table shows the different types isolated from cooked samples, the staphylococcus aureus 20 (55.6%) (Asperger, 1994) reported that saureus are gram positive cocci and are catalase positive, non motile, non spore forming, colonial pigment is variable from gray or white with yellowish tint.
(Ndeshiyun et al, 1997) reported that enterotoxin producing staphylococcus species (S.aureus in particular) are leading to food born diseases.

Other types of bacteria isolated from cooked food samples as epidermidis (19.4%) aerococcusviridans (2.8%) micrococcus varians (13.9%), corynobacterium murium (8.3%).

The above result revealed that S.aureus was recorded of a higher percentage (55.6%), which may constitute a public health hazards.

Table No. (4):
Source of food contamination (worker hands)

<table>
<thead>
<tr>
<th>Type of samples</th>
<th>Types of bacteria isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal no</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-ve</td>
</tr>
<tr>
<td>2</td>
<td>-ve</td>
</tr>
<tr>
<td>3</td>
<td>Staphylococci</td>
</tr>
<tr>
<td>4</td>
<td>-ve</td>
</tr>
<tr>
<td>5</td>
<td>-ve</td>
</tr>
<tr>
<td>6</td>
<td>Staphylococci</td>
</tr>
<tr>
<td>7</td>
<td>Staphylococci</td>
</tr>
<tr>
<td>8</td>
<td>-ve</td>
</tr>
<tr>
<td>9</td>
<td>-ve</td>
</tr>
<tr>
<td>10</td>
<td>Staphylococci</td>
</tr>
<tr>
<td>11</td>
<td>-ve</td>
</tr>
<tr>
<td>12</td>
<td>Staphylococci + E.coli</td>
</tr>
<tr>
<td>13</td>
<td>-ve</td>
</tr>
</tbody>
</table>

The above result shows that staphylococcus contaminations was the main types of organisms had been found in the majority of samples taken from food cookers and handlers where one sample contain  staphylococcus and E.coli and other samples were found -ve.
Table No (5) Sources of contamination Non food materials (utensils & equipment)

<table>
<thead>
<tr>
<th>No</th>
<th>Type of Sample</th>
<th>Type of bacteria isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-</td>
<td>pot used for meal cooking</td>
<td>+ve staphylococci</td>
</tr>
<tr>
<td>2-</td>
<td>Wooden spoon used for food blending</td>
<td>+ve staphylococci</td>
</tr>
<tr>
<td>3-</td>
<td>Large plate used for keeping of cooked meat.</td>
<td>+ve staphylococci</td>
</tr>
<tr>
<td>4-</td>
<td>Knife</td>
<td>+ve staphylococci</td>
</tr>
<tr>
<td>5-</td>
<td>Small plate used for keeping of cut fruits</td>
<td>-ve</td>
</tr>
<tr>
<td>6-</td>
<td>Plate used in distribution of vegetable salad in word.</td>
<td>-ve</td>
</tr>
<tr>
<td>7-</td>
<td>Tray used for meal distribution in word</td>
<td>+ve staphylococci</td>
</tr>
<tr>
<td>8-</td>
<td>Cup used for juice in word</td>
<td>+ve staphylococci</td>
</tr>
</tbody>
</table>

The result obtained from experiment No (9) which investigated some non-food materials had been taken from Khartoum Teaching Hospital kitchen (utensils equipment) (photo No 1,2,3,4) revealed the following facts:

The sample taken from the pot which is used for meat cooking was contaminated with staphylococci species. (Photo No 1).

The sample taken from the wooden spoon used for food blending contained staphylococcus organisms.

The table also shows that the large plate used in keeping of cooked meats with staphylococcus organisms, and also examination of the knife used for cutting of vegetables and fruits showed staphylococcus microorganisms.(photo No 5,6,7)

Investigation of the sample taken from the small plate used in keeping of cut fruits revealed the unavailability of organisms.

The result also explains the cleanliness of the plate used in distribution of the vegetable salad in the words from these organisms. (Photo No 8)

Table 9 also shows types of micro-organism found on the tray used in food distribution in the words which were staphylococcus species and no other micro-organism had been found.
Table No (6): Source of contamination Non food material (utensils and equipment)

<table>
<thead>
<tr>
<th>No</th>
<th>Type of Sample</th>
<th>Type of bacteria isolate</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-</td>
<td>Marble table used for cutting of all types of food material</td>
<td>+ve staphylococci + E.coli</td>
</tr>
<tr>
<td>10-</td>
<td>Table used for meet cutting</td>
<td>+ve staphylococci + E.coli</td>
</tr>
<tr>
<td>11-</td>
<td>Large plate for vegetable and fruits cutting</td>
<td>-ve</td>
</tr>
<tr>
<td>12-</td>
<td>Knife used in cutting of all items</td>
<td>+ve Staphylococci</td>
</tr>
</tbody>
</table>

The above table shows the marble table which all types of food were placed and cut with staphylococcus as the main isolated bacteria in addition to E.coli bacteria and no other micro-organism species was found.

Also the result showed that the table used for meet cutting was found to be contaminated with staphylococcus and E.coli organisms. (Photo No 5).

The experiment was also explains the void of the plate used in fruits cutting from all organisms.

Examination of the knife reveals +ve detected of staphylococcus SPS, and no other micro-organism was observed. (Photo No 7).

Table No (7): The type of bacteria isolated from hands of food workers and utensils & equipments

<table>
<thead>
<tr>
<th>Total samples</th>
<th>Total isolate</th>
<th>Types of bacteria</th>
<th>No of positlim sample isolate</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>17</td>
<td>S aureus</td>
<td>14</td>
<td>82.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. Coli</td>
<td>3</td>
<td>17.6%</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

The above table shows that the abundant type of isolated bacteria is saureus 82.4%.

In addition to E.Coli 17.6 as a result of fecal contamination.

The prevalent of staphylococcus aureus among the hospital catering staff was very high. This result was identical to result (Nagat, 1997), who studied the carrying of staphylococcus SPP in hospital population.
This result assume that this group has become a risk factor to the patient in hospitals especially those patients under surgical procedure or patient under intensive care unit also represent a risk factor for neonatal who are having immature immunity.

So that infection with staff staphylococcus can result in skelded skin syndrome, skin rash and other disease condition. (Tullach, 1954)

**Properties of some isolated bacteria:**

1. Staphylococci:

   They were gram-positive cocci on stained smears; they were arranged in clusters or pairs. The colonies were white or creamy.

   They were B. hemolytic and which was clear when stored overnight at 4°C in a refrigerator. These were identified as staphylococcus aureous.

   Gram positive cocci that grew on Chapman stone medium and when they did not coagulate human plasma they were identified as coagulase negative staphylococcus.

2. Enterobacter aerogenes:


   The result in the above tables indicate that the number of bacteria from cooked food taken from kitchen was increased in the same item taken from the wards, which indicated the possible food contamination when food take long time in the ward.

   As indicated in table number 4, that 5 out of 13 were observed to be +ve with staphylococcus and one was observed with staphylococcus and *E.coli*. (The percentage is 38.5%), and as indicated in tables 5 and 6 that 9 out of 12 were observed +ve with staphylococcus and *E.coli*.

   The dominant bacteria which isolated from cooked food which was staphylococcus aureus and other bacteria isolated
from utensils, equipment and food workers are staphylococcus, and *E.coli*.

The similarity of isolated bacteria in food and utensils and food workers may reflect the contamination during food handling and food distribution.

Also this study reflected that there was possible contamination during food processing or food handling as very important sources of contamination, which indicate the poor hygienic practices.

**To achieve the improvement of patients' nutritional status more efforts need to be exerted in hospital catering as:**

- Quality of food received from the contractor.
- Supervision of the kitchen, workers.
- Food preparation and distribution.
- Concern on the health of the staffs. (Abernathy, 1983).

**There are fundamentals of food services in health care facilities as:**

F: familiar food with fresh homelike flavor
U: up to date method of preparing and certain food.
N: nourishing food which include the 4 basic group ( ie fat, protein, carbohydrate, vitamins and minerals).
D: Dishes sparkling clean and free from stein.
A: Attitude and appearance of serving food should be clean and friendly.
M: Menu planned a head for at least one week.
E: Excellent cooking.
N: nutritious main dishes made appetizing.
T: Training a good employee become better when trained.
L: look a head, plan for special occasions.
S: Sanitation, safe and sanitary food service. (Robinson, 1986).

The study concern in food service in the hospital because food can a vehicle for disease transmission.

Equipment and utensils made of materials difficult to clean or were through cleaning is in convenient can be a source of contamination in the kitchen so through and regular cleaning is important.
Floor, wall and ceiling is important to maintain the sanitary condition of the kitchen, holes in floor to be repaired because it may be a breeding ground for bacteria as well other pests.

Sanitary sewage disposal should prevent the contamination of the ground and the water supply because sewage is one of the most dangerous source of human pathogens thus should not make any contact whatever with food, drink, equipment, utensils and any other surface which make contact with food. (Longree, 1985).

Control measures in reducing the danger of undesirable bacterial activity in the food service department are:

- The chance of multiplication of bacteria must be stopped.
- Kitchen keeping clean every step of food preparation service and storage.
- Provision of adequate sanitizing facilities for equipment use in food preparation.
- Give direction for sanitary maintenance.
- Garbage and rubbish must be stored in containers constructed of durable metal or other materials which don't absorb odors and can easily cleaned.
- The floor and equipment in the area were food is stored, prepared and served should be maintained in state of excellent repaired and cleanliness.
- Regular inspection and effective method of cleaning are basic of sanitary measures.
- A food service worker should not be on duty when she or he has an acute form of communicable disease.

Continuous watchful of employee in food service department is important especially periodic.
Fig (1) Rate of bacteria isolated from different cooked food samples

<table>
<thead>
<tr>
<th>Type of Bacteria</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus</td>
<td>a</td>
</tr>
<tr>
<td>Aerococcus viridans</td>
<td>b</td>
</tr>
<tr>
<td>S. epidermidis</td>
<td>c</td>
</tr>
<tr>
<td>Micrococcus varians</td>
<td>d</td>
</tr>
<tr>
<td>Corynebacterium murium</td>
<td>e</td>
</tr>
</tbody>
</table>
Figure No (2): rate of bacteria isolated from hands of food workers and utensils & equipment.

a. S.aureus.
b. E.coli
Fig No (3). The result of food worker hands analysis

- 38.5% positive
- 61.5% negative
Fig No (4). The result of equipments & utensils analysis

- Positive: 42%
- Negative: 58%
<table>
<thead>
<tr>
<th>S. PP</th>
<th>Coagulase</th>
<th>Urease</th>
<th>Nitrate reducse</th>
<th>V.P</th>
<th>Maltose</th>
<th>O.F</th>
<th>Glucose</th>
<th>Oxidase</th>
<th>Catalse</th>
<th>Grow on air</th>
<th>Motility</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>F</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Staphylococcus epidermidis</td>
<td>-</td>
<td>+</td>
<td>D</td>
<td>D</td>
<td>+</td>
<td>F</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Micrococcus varians</td>
<td>-</td>
<td>+</td>
<td>D</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>O</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Aerococcus viridans</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>F</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>S</td>
</tr>
</tbody>
</table>

S: Coccus – shaped.
R: Rod – shaped.
F: Fermentation.
O: Oxidation.
D: Different: reaction in different strain.
Table No (9): Biochemical reactions for identification of bacteria (gram positive rod) according to (Cowan & Steel, 1985)

<table>
<thead>
<tr>
<th>S. PP</th>
<th>Urease</th>
<th>Nitrate reduce</th>
<th>V.P</th>
<th>Trehalas</th>
<th>Maltose</th>
<th>O.F</th>
<th>Oxidase</th>
<th>Catalse</th>
<th>Glucose</th>
<th>Grow on air</th>
<th>Motility</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corynebacterium murium</td>
<td>d</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>F</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>R</td>
</tr>
</tbody>
</table>

R: Rod - shaped.
F: Fermentation.
D: Different: reaction in different strain.
<table>
<thead>
<tr>
<th>Type of bacteria</th>
<th>Shape</th>
<th>Acid fast</th>
<th>Growth aerobic</th>
<th>Catalase</th>
<th>Oxidase</th>
<th>Motility</th>
<th>Glucose</th>
<th>O.F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia</td>
<td>Rods</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>F</td>
</tr>
<tr>
<td>Organism</td>
<td>Enterobacter</td>
<td>Ascorbic acid</td>
<td>V.P</td>
<td>Indol</td>
<td>H.S</td>
<td>Gelatin Hydrolysis</td>
<td>Lactose</td>
<td>Maltose</td>
</tr>
<tr>
<td>----------</td>
<td>--------------</td>
<td>---------------</td>
<td>-----</td>
<td>-------</td>
<td>-----</td>
<td>-------------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Cowan, 1985)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table No (11): Biochemical reaction of coliform bacteria**
5.1 Conclusion

From this study, which conducted in Khartoum Teaching Hospital, all the result indicated that the catering system has a direct effect in the hygiene of food. This was reflected through examined samples taken from food handlers, utensils and other equipment as the sources of food contamination in the targeted hospital.

The study indicated that there is increasing in bacterial isolation from food samples taken from wards, when food stay for along time, which indicated that food distributed in wrong time, that lead to be staying long time before being eaten.

Results also show there is E.coli isolated, which indicate the poor hygiene as a result of location of bathroom near the dietetic unit and kitchen and poor clinical check up.

So, there are multiple causes of food contamination in hospital catering system in the targeted hospital.
5.2 *Recommendation*

From the outcomes of this study the following recommendations are suggested.

1. The structure of kitchen and food rooms must be kept in good ventilation light, and in good repair to enable them to be cleaned.
2. Awareness of workers in all dietary department especially in kitchen and food handlers to be in clean clothes, hands, hairs and to follow correct foods process.
3. Medical check of worker every 3 month.
4. Food must be given to the patient immediately to avoid any multiplication of micro-organism.
5. Isolated bathroom from kitchen.
6. Equipment must be cleaned before and after food preparation or food distribution.
7. Ill workers should be isolated until treated.
8. Covering of food during distribution to avoid any contamination from outside.
9. Kitchen structure must be changed to be suitable with the targeted hospital to avoid all hazards.
10. The distribution of meals in the hospital always in wrong time (medical round and visiting hours). So the time of food distribution must be corrected.
11. Involvement of professional in making catering services and kitchen reconstruction.
12. Clean water must be available all time in the kitchen and all dietetic units.
13. Suitable cleaning materials must be available in kitchen and all dietetic units.
6. References:


19. marques D. E. (2003), Hygiene and Sanitary Conditions of hospital diets in the state of Para, Barazilian University


