

Safety of Two Sudanese Street Foods of Plant Protein Origin

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Abstract: The main objective of this research was to study the safety aspects of two Sudanese street foods, namely: Tamia (Falafil) and Dakwa (peanut butter) collected from different sources in Khartoum State. Samples for Tamia were obtained from Albait Alssory-Khartoum North, College of Agricultural Studies-Sudan University of Science and Technology and Omdurman market. Samples for Dakwa were obtained from Shambat Central Market and crusher machine. Microbial and chemical characteristics were evaluated. The total bacterial count (TBC) (cfu/g) in Tamia was 5.6×10^3 , 3.9×10^4 and 4.9×10^5 in samples of Albait Alssory, College and Omdurman market, respectively. Coliforms and moulds and yeasts in Tamia were not detected in Albait Alssory and College, while Omdurman market samples recorded 1.7×10^3 for coliforms and 5.8×10^2 for moulds and yeast. Pathogenic bacteria (*E. coli*, *Staph. aureus* and *Salmonella*) were not detected in all samples except *Staph. aureus* were detected in Omdurman market (3.9×10^2). TBC in Dakwa were 5.4×10^3 , 5.6×10^4 and 6.4×10^4 in crusher machine, Shambat market and Omdurman market, respectively. Coliforms were detected in all sources of Dakwa, while moulds and yeasts were detected only in Omdurman market. Albait Alssory was the only source of Dakwa free of pathogenic bacteria. Lead (Pb) in Tamia was 3.04 (ppb) in Albait Alssory and was not detected in the other two sources (College or Omdurman market). Aluminium (Al) and peroxide values were found in all sources of Tamia. Pb in Dakwa was 3.20 in Shambat market and was not detected in crusher machine and Omdurman market. Al in Dakwa was present in all sources while peroxide value was absent in the crusher machine.

Key words: Street foods • Dakwa • Tamia • Sudanese • Safety

INTRODUCTION

There are many types of foods all over Sudanese streets, which include different types of cooked foods such as meat, chicken, vegetables, bean (faba bean, medammes), lentils, 'Tamia', 'Dakwa' (peanut butter) and some other traditional foods beside tea and ice cream. These cooked meals are usually consumed within 1-4 hours after being prepared. Cooked bean (medammes) and lentils are usually consumed in breakfast after 14hrs of their preparation.

During the above mentioned different storage periods, prepared meals become subjected to different levels of microbiological, chemical and sensory changes. However, contamination by different types of microorganisms may be during the different steps of processing. Microbial contamination of foods could be caused from soil, air, used water, bad handling,

equipments and other sources. On the other hand, chemical contamination could be mainly from cooking vessels beside other sources of contamination.

Foods and food products may transmit certain food poisoning by microorganisms that can lead to either food borne infection or intoxication. Infection is caused by *Salmonella*, *Bacillus cereus*, pathogenic *Escherichia coli* and other pathogenic microbes. Intoxication occurs when toxins are released in food by microorganisms like *Staphylococcus aureus* and *Clostridium botulinum* [1]. However, street foods are frequently associated with diarrhoeal diseases due to improper handling and serving practices [2].

Hence the primary goal of food service programs was to protect consumers from any food contamination or, at least, to reduce the effect of any health hazard. Yet, it is difficult to prevent contamination by the different microorganisms which are found everywhere [3].

Therefore, this study was carried out to determine the degree of safety from microbial and chemical contamination of some of the commonly consumed Sudanese foods on the streets.

MATERIALS AND METHODS

Sample Collection: Two types of street foods, namely, Tamia (Falafil) and Dakwa (peanut butter) were collected during February and March, 2009 from different places in Khartoum State. Tamia was collected from Albait Alssory in Khartoum North, College of Agricultural Studies-Sudan University of Science and Technology and from Omdurman market. Peanut butter was directly collected from the crusher machine-Khartoum North, Omdurman market and Shambat central market-Khartoum North).

Microbiological Analyses: Ten grams of each sample were weighed aseptically and homogenized in 90ml of sterile diluent (0.1% peptone water to give 10^{-1} dilution). Aseptically 1ml from the dilution 10^{-1} was transferred to a tube contacting 9ml sterile diluent. This made dilution to 10^{-2} . In the same way preparation of serial dilutions was continued up to dilution of 10^{-6} . Serial dilutions were sterilized by autoclaving at 121°C for 15 minutes under pressure 151lb/in^2 . Total bacterial viable count (TBC) and total coliforms were carried out as described by Harrigan [4]. For detecting *E. coli* a fermentation tube containing *E. coli* broth medium was inoculated from every tube showing positive result in the presumptive test of coliforms. The tubes were incubated in water bath at 44.5°C for 24 hours and the presence of *E. coli* recorded. For further confirmation of *E. coli* test a plate of Eosin Methylene Blue agar (EMB) was aseptically inoculated by streaking from a tube of *E. coli* broth showing positive result. The plates were incubated at 37°C for 48 hours. Colonies with metallic green sheen indicated positive result for *E. coli*. For counting moulds and yeasts, from suitable dilution of every sample 0.1ml was aseptically transferred on to sterile solidified potato dextrose agar (PDA) containing 0.1g chloramphenicol per one liter of medium to inhibit bacterial growth. The sample was spread all over the plates using sterile bent glass rod. Plates were then incubated at 28°C for 48-72 hrs. Viable colonies were counted (cfu/g). For *Staphylococcus aureus*, an amount of 0.1ml from every dilution was transferred on to the surface of each sterile well dried Baird parker agar medium in plates and spread all over the plates using sterile bent glass rod. Then incubated at 37°C for 24-36 hours. Plates were examined for *Staphylococcus aureus* which appeared as black shiny convex colonies surround by a clear zone of 2-5mm in width. Twenty five

grams of sample were weighed aseptically and mixed well with 250ml sterile nutrient broth. This was incubated at 37°C for 24 hours. Then 10ml were drawn aseptically and added to 100 ml of selenite cystine broth. The broth was incubated at 37°C for 24 hours. Then with a loop full streaking was done on solidified bismuth sulphite agar in plates. The plates were then incubated at 37°C for 72 hours. Black metallic sheen colonies indicated the presence of *Salmonella italies*. A confirmatory test was carried out by taking a discrete black sheen colony and subculturing in triple sugar iron agar tubes. Production of a black colour at the bottom of the tube confirmed the presence of *Salmonella*.

Minerals Determination: Minerals were determined according to FAM [5] using atomic absorption spectrophotometer.

Peroxide Value (PV): The PV of the oil samples was determined according to the AOAC [6]. Calculation was done according to the following equation:

$$\text{PV of the oil} = \frac{(b-a) \times N \times 100}{S}$$

where,

b: Reading of blank (ml)

a: Reading of oil sample (ml)

S: Original weight of oil sample (gm)

Statistical Analysis: Statistical analysis was carried out using Statistical Analysis System (SAS) software Ver. 12. Analysis of variance was performed to examine the significant effect of parameters measured. Duncan Multiple Range Test was used to separate means [7].

RESULTS AND DISCUSSION

Microbiological: Total bacteria, coliforms and moulds and yeasts counts of Tamia are shown in Table 1. The total bacterial viable count (TBC) (cfu/g) of samples collected from Albait Alssory was 5.6×10^3 and in samples from the College of Agriculture was 3.9×10^4 and in samples from Omdurman market was 4.9×10^5 . Coliforms (cfu/g) and moulds and yeasts (cfu/g) were not detected in Albait Alssory and College samples, while Omdurman market samples recorded 1.7×10 and 5.8×10^2 , respectively. In Table 2 pathogenic bacteria were not detected in Albait Alssory and the College of Agriculture samples which indicated freedom from *E. coli*, *Salmonella spp* and *Staph aureus*. However, samples collected from Omdurman market were positive for *E. coli*, *Salmonella spp* and

Table 1: Total microbial count (cfu/g) in 'Tamia' from different sources

Source	Total bacterial viable count	Coliforms	Moulds and yeasts
Albait Alssory	$5.6 \times 10^3 \pm 0.04^a$	Not detected	Not detected
College of Agric. Studies	$3.9 \times 10^4 \pm 0.01^c$	Not detected	Not detected
Omdurman market	$4.9 \times 10^5 \pm 0.02^b$	$1.7 \times 10 \pm 2.01^a$	$5.8 \times 10^2 \pm 0.03$

Means _a bearing different superscript letters within a column are significantly different (P=0.05).

Table 2: Pathogenic bacteria in 'Tamia' from different sources

Source	<i>E. coli</i>	<i>Staph. aureus</i>	<i>Salmonella</i>
Albait Alssory	Not detected	Not detected	Not detected
College of Agric. Studies	Not detected	Not detected	Not detected
Omdurman market	+ve	$3.9 \times 10^2 \pm 0.02$	+ve

Table 3: Total microbial count (cfu/g) in 'Dakwa' from different sources

Source	Total bacterial viable count	Coliforms	Moulds and yeasts
Crusher-machine	$5.4 \times 10^3 \pm 0.03^b$	11.7 ± 0.09^c	Not detected
Shambat market	$5.6 \times 10^4 \pm 0.07^b$	22.3 ± 0.06^a	Not detected
Omdurman market	$6.4 \times 10^4 \pm 0.05^a$	15.3 ± 0.04^b	$4.5 \times 10^2 \pm 0.01$

Means \pm bearing different superscript letters within a column are significantly different (P=0.05).

Table 4: Pathogenic bacteria in 'Dakwa' from different sources

Source	<i>E. coli</i>	<i>Staph. aureus</i> (cfu/g)	<i>Salmonella</i>
Crusher machine	Not detected	Not detected	Not detected
Shambat market	+ve	$4.2 \times 10^2 \pm 0.01^a$	+ve
Omdurman market	Not detected	$3.9 \times 10^2 \pm 0.02^b$	+ve

Means \pm bearing different superscript letters within a column are significantly different (P=0.05).

Table 5: Peroxide value and toxic minerals in 'Tamia' from different sources

Source	Peroxide value (%)	Al (ppm)	Pb (ppb)
Albait Alssory	4	<0.30	3.04
College of Agric.Studies	3	6.16	Not detected
Omdurman market	4	2.75	Not detected

Table 6: Peroxide value and toxic minerals in 'Dakwa' from different sources

Source	Peroxide value (%)	Al (ppm)	Pb (ppb)
Shambat market	4	4.11	3.21
Crusher-machine	0	< 0.30	Not detected
Omdurman market	3	2.75	Not detected

Staph. aureus. The highest contamination by TBC and pathogenic bacteria were found in samples from Omdurman market and the lowest contamination was found in samples from Albait Alssory. This high contamination might be due to the in-proper washing, handling and packing of food and from workers hands. Splittstoesser [8] found that TBC in raw green beans was 28×10^6 and spore formers count was 10.7×10^4 cfu/g.

In Dakwa, TBC was 5.4×10^3 (cfu/g) in crusher machine samples and 5.6×10^4 in Shambat and 6.4×10^4 in Omdurman markets. Coliforms counts (cfu/g) were 11.7, 22.3 and 15.3 in crusher machine, Shambat and Omdurman markets,

respectively. Moulds and yeasts count was nil in crusher machine and Shambat market, while it was 4.5×10^2 in Omdurman market (Table 3). On the other hand, pathogenic bacteria in crusher machine samples was nil for *E. coli*, *Salmonella spp* and *Staph aureus*, whereas samples collected from Shambat market showed positive result for the three types of pathogenic bacteria. The presence of *E. coli* and other coliforms could be due to inadequate hand washing by food workers and absence of good manufacturing practices [9]. Samples collected from Omdurman market have no *E. coli*, but have 3.9×10^2 (cfu/g) for *Staph. aureus* and +ve *Salmonella* (Table 4).

The lowest number of total microbes besides the absence of pathogenic bacteria in the crusher machine samples may be attributed to the fact that these samples were still fresh and not exposed to contamination for a long time in common places. Roasted groundnut was found to contain *E. coli*, *S. aureus* and *Bacillus* [10]. Agnes *et al.* [11] reported that 35% of street foods were found unsuitable for consumption according to microbiological criteria with *Bacillus cereus* being the greater risk among pathogens.

Chemical: Tamia' samples collected from Albait Alssory were the only samples that showed presence of Pb (3.04 ppb) (Table 5). This could be attributed to combustion from vehicles, which usually contain Pb, as Albait Alssory is located on a main street.

Table 5 clearly shows that the highest concentration of Al (ppm) in Tamia was in samples collected from the College of Agriculture (6.16 ppm) and that might be from the chickpea crusher machine (made from Aluminum) in which the raw material for making Tamia is usually crushed. This contamination of Tamia by Al could also be from the Aluminum pan in which Tamia was fried. The lowest concentration of Al was found in samples collected from Albait Alssory (as stainless steel utensils are used). Table 5 also shows that peroxide values in Tamia were high in the samples collected from Omdurman market and Albait Alssory (4% each). This may be due to large quantities of Tamia produced through the day using the same oil i.e. no fresh oil is replaced. The lowest result was found in samples collected from the College of Agriculture (3 %).

It is clear from table 6 that the highest concentration of Pb (ppb) was found in Dakwa samples collected from Shambat market (3.21 ppb) whereas no Pb was detected in samples collected from the crusher machine and Omdurman market. Table 6 also shows that the level of Al (ppm) in Dakwa is the highest in samples collected from Shambat market (4.11 ppm) and the lowest level was found in samples collected from the crusher machine (< 0.30%). This could also be attributed to that; Dakwa from crusher machine is still fresh and not yet exposed to contaminants in the market.

Further, table 6 shows that, the highest PV was found in samples collected from Shambat market and this could be due to the way 'Dakwa' is sold under the sun (with no shelter). The lowest PV was found in samples collected from the crusher machine and that was because Dakwa was not subjected to the same conditions of direct sun as with the other samples.

Al has historically been considered to be relatively non-toxic in healthy individuals, who can tolerate an oral daily dose of as much as 7.2 g of Al [12]. However, high intake of Al by susceptible individuals including the elderly and low-birth-weight infants may lead to pathological changes [13].

Haidar [14] found that Pb concentration range (ppm) in cooked chickpeas and beans were 0.17-0.03 and 0.16-0.06, respectively. The range for Pb concentration in Falafel was found to be 0.25-0.04 ppm [14]. UNEP, FAO and WHO [15] reported that the natural levels of Pb concentrations in plants and vegetables range between 100 and 250 ppb.

In conclusion, from the above findings it is clear that street foods which are mishandled are good sources of pathogenic bacteria and carcinogenic chemicals. However, because of socio-economic importance of street foods it is a must for both authorities and street food sellers to collaborate in taking actions to prevent harms to public health from these foods.

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