

Bacteriological Quality of Street-vended Um-Jinger: a Traditional Sudanese Food

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Abstract: Um-Jinger is a fermented indigenous Sudanese food product made mainly from cooked grinded pearl millet to which sugar, yogurt, lemon and salt will be added upon serving. It is vended by women and widely consumed by workers in industrial areas in Khartoum State, Sudan. Sixty samples of Um-Jinger were randomly collected from vending women near industrial areas in Khartoum State over a period of three months from 21st May to fifth of September 2007. The study was focused on determine bacteriological quality and safety of street vended Um-Jinger. Microbial analysis resulted in aerobic plate counts from 3×10^4 to 3.5×10^7 colony forming unit (cfu)/ml, while MacConkey's agar counts ranged from 2×10^2 to 2.7×10^3 cfu/ml and Mannitol salt agar growth of about 2×10^2 to 1.6×10^3 cfu/ml. Total coliform ranged from 3 to 1400 MPN/100 ml. *Bacillus spp.*, *Staphylococcus aureus*, *Escherichia coli* and *Salmonella spp* were detected in 70%, 68.3 %, 6.6 %, 5% of samples respectively. *Pseudomonas spp.* and several enterobacteriaceae species were isolated including *Protues spp.*, *Klebsiella spp.*, *Hafnia spp.*, *Escherichia spp.* The minimum pH of Um-Jinger samples was 3.4 where the highest pH was 6.7. Alteration of the traditional formula by omitting yoghurt and replace it with citric acid showed that this street foods nutritional value could be reduced to meet the low price requirements. Observation of Um-Jinger vending places showed that these were crowded, unclean and the sanitary levels were low. In spite the high nutritional value of this product and its importance for low income consumers, the established results in addition to close observation of Um-Jinger marketing conditions indicate that consumption of street vended Um-Jinger may have a negative effects on public health. Therefore, vending this type of food require more attention from health authorities, educational programmes for vendors and improvement of preparation and handling environment.

Key words: Um-Jinger, fermented Sudanese food, Street food, foodborne pathogens.

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Introduction

Researchers who investigated the microbiological quality of street-vended foods have reported high bacterial counts and a high incidence of food borne pathogens in such foods in different countries (Bryan et al. 1992). More than 200 known diseases are transmitted through food. Viruses, bacteria, parasites, toxins and chemicals, could cause food borne illness. The symptoms range from mild gastroenteritis to life-threatening neurologic, hepatic and renal symptoms. The number of people suffering from food borne illness has increased dramatically over the last decade (Altekruse et al. 1997).

Um-Jinger is a fermented indigenous Sudanese food product made from pearl millet, it is virtually restricted to the regions of Darfur and Kordofan (Dirar 1993). A great increase in its consumption by industrial zones workers, out of its traditional places, has been recognized, as it is readily available, inexpensive and nutritious ready-to-eat meal.

It is mainly prepared from grinded millet, sugar, yogurt, lemon, little salt, and sometime dry Halawa Tahineya (sweet sesame seed paste) is added. Millet is cooked then other constituents are added without cooking.

No information concerning the safety of this type of street food is available.. Reported information in this study could be used to improve handling and preparation condition of this nutritious food and protect its consumers. The aim of this study is to determine the microbiological quality and safety of the traditional Sudanese food (Um-Jinger) sold by women vendors in Khartoum State, Sudan.

Materials and Methods

Samples collection. Sixty samples of Um-Jinger were randomly collected from women vendors in Khartoum markets. Sampling was performed weekly over a period of three months from 21st May to fifth of September 2007. The samples were collected in sterile glass containers and transported in an icebox to the laboratory of the Department of Food Hygiene and Safety at University of Khartoum within two hours, where they were analyzed.

Prior to sample collection, observation notes regarding ingredients, serving procedures and environmental health conditions of sale surrounding area were taken after permission from local environmental health office and upon the agree of vendors to cooperate.

Aerobic Plate Count (APC). APCs were determined using plate count agar. One ml from each sample homogenate was added to 9 ml peptone water tube and the process was repeated to make serial dilutions (from 10^{-1} to 10^{-6}), then 0.1 ml was taken from each of 10^{-4} and 10^{-6} dilutions and plated on the surfaces of agar plates in duplicate. The plates were incubated at 37 °C for 48 hr before colonies were counted.

Coliforms count. From each sample homogenate; 10 ml, 1 ml and 0.1 ml were inoculated into nine tubes (three tubes for each volume), each tube contained 10 ml of MacConkey's broth with inverted Durham's tubes. Those tubes to which were added to each 10 ml portions of samples contained double strength medium. , the tubes were incubated at 37°C for 24- 48hr. Then the tubes were observed for acid and gas production. Coliforms counts were calculated from MPN tables (International Standards Organisation 1991; Mosupye and Holy 1999).

MacConkey's agar count. From each samples of previously prepared serial dilution (10^{-2} and 10^{-3}) 0.1 ml was transferred into sterile Petri dishes contained 15 ml of MacConkey's agar medium and incubated at 37°C for 24hr. Then, pink colonies were observed and counted with a colony counter.

Mannitol salt agar count. Mannitol salt agar medium was used , 0.1 ml of the previously prepared serial dilution (10^{-2} and 10^{-3}) was taken from each sample and transferred to the sterile medium , incubated at 37°C for 24 hr . Yellow and orange colonies surrounded by yellow zones due to mannitol fermentation were enumerated and further tested by coagulase test after overnight sub-culturing in nutrient agar plates.

pH Measurement . pH of all samples were measured by p H meter (Hanna Instruments Ltd, Italy).

Examination of morphological features of isolates. Microscopic investigation of morphological features of isolates using Gram's stain was performed for each colony using standard methods.

Biochemical methods used for identification of isolated bacteria. All biochemical tests were performed according to Cheesbrough (1999). They included: Indole test, methyl red test (MR), citrate utilization, catalase test, oxidase test, coagulase test, oxidation – fermentation test, fermentation of sugars and motility test.

Table 1. Bacteriological analysis of Um-Jinger samples

Microorganisms	Minimum	Maximum
APCs	3×10^4 / ml	3.5×10^7 / ml
Coliform count	3/100 ml	1400/100 ml
MacConkey's agar count	2×10^2 / ml	2.7×10^4 / ml
Mannitol salt agar count	2×10^2 / ml	1.6×10^4 / ml

Table 2. Incidence of *Enterobacteriaceae* and *Pseudomonas* species recovered from analyzed samples of Um-Jinger as presumptively identified:

Organism	Number of samples	Percentage
<i>Proteus spp.</i>	5	8.3
<i>Klebsiella spp.</i>	5	8.3
<i>Hafnia spp.</i>	5	8.3
<i>Escherichia coli</i>	4	6.7
<i>Salmonella spp.</i>	3	5
<i>Escherichia spp.</i>	2	3.3
<i>Pseudomonas spp.</i>	2	3.3
Total	26	43.3%

Results

Um-Jinger sale zones are located mainly in industrial areas and their nearby bus stations, markets and residential areas. All these places were crowded and unclean. The sanitary levels in the sale places were low; food remains, wastewater, solid wastes and flies were evident.

Observation of women vendors revealed that they used plastic buckets and utensils for carrying and distributing Um-Jinger meals. Aluminum bowls were used for serving Um-Jinger meals.

For washing serving bowls and spoons, each vendor used single bucket containing water. The bucket water became dirty just after the first wash turn, but vendors continue using it for washing bowls and spoons during serving meals. The personal hygiene of women vendors was poor and no other cleaning facilities were present. In addition to unsafe handling practices no food preservation or cooling facilities were present.

The results of bacteriological analysis of Um-Jinger samples demonstrate population of aerobic plate count ranging from 3×10^4 to 3.5×10^7 cfu per ml of sample. Whereas the total coliform count are ranging from 3 to 1400 MPN per 100 ml. The MacConkey's agar count ranged from 2×10^2 to 2.7×10^4 and Mannitol salt agar count ranged from 2×10^2 to 1.6×10^4 per ml (Table 1).

Samples of Um-Jinger showed high incidence of *Staphylococcus aureus*, *Bacillus spp* in addition, to *enterobacteriace*. The percentage of samples from which *Staphylococcus aureus* was isolated was 68.3% whereas, the *Bacillus spp* Isolated from 70% of samples and *Enterobacteriace* form 43% of samples. The minimum pH of Um-Jinger samples was 3.4 where the highest pH was 6.7.

Presumptive identification of *Enterobacteriace species* showed the presence of *Salmonella spp.*, *Escherichia spp.*, *Proteus spp.*, *Klebsiella spp.* and *Hafni spp.* ranging from 3.3 to 9.9 percent of total samples. *Pseudomonas spp.* isolated from 3.3 % of samples (Table 2).

Discussion

Street vended foods are important source of nutrients to low income populations group in developing countries. This emphasizes the necessity of organizing this sector to improve its low hygienic and hazardous situations.

Many workers in workshops in Khartoum, Sudan depend on the high carbohydrate enriched food Um-Jinger to provide energy for their long working hours in a price they can afford. Um-Jinger is mainly prepared from millet (after grind), sugar, yogurt, lemon and salt. However, it was recognized from this study that some vendors changed the formula by omitting yogurt from the ingredients and replace it with citric acid to add the bitter taste.

Um-Jinger prepared and served in poor hygiene conditions; the study confirmed that the sanitary level in the sale places are deteriorated, leading to the occurrence of severe public health hazards (Hobbs and 1993). As observed in the study; women vendors lack good personal hygiene, which is vital in reducing the chance of contamination of foods. The study indicated that the sale zones are centered in crowded areas of industrial zones and crowded traffic stations. In spite of the economical benefits gained by women vendors in selling their food there, such places increases chances of contamination and disease transmission increased significantly. Intense traffic in the area increase dust formation which is one of major sources of enterotoxigenic *Bacillus cereus*. The APCs reflects the microbial content and sanitary conditions during preparation and storage. The soil bacteria *Bacillus spp* indicate clearly the effect of crowding and forming dust as these soil bacteria are widely distributed in nature (human, animals, soil, water and food). It is not surprising in such poor hygiene and handling situation to isolate *Staphylococcus spp* from the majority of samples

The utensils used for preparation and serving are made of low quality plastic and aluminum that are difficult to be clean. Washing of these utensils were not carried properly because they were washed in a single bucket with unchanged water. This method of washing utensils act as a source of contamination by pathogenic bacteria and viruses from person to person as the water became contaminated from the first wash turn and the water is getting dirtier after each washing turn. Women vendors belong to the most economically fragile community sector, they cannot afford high quality utensils.

implementing proper cleanliness procedures through food hygiene basics training has significant role in minimizing health hazards associated with this type of food as stated by Jay (2000) 'the Cleanliness has play basic role in the application of hygienic practices' [8]. However, without organizing street-vended food basic food hygiene training cannot be implemented.

The isolation of Enterobacteriaceae species and the high MPN prove clearly that such poor hygiene meals could be sources of typhoid, dysentery or cholera (Motarjemi et al. 1993).

Low pH can slow or stop multiplication of microorganisms (Jay et al. 2005). However, low pH does not reduce the high load of bacterial contaminants to a degree that make it save. The absence of a stable formula for preparing Um-Jinger could result in changing pH and unstable nutritional value.

Alteration of the classic formula, for example by omitting yoghurt and replace it with citric acid showed that street foods nutritional value could be reduced to meet the low price requirements. This also showed that the chances of food adulteration could increase significantly.

To minimize health risks associated with this type of food it is important to organize Um-Jinger vendors in stable stalls supplied with clean water facilities , cooling and sanitation

facilities in addition to provide vendors with basic food hygiene training.

ACKNOWLEDGMENTS

The authors are thankful to the Food Hygiene and Safety Department at Faculty of Public and Environmental Health, University of Khartoum for supporting this work.

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