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Hygienic and Sanitary Assessment of Street Food Vendors in Selected Towns of Enugu North District of Nigeria

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Abstract: Sixty three vending sites were randomly selected for this study. The microbiological assessment of dish washing waters, drinking water served in jugs and kettles, piece of money handled while serving food and utensils surface showed the presence of large number of food related bacteria such as coliforms and *Staphylococcus aureus*. Results showed that 100% of the first dish washing water (W_1) had unacceptable levels of contamination. While the second dish washing water (W_2) had 40% each of impure and very impure waters. 52% of the last dish washing waters (W_3) had acceptable level of purity and 24% each were impure and very impure. Open shade and road side vendors served consumers impure water (10^3<Tcc<10^4) while those in stalls and wheel barrow served acceptable water (Tcc<10^3). Only the road side vendors served consumers with water contaminated by *Salmonella spp*. (count/ml = <10). Analysis of utensils surface reveals that 100% of the knives were appreciably contaminated (Tcc>10^3). *Staphylococcus aureus* (Tcc<10^3) were detected in the entire utensil used. There was a prevalent presence of coliforms and *S.aureus* in the pieces of money handled by vendors. The average coliforms and thermotolerant coliforms number were $2.4x10^3$ and $8.6x10^1$ cfu/mo respectively. The average count per money for *S. aureus* was $2.5x10^2$.

Key words: Hygienic · Street food · Vendors · Coliforms · *Staphylocuccus aureus* · Dish washing water

INTRODUCTION

Food and water can carry, or be sources of harmful micro organisms, chemical compounds and particulate matter. Street food is defined as food prepared on the streets and ready-to-eat, or prepared at home and consumed on the streets without further preparation [1].

Street foods are well appreciated by consumers, because of their availability at right time, low price and taste [2, 3]. However, street foods are frequently associated with diarrheal diseases due to their handlings [4, 5]. Food poisoning occurs when contaminated food or water is ingested.

In safeguarding public food and water supplies, health authorities and water engineers rely on information obtained from the result of frequent bacteriological tests. With increased cases of food allergies and food related diseases, the public health workers are challenged and hence they focus on the knowledge and practices of food handlers. It is known that the hygienic and sanitary knowledge of food handlers is deficient, regardless of the type of establishment where they work [6-9]. Thus, it is essential to improve the practices involved in the preparation and handling of food in a search to prevent the occurrence of food allergies. This directly involves qualification of the handlers responsible for preparing the meals, but as yet little is known about their knowledge and practices regarding food allergies. Street food trade is popular in Burkina Faso but only little information is available on their related diseases [10]. In Owerri, Nigeria, 66.67% of the street food vendors are women while 33.33% were males and age group between 31-40 years. 23.81% of the vendors prepared food in unhygienic conditions [11]. This work is aimed at investigating the hygienic parameters and contamination levels of street food sold by vendors in Enugu north district of Nigeria.

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MATERIALS AND METHODS

Study Site and Sample Collection: Investigations were done in the year 2012. The study was conducted in the major streets, markets and schools in three districts of Nsukka: Ibagwa-Aka, Obollo-Afor and Nsukka metropolis. Sixty three (63) randomly selected street food vending sites were recruited into the study after the owners of the vending sites had been assured of total confidentiality. Samples were collected during the visit to the sites. Information regarding personal hygiene, knowledge acquisition, method of washing utensils and source of water were ascertained by use of structured interview and through observations.

Dish Washing Waters: Three types of dish washing water used for washing of utensils were collected from sixty-three (63) street food vendors. The first utensil washing water (W_1) is soapy and dirty and used for pre-washing. The second (W_2) and the third (W_3) are used according to the vendors for utensils rinsing. 100 ml each of the dish washing waters were taken in sterile bottle for microbiological analysis within two hours of collection.

Water Served for Drinking in Jugs and Kettles: Specimens were collected from (63) sixty-three vending sites with sterilized bottle of 230 ml capacity, with glass stoppers having an overhanging rim; the stopper and the neck of the bottle being covered over by two layers of craft paper. The opening and closing of the bottle in this process were meticulously done to avoid any bacterial contamination from an outside source. The water samples were used for bacteriological analysis within two hours of collection.

Pieces of Money Collection: One hundred and twenty pieces of naira notes of different denominations were collected from thirty vendors during food vending operations and placed in separate sterile containers for laboratory analysis.

Utensils Surface Sampling Procedure: Thirty (30) spoons, thirty dish plates of 25 cm diameter made of plastics, stainless steel or aluminum and twenty five (25) knives washed by vendors were randomly selected for surface sampling procedure. Surface was rinsed each with 100 ml of sterile buffered peptone water. The rinsing water of each utensil was collected in a sterile bottle. Samples were kept at 4°C on ice and transported to the laboratory for microbiological test the same day.

Bacteria Identification and Counting: All the samples collected were prepared in the laboratory for microbiological tests. Ten (10) ml each of dish washing water, water served from jugs and kettle for drinking and utensil surface rinsing water were diluted 1:10 with 90 ml of sterile buffered peptone water [12].

Naira notes were placed in 100 ml of sterile peptone water and shaken vigorously to remove bacteria which might have adhered. Again, ten fold serial dilutions were made with sterile peptone water. 0.1 ml of each dilution was spread over the specific growth media prepared and set in plates. Isolation and counting of bacteria were done in triplicates and according to standard microbiological methods [13].

Mesophilic aerobic bacteria (MAB) were isolated on plate count agar (Fluka Biochemica 70152). The specific bacteria examined were coliforms which are indicative of faecal contamination. For detection of faecal coliforms, the production of acid and gas were taken as positive indication. The enterobacteriaceae were isolated on violet red bile lactose agar medium (Fluka Biochemica 70189) incubated aerobically for 24 hr at 44°C. *Staphylococci* were counted on Chapman Mannited Medium (Difco) and incubated aerobically for 24 hr at 37°C. The detection of bacteria belonging to *Salmonella* and *Shigella* genera were done on the SS medium (Fluka biochemical 85640). Inoculated media were incubated aerobically at appropriate conditions according to the method described by [14]. After incubations, suspected colonies were identified based on their morphological, physiological and biochemical feature using Bram staining, microscopy and standard biochemical methods.

Data Analysis: The number of colony forming unit per milliliter of drinking water (cfu/Dw), per utensil (cfu/ut), per piece of money (cfu/mo) and per dish washing water (cfu/Dww) were calculated by standard methods. The data was analysed using Statistical Package for Social Sciences (SPSS) version 11. Statistical significance of any observed difference was set at $P \leq 0.05$.

RESULTS

Bacteria counts on dish washing waters, drinking water served in jugs and kettles, Naira notes and utensil surface showed presence of large number of food related pathogens such as coliforms, *Staphylococcus aureus* and *Salmonella* species. The results of the microbiological assessment of dish washing waters used by vendors are shown on Table 1.

Table 1: Microbiological examination, bacterial count and isolation in dish washing water (cfu/ml)

Vending site	Dish water	MAB	Coliforms	*S.aureus*	*Sal.spp*
Stalls N=23	W_1	1.2×10^6	2.3×10^5	0.7×10^4	<10
n=10 (43.48%)	W_2	3.1×10^5	4.7×10^4	1.4×10^3	ND
m=13 (56.52%)	W_3	4.3×10^4	2.3×10^2	1.4×10^1	ND
Open shade	W_1	4.0×10^7	4.3×10^5	2.6×10^4	<10
N=20; n=10 (50%)	W_2	3.2×10^6	3.4×10^4	2.0×10^3	ND
m=10 (50%)	W_3	2.1×10^5	5.2×10^2	1.6×10^2	ND
Road side and	W_1	4.2×10^8	5.6×10^4	2.1×10^4	<10
Wheel barrow	W_2	3.8×10^7	4.1×10^3	1.3×10^3	ND
N=20; n = 56.6 (25%)	W_3	2.1×10^5	3.3×10^2	2.6×10^2	ND
m=15 (75%)					
Butcher's Knives					
N=10; m=8 (80%)	W_1	4.2×10^7	4.2×10^4	0.6×10^4	1.6×10^1
n=2 (20%)	W_2	2.1×10^5	2.1×10^3	1.1×10^3	1.1×10^1
Average	W_1	12.6×10^7	1.9×10^5	1.5×10^4	1.2×10^1
	W_2	10.4×10^6	2.3×10^4	1.5×10^3	0.3×10^1
	W_3	1.5×10^5	3.2×10^2	1.4×10^2	ND

N = number of vendors, n = numbers of vendors using 2 dish washing waters, m = numbers of vendors using 3 dish washing water W_1, W_2 and W_3 = 1st, 2nd and 3rd dishwashing waters, MAB = mesophilic aerobic bacteria, in brackets, = % of vendors using 2 or 3 dishwashing waters, cfu/ml = coliform forming unit per milliliter. N_T; n_T; m_T = totals,ND = not detected.

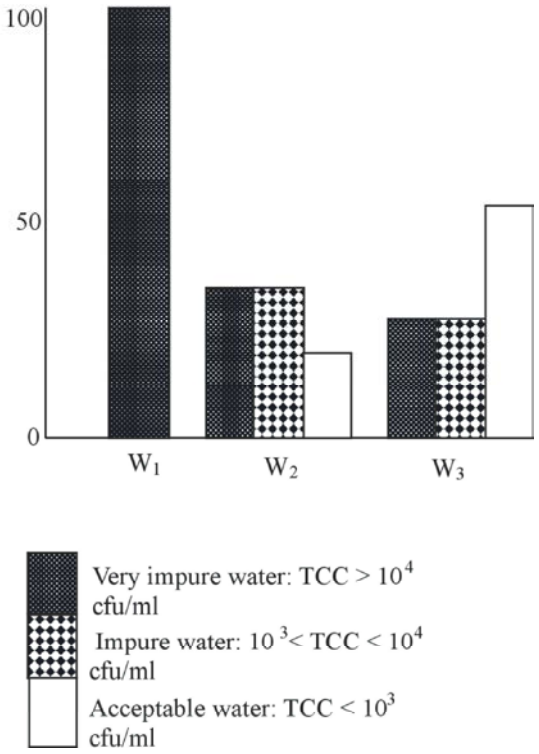

Fig 1: Percentage of dish washing waters according to their total coliforms. Tcc = Total coliform count, W_1, W_2, W_3 – 1st, 2nd and 3rd dish washing water.

Approximately, forty-three percent (42.86%) of the vendors use the three types of dish washing waters (W_1, W_2 and W_3). The others (57.14%) used two types of dish washing water (W_1 and W_2).

The mesophilic aerobic bacteria count in the first dish washing waters (W_1) was 12.6×10^7 cfu/ml and total coliforms count was 1.9×10^5 cfu/ml. Very few bacteria belonging to *Salmonella* species were identified in W_1 and W_2 especially in the butcher's knives, while the average coliforms count was 2.3×10^4 and 3.2×10^2 respectively for dish rinsing water W_2 and W_3 respectively.

The waters for washing and rinsing the utensils were rarely changed and thus observed to be dirty and high in bacteria quantity due to the non-renewal of dish washing waters.

Figure 1 shows the classification of dish washing waters according to their total coliform load. The first dish washing water (W_1) had unacceptable levels of contamination and was classified as very impure. The second dish washing water (W_2) had equal percentages (40%) of impure and very impure qualities of water and only 20% of acceptable water. The last dish rinsing water (W_3) had acceptable quality and 24% each of impure and very impure waters.

The result of the level of coliform and other bacterial contamination of drinking water served in jugs and kettles by vendors revealed that open shade and road side vendors serve consumers impure water (10^3<Tcc <10^4) while those in stalls and those that use wheel barrow serve acceptable water (Tcc <10^3) (Table 2). Only the road side vendors serve consumers with water contaminated by *Salmonella spp.* (count/ml = <10).

Table 2: Hygienic assessment of water served in jugs and kettles for drinking

Water served for drinking in jugs and kettles	MAB	Coliforms	*S.aureus*	*Sal.spp*
Stalls (n=30)	$1.2x10^2$	$1.2 x10^1$	$1.6 x10^1$	ND
Open shade (n=25)	$1.8 x10^3$	$2.3 x10^3$	$2.1 x10^2$	ND
Road side (n=15)	$2.2 x10^4$	$2.8 x10^3$	$2.8 x10^2$	<10
Wheel barrow (n=10)	$1.1 x10^2$	$1.4 x10^1$	$1.7 x10^1$	ND

n = number of samples, MAB= mesophilic aerobic bacteria cfu/ml = coliform forming unit per mililitre,ND = not detected.

Table 3: Bacterial isolation and count (cfu/ut) on the surface of utensils used for serving food

Utensils	MAB	TCC	TMC	*S.aureus*	*Sal.spp*
Plates (n=23)	$4.4 x10^4$	$2.9 x10^3$	$1.2 x10^1$	$2.2 x10^2$	ND
Spoons (n=20)	$2.9 x10^2$	$2.4 x10^2$	$1.4 x10^1$	$3.1 x10^2$	ND
Knives (n=20)	$6.7 x10^5$	$4.8 x10^4$	$2.1 x10^2$	$2.8 x10^2$	$1.6 x10^1$

cfu/ut = colifroms forming unit per untensil, MBA=mesophilic aerobic bacteria, n = number of samples, Tcc = total coliform count, Tmc = Thermotolerant coliforms, ND = not detected.

Table 4: Level of bacteria in Naira notes handled by vendors while serving food (cfu/mo)

Denomination of money	MAB	TCC	TMC	S.aureus	Sal.spp
Ten naira note (n=15)	$2.8 x10^2$	$1.3 x10^2$	$1.2 x10^2$	$2.7 x10^1$	ND
Twenty naira note (n=15)	$6.2 x10^2$	$1.5 x10^2$	$1.0 x10^2$	$2.9 x10^1$	ND
Fifty naira note (n=15)	$2.8 x10^2$	$1.2 x10^2$	ND	$3.2 x10^2$	ND
Hundred naira note (n=25)	$3.9 x10^2$	$2.6 x10^2$	ND	$3.3 x10^2$	ND
Two hundred note (n=25)	$6.4 x10^3$	$7.4 x10^3$	$1.2 x10^2$	$3.6 x10^2$	ND
Five hundred note (n=25)	$5.2 x10^3$	$6.6 x10^3$	$1.8 x10^2$	$4.1 x10^2$	ND
Average (n=120)	$2.9 x10^3$	$2.4 x10^3$	$8.6 x10^1$	$2.5 x10^2$	-

MAB = mesophilic aerobic bacteria, n = number of samples, cfu/mo = colony forming unit per money. Tcc = Total coliform count, Tmc = Thermotolerant coliforms, ND = not detected.

The microbiological analysis of utensil surface reveals that 100% of the knives were appreciably contaminated (Tcc > 10^3). *Staphylococcus aureus* (Tcc <10^3) were detected in all the utensils used (Table 3). Many authors have observed that bacteria from dirty dish washing waters and other sources can adhere to utensil surface and constitute a risk for contamination during food vending [15, 16]. During preparation and vending, food items like raw meat e.g., 'suya' (roasted pieces of meat attached to a stick) and salad raw materials were cut using the same knife without in-between washing. The knives sometimes were not washed at all and often were invaded by flies. Hence, this explains why knives were well contaminated as shown by the result of the present study.

Naira notes handled by vendors while serving food carry various bacteria as shown on table 4. Money handling while serving food constitutes a risk factor for street food contamination [12]. Several authors have reported the microbiological status of money handled by vendors to be associated with micro organisms under temperate climate conditions [17]. In our present study, there was a prevalent presence of coliforms and *S.aureus*. The average coliform and thermotolerant coliform numbers were $2.4 x10^3$ and $8.6x x10^1$ cfu/mo respectively. The average coliform counted for *S.auerus* was $2.5 x10^2$. There was no evidence of *Salmonella* species. It was observed generally that, during vending operations, the same hand used in serving food is also used for handling money [1, 10]. Pieces of money are in continuous circulation, passing in all environments that constitute a reservoir of various bacteria some of which can survive eleven days on an inert surface.

CONCLUSION

Bacterial contamination can occur at any stage in food handling. These bacteria can survive and multiply if maintained for prolonged periods at ambient temperature. Our results showed variable levels of contamination that occur during preparation and serving of food by street food vendors. This research advocates the need for good manufacturing practices (GMP) and Good Hygiene Practice (GHP) to reduce street food contamination. The hygienic state of many food handlers themselves could be sources of pathogens and they contribute to the hazardous condition of the food through unsafe handling and preparation practices.

Basic training in food and personal hygienic and environmental management is recommended to ensure that food vendors follow the required rules for proper hygiene and sanitation. The participation of government agencies is important in establishment of code of practice and development of educational campaigns which is necessary for the food industry.

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