

## Quality Evaluation of Two Sudanese Street Foods of Animal Origin

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**Abstract:** The aim of this study was to detect the safety of two foods (Shawerma and ice cream ) usually sold in streets of Khartoum State. They were collected from different sources (Albait Alssory-Khartoum North, College of Agricultural Studies - Sudan University of Science and Technology, Omdurman maket, Almazallt, Freeway Factory and household). Total Bacterial Count (TBC) (cfu/g) in Shawerma was found to be  $5.3 \times 10^3$ ,  $8.4 \times 10^3$  and  $5.3 \times 10^4$  in Albait Alssory, Collage and Omdurman market, respectively. Coliforms count (cfu/g) was found to be nil,  $1.7 \times 10$  and  $2.6 \times 10$  in Albait Alssory, College and Omdurman market, respectively. The samples of College were found to be highly contaminated by TBC and moulds and yeasts compared to other two sources. On the other hand Omdurman samples were found to be highly contaminated with coliforms. With regard to pathogenic bacteria they were highly contaminating Shawerma of Omdurman Market, while Shawerma of Albait Alssory was of the least contamination by the pathogenic bacteria. TBC of ice cream was  $5.9 \times 10^4$ ,  $3.6 \times 10^3$  and  $5.9 \times 10^4$  in factory, Almazallat and household, respectively. Moulds and yeasts were not detected in Almazallat and household ice cream, while they were  $4.3 \times 10^2$  in the factory. However, Almazallat and Factory ice cream were free of *E. coli*, *Salmonella* and *Staph.aureus*. Household was free of *E. coli* but with *Salmonella* and *Staph. aureus*. The Pb 1 (ppb) in Shawerma of Albait Alssory was 24.84 and 2.90 in College and not detected in Omdurman market. The Pb in ice cream was 5.10, 8.32 and 0.26 in Almazallat , factory and household, respectively. The Al (ppm) in Shawerma of Albait Alssory, College, and Omdurman market was 1.37, <0.30 and 1.75, respectively. The Al was 3.5, <0.30 and <0.30 in Almazallat, factory and household, respectively. The peroxide value (%) in Shawerma was not detected in Albait Alssory and College but 10.0 in Omdorman market samples, while it was 4.0 in ice cream samples. Interactions between authorities and consumers are needed to avoid harms possibility from street foods.

**Key words:** Ice- cream, quality, street foods, Shawerma, Sudanese

### INTRODUCTION

There are many types of foods in all over the streets of the Sudan, especially the towns. These foods include different types of cooked foods such as meat and meat products e. g. Shawerma, chicken, vegetable products, faba bean, lentils, Tamia (legume product), peanut butter, ice cream and other Sudanese traditional foods. Usually, the cooked meals are consumed within 1-4 h after being prepared. Cooked faba bean (medammes) and lentils are usually consumed in the breakfast after 14hrs of their preparation.

During the above mentioned different storage periods (at ambient temperature), the prepared meals become subjected to the microbiological, chemical and sensory changes with different levels. However, the contamination

by different types of micro-organisms may be during the different steps of processing. The microbial contamination of foods could be caused from soil, air, used water, bad handling, equipments and the most dangerous one from the human being. On the other hand chemical contamination could be mainly from cooking vessels beside the other sources of contamination.

Foods and food products may transmit certain food poisonings by microorganisms that can lead to either food borne infection or intoxication. The first type of poisoning (infection) is caused after the growth of e.g. *Salmonella*, *Bacillus cereus*, pathogenic *Escherichia coli* and the other pathogenic microbes. While the second type of infection of food poisoning (intoxication) occurs when toxins are released in food as the microorganisms multiply e.g. *Staphylococcus aureus* (Pingar and Cooke, 1985). 35% of

selected street foods were considered unsuitable for consumption according to the microbiological criteria (Agnes *et al.*, 2005). With the increasing pace of globalization and tourism, the safety of street food has become one of the major concerns of public health, and a focus for governments and scientists to raise public awareness. The primary goal of food service programs is to protect the consumers from any food contamination or at least to reduce the effect of any health hazard (Montney and Gould, 1988). Hence, this study was carried out to fulfill the following objectives:

- To determine the degree of safety in some of the Sudanese street foods
- To study the microbial load plus the pathogenic microorganisms in these foods
- To detect the presence of some harmful chemicals, particularly Pb, Al and peroxide value

## MATERIALS AND METHODS

**Sample collection:** Two types of street foods of animal origin were collected during February and March, 2009 from different places in Khartoum state (Shawerma from Albait Alssory, College of Agricultural Studies- Sudan University of Science and Technology and from Omdurman market. Ice cream from Almazallat, Freeway Factory and from household).

**Microbiological analyses:** Ten grams of each sample were weighed aseptically and homogenized in 90 ml of sterile diluent (0.1% peptone water to give  $10^{-1}$ ) dilution. Then by the same way the preparation of serial dilutions was continued up to  $10^{-6}$ . The serial dilutions were sterilized by autoclaving at 121°C for 15 min under pressure 151 b/in<sup>2</sup>.

Total bacterial viable count was carried out by using the pour plate count method as described by Harrigan (1998). Coliform bacterial count was carried out by using the Most Probable Number (MPN) technique (Harrigan, 1998). Fermentation tubes of EC broth medium were inoculated from every tube showing positive result in the presumptive test for detecting *E. coli*. The tubes were incubated in water bath at 44.5°C for 24 h. The presence of *E. coli* was recorded. For further confirmation of *E. coli* test, a plate of Eosin Methylene Blue agar (EMB) agar was aseptically inoculated by streaking from a tube of *E. coli* broth showing positive result. The plates were incubated at 37°C for 48 h. Colonies with metallic green sheen showed a positive result for *E. coli*. Moulds and yeasts were determined by surface plate method using

PDA with chloramphenicol as antibacterial and the plates were incubated at 28°C for 48 h.

Amount of 0.1 mL 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 for 24-36 h at 37°C and the plates were examined for *Staphylococcus aureus* which appeared as black shiny convex colonies and surround by a clear zone of 2-5 mm in width. Twenty five grams of sample were weighed aseptically and mixed well with 250 mL sterile nutrient broth. This was incubated at 37°C for 24 h. Then 10ml were drawn aseptically and added to 100 mL of selenite cystine broth. The broth was incubated at 37°C for 24 h. 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 h. Black metallic sheen colonies indicated the presence of *Salmonella*. A confirmatory test was carried out by taking a discrete black sheen colony and subculturing it 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 (2004) using atomic absorption spectrophotometer.

**Peroxide value (PV):** The PV of the oil samples was determined according to AOAC (1998).

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

b: Reading of blank (mL)

a: Reading of oil sample (mL)

S: Original weight of oil sample (g)

**Statistical analysis:** Statistical analyses were 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 the means according to Duncan (1955).

## RESULTS AND DISCUSSION

**Microbiological:** For shawerma as shown in Table 1 the total viable bacterial count (cfu/g) was found to be  $5.3 \times 10^3$ ,  $8.4 \times 10^3$  and  $5.1 \times 10^4$  in Albait Alssory, College of Agricultural Studies and Omdurman market, respectively. Coliforms counts (cfu/g) were negligible,

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

Source	Total bacterial viable count	Coliforms	Moulds and yeasts
Albait Alssory	$5.3 \times 10^3 \pm 0.06^b$	Negligible	Negligible
College of Agric. Studies	$8.4 \times 10^3 \pm 0.09^a$	$1.7 \times 10 \pm 0.12^b$	$3.1 \times 10^2 \pm 0.05^c$
Omdurman market	$5.1 \times 10^4 \pm 0.03^b$	$2.6 \times 10 \pm 1.05^a$	Negligible

Means±S.D. bearing different superscript letters within a column are significantly different ( $p \leq 0.05$ )

Table 2: Pathogenic bacteria in Shawerma from different sources

Source	<i>E. coli</i>	<i>Staph. aureus</i> (cfu/g)	<i>Salmonella</i>
Albait Alssory	-ve	ND	-ve
College of Agric. Studies	-ve	ND	-ve
Omdurman market	+ve	$4.3 \times 10^2 \pm 0.02$	+ve

ND: Not detected

$1.7 \times 10$  and  $2.6 \times 10$  in Albait Alssory, College and Omdurman market, respectively. Moulds and yeasts (cfu/g) were negligible in Albait Alssory and Omdurman market samples, whereas in the College samples were  $3.1 \times 10^2$ . The samples of College were found to be highly contaminated by total viable bacteria and moulds and yeasts compared to the other two sources. On the other hand Omdurman samples were found to be highly contaminated with coliforms. Cooked meat was found to contain total viable bacterial count of 4.6 cfu/g (Abdalla *et al.*, 2009).

The pathogenic bacteria in shawerma samples are shown in Table 2. The only source contaminated by pathogenic bacteria was Omdurman market. The high contamination in Omdurman market samples may be attributed to the improper washing, packing and handling and the area of production (dusty) through the preparation process and during exhibition. The most prevalent isolated bacteria from cooked meat were *Escherichia coli*, *Staphylococcus aureus* and *Bacillus sp.* (Abdalla *et al.*, 2009).

Shawerma in Lebanese market was contaminated with *Salmonella paratyphi* (77%) and *E. coli* (69%) and meat-based fast foods in Lebanon could be a public health hazard especially Shawerma as they may act as a potential vehicle for many antimicrobial resistant pathogenic organisms (Harakeh *et al.*, 2005). On the other hand coliforms in raw meat were found to be  $25 \times 10^6$  cells/100 g (Hall *et al.*, 1967). The high total bacterial viable count and coliforms reflected poor handling, storage and sanitation practice Chambers *et al.*, 1976). However, most of microorganisms in poultry and poultry products come from the raw chilled poultry meat itself and coliforms of raw poultry reached up to  $9.3 \times 10^6$  /100 g (Walker and

Table 3: Total microbial count (cfu/g) in ice cream from different sources

Source	Total bacterial viable count	Coliforms	Moulds and yeasts
Home made	$5.9 \times 10^4 \pm 0.01^a$	$0.0 \pm 0.0^b$	ND
Almazallat	$3.6 \times 10^3 \pm 0.02^b$	$0.0 \pm 0.0^b$	ND
Factory	$5.9 \times 10^4 \pm 0.01^a$	$3.0 \pm 0.00^a$	$4.3 \times 10^2 \pm 0.02$

Means±S.D. bearing different superscript letters within a column are significantly different ( $p \leq 0.05$ ); ND: Not detected

Ayres, 1956). According to Vazgecer and Oztan (2004) mesophilic aerobic bacterial counts in doona kebab were found to be in the range of  $1.0 \times 10^2 - 6.4 \times 10^5$  g<sup>-1</sup>. *B. cereus*, *Staphylococcus* and coliforms counts were less than  $1.0 \times 10^2$  g<sup>-1</sup> for the total of 48, 50 and 61%, respectively. *E. coli* was found in 31% of the samples ranged between  $2.0 \times 10$  and  $5.0 \times 10^2$  g<sup>-1</sup>. Although several samples gave colonies indicating the presence of coagulase-positive *Staphylococcus*, representative isolates were not identified as *S. aureus*. Sulphite reducing clostridia were detected in five samples (7%). *Salmonella* was not detected from 72 samples of chicken döner kebab. Albait Alssory, and Agricultural College samples were free from pathogenic bacteria (*Salmonella*, *Staphylococcus aureus* and *E. coli*). These findings almost are in agreement with that of Hall *et al.* (1967) who found that, a great number of fresh meat were free from *Salmonella*. Total bacterial count in cooked meat using microwaves (93°C) was  $2.0 \times 10^6$  cfu/100 g (Cremer and Chiple, 1980). y and  $2.5 \times 10^6$  cfu/100 g (Ocherman and Stec, 1980). ICMSF (1980) recommended that the acceptable standard of total bacterial count in cooked meat, chicken, vegetable and rice is  $1.0 \times 10^7$  cfu/100 g.

With regard to ice cream, as shown in Table 3, the total viable bacterial count (cfu/g) was  $5.9 \times 10^4$ ,  $3.6 \times 10^3$  and  $5.9 \times 10^4$  for the factory, Almazallat and home made ice cream, respectively. The factory and Almazallat ice creams were free of coliforms and moulds and yeasts, but the samples of the home were found to contain 3.0 and  $4.3 \times 10^2$  (cfu/g) for coliforms and moulds and yeasts, respectively. *E. coli*, *Salmonella* spp and *Staph. aureus* were not detected in factory ice cream and only *Salmonella* was detected in Almazallat samples while home ice cream showed presence of both *Staph. aureus* and *Salmonella* (Table 4). The highest contamination with total bacteria and pathogenic bacteria was found in the samples collected from the home made ice cream, and the lowest contamination was in the samples collected from the factory ice cream. The highest contamination in the home made ice cream samples may be due to the incorrect handling of ice cream and inadequate cleaning and sanitization of the ice cream containers. Ice cream is a

Table 4: Pathogenic bacteria in ice cream from different sources

Source	<i>E. coli</i>	<i>Staph. aureus</i> (cfu/g)	<i>Salmonella</i>
Home made	-ve	ND	-ve
Almazallat	-ve	ND	+ve
Factory	-ve	3.7×10 <sup>3</sup> ±0.02	+ve

ND: Not detected

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

Source	Peroxide value (%)	Al (ppm)	Pb (ppb)
Albait Alssory	ND	1.37	24.84
College of Agric.	ND	<0.30	2.90
Omdurman market	10	1.75	ND

ND: Not detected

Table 6: Peroxide value and toxic minerals in ice cream from different sources

Source	Peroxide value (%)	Al (ppm)	Pb (ppb)
Factory	4	<0.30	5.08
Almazallat	4	<0.30	8.31
Home made	4	3.5	ND

ND: Not detected

nutritious food for man and also an excellent medium for the growth of many microorganisms including some which may be pathogenic to man. Possible sources of these micro organisms in ice cream have been reported to include raw materials used for the composition of ice cream mix such as separated milk and milk powder, cream, flavouring and colouring substances and sterilizers (Barth, 1986). Total viable bacterial count in ice cream ranged 1.8×10<sup>3</sup> - 2.0×10<sup>4</sup> (cfu/g) and also pathogenic bacteria (*Staphylococcus* and *Klebsiella*) and *Aspergillus* Spp. were detected (Ojokoh, 2006). However, some pathogenic bacteria e. g. *Staphylococcus aureus*, *E. coli*, *Enterococcus faecalis* and *Salmonella* were found to survive by the freezing process in ice cream samples during the storage periods of two months (Sinan *et al.*, 2004). There are couple of possible hazards (*Bacillus cereus* and *Salmonella* spp.), which could be associated with ice cream (Carlsson, 2006). Again, there is a risk for getting the aflatoxins into the ice cream (Carlsson, 2006). Also *Listeria monocytogenes* was recognized in ice cream (Lake *et al.*, 2003). In Pakistan retail stores ice cream total viable bacterial count was found to range 3.28×10<sup>3</sup> - 4.25×10<sup>4</sup> (cfu/mL) (Elahi *et al.*, 2004).

**Chemical:** In Table 5 the average concentration (ppb) of Pb in Showerma from Albait Alssory was the highest (24.84). This may be due to the heavy traffic in the street or from the meat (the raw material). However, the Pb was not detected in the samples collected from Omdurman. According to UNEP, FAO and WHO (1988) the natural levels of lead concentration in plants and vegetables,

range between 100 and 250 (ppb). The known concentration of lead in meat ranges 0.0-0.37 (INCD, 2004). In showerma Pb of 0.28 (ppb) was detected (Haidar, 2007). Al (ppm) was found high in Omdurman (1.75) and very low in the College samples (<0.30). The high concentration of Al in Omdurman samples may be due to the container in which it was processed. Again Table 5 shows the peroxide value (PV) in Showerma. The highest concentration was in the samples collected from Omdurman market (10.0) and not detected in the other two sources, and that may be due to the fact that they are not exposed to the sun rays. Frying with oils once will not kill us, and so [this practice] seems harmless. Our body copes with toxic substances. But over 10, 20, or 30 years, our cells accumulate altered and toxic products for which they have not evolved efficient detoxifying mechanisms. The altered and toxic substances interfere with our body's life chemistry, our 'bio-chemistry'. Cells then degenerate, and these degenerative processes manifest as degenerative diseases (Udo, 1993).

As shown in Table 6 the average concentration of Pb (ppb) in ice cream was high in the samples collected from Almazallat. This may be due to its location on the main road crowded with vehicles. There are many potential sources of exposure to lead, as it spread in all parts of the ecosystem. As well as to make it normal, lead is used in the manufacture of electrical cables and water pipes in the industry, batteries and ammunition and the types of glass and crystal in the printing, but the addition of lead is considered as an addendum to one of the sources of benzene exposure is the major human (Haidar, 2007). This mineral was not detected in the home made ice cream.

The levels of Al (ppm) in ice cream showed that the highest concentration was in the samples collected from Almazallat and that might be due to the container. High amounts of Al migrated into acidic products such as mashed tomatoes during normal processing in normal, non-coated Al pans. After 60 min cooking an Al content of 10-15 mg/kg was measured in tomato sauce. Comparatively the other two sources showed a very low concentration of Al (<0.3). The values of Pb (0.28 mg/L) and Al (0.76 mg/L) were higher than the (WHO) recommended limits (Wattoo *et al.*, 2005). Also Table 6 shows the peroxide value in ice cream which is the same (4.0%) in the three sources.

## CONCLUSION

This study revealed that some of street foods were contaminated with pathogenic bacteria and carcinogenic metals. On other hand the practice of consuming street

foods and prohibition vendors from selling them is rather difficult. Hence this trend demands actions by the authorities and consumers to improve safety of street foods.

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