

MICROORGANISMS ASSOCIATED WITH THE PALMS OF FAST-FOOD HANDLERS IN ABEOKUTA, NIGERIA

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ABSTRACT

The palms of 87 food vendors in Abeokuta metropolis were sampled for the presence and types of microorganisms. The food handlers were grouped into six categories based on the type of vending sites: hawkers (15), roadside (13), open air (15), closed / roofed (21), restaurants (12) and hotels vendors (11). Only 43.7% of the 87 vendors sampled had undergone the annual medical check up while 56.3% had never done the check up. None of the hawkers sampled had ever done the medical check up while all the hotel food handlers had the health certificate indicating that they have done the routine medical check up. Bacteria isolated from the hands of the food handlers included *Staphylococcus aureus*, *S. epidermidis*, *Alcaligenes spp.*, *Bacillus subtilis*, *Listeria spp.*, *Enterobacter sp.*, *Escherichia coli*, *Klebsiella aerogenes*, *Proteus vulgaris* and *Vibrio cholerae*. The fungi were *Rhizopus sp.*, *Aspergillus niger* and *Sachharomyces cerevisiae*. This work suggests that food handlers were possible sources of microorganisms implicated in food poisoning and food spoilage. Proper policing of vendors to ensure that they undergo the annual physical and medical examinations and proper education of food handlers on personal hygiene is recommended.

Key words: Palm, food vendors, microorganisms, vending sites, hawkers.

INTRODUCTION

Food handlers also known as food vendors are vital components in the interaction between the cooking environment and the food which is being prepared or served. WHO (1989) defined food handlers as those who, in the course of their normal routine work, handle food or items that may come into contact with food, such as eating and drinking utensils not meant for their personal use. During food handling and preparation, microorganisms on raw foods can be transferred to the hands of a food worker and subsequently to other surfaces (such as water faucet handles) contacted by contaminated hands. The hand is

also a potentially critical point for cross contamination for ill and asymptomatic food workers who may shed high levels of pathogens in their faeces (Rocourt and Cossart, 1997; Fendler *et al.*, 1998; Rose and Slifko, 1999).

Several reports have suggested that infected food handlers may play important role in food contamination and food-borne disease outbreaks (Rose and Slifko, 1999; Dawson and Canet, 1991). Purchasing ready-to-eat foods and ingredients from food handlers poses a considerable risk to public health, especially due to the observed poor hygienic practices of some food handlers (Bryan *et al.*,

1988; Edema and Omemu, 2004). Lack of basic facilities like water and toilet also affect the safety of ready-to-eat foods handled by food handlers. Where food vendors lack water, they seldom wash their hands even when they visit the toilet or handle money. Most vendors are known to wash their hands only when the hands are visibly dirty. These practices tend to subject foods and ingredients to repeated contamination. Failure to perform appropriate hand hygiene has been recognized as a significant contributor to outbreaks of food borne diseases (Bryan *et al.*, 1988). It has also been established that lack of adequate hand washing by food handlers who prepare, process and handle food in the retail food system can transmit pathogens especially fecal pathogens to food products after a food worker uses the toilet (Doebbeling *et al.*, 1988; Borgatta *et al.*, 1989). When consumed in food, these pathogens can cause illness and disease (FDA, 1997).

There are several formal and informal food vending outlets within Abeokuta metropolis in Ogun state. A state-issued memorandum dedicated to controlling street food vending in Ogun state requires the food handlers to obtain health certificates issued by the hospitals authorized by the State Ministry of Health (SMH) after a complete physical and medical exam. The vendors are to keep the health certificate and present it on demand to health officers. The health certificate is expected to be renewed annually (SMH, 2005, personal communication).

This study was undertaken to assess the response of food handlers to the recommended annual medical examination; and also to determine the presence and types of microorganisms on the palms of food handlers. The information gathered from this

study could be used the state in development of strategic plans towards controlling food handlers in both the formal and informal set up.

MATERIALS AND METHODS

Sampling method

Eighty-seven food handlers from formally registered food services centers (restaurants and hotels) and informal establishments (streets) within Abeokuta metropolis were used for this study. Based on the type of vending sites, the food handlers within Abeokuta metropolis were classified into 6 categories: hawkers, roadside, open air, roofed/closed canteen, restaurants and hotels. One health officer from local government office of each of the local government area sample followed the researcher on each sampling day. The health officer asked the food handlers for the health certificate before sampling was done.

Sample collection

Eighty-seven (87) palm swabs samples were collected from each the food handlers. Three independent replicate surveys of each vendor were conducted. The palm of each vendor was swabbed using a sterile cotton swab moistened in sterile Quarter Strength Ringers Solution (Oxoid, Basingstoke, UK). All swab samples were transported to the laboratory on ice and analyzed the same day. The vendors were also asked to present their routine medical health certificate before sampling.

Sample analysis

The swab samples were shaken in 10ml Quarter Strength Ringer's Solution for 30 seconds to resuscitate metabolically injured bacteria, followed by serial dilutions. The spread plate technique was used to prepare duplicate plates for the determination of to-

tal aerobic plate counts (APC), Enterobacteriaceae counts (EC), *Staphylococcus aureus* and *Bacillus cereus* counts. Aerobic plate counts (APC) was made on plate count agar (Oxoid CM463) at 35°C for 72h. Counts of Enterobacteriaceae, *Staphylococcus aureus*, and *Bacillus cereus* were made using Violet Red Bile Lactose agar (Oxoid CM107), Baird-Parker agar (Oxoid CM275) and *B. cereus* selective agar (Oxoid CM617) respectively. After appropriate incubation, dilutions with 30–300 colonies were selected and counted. Predominant colonies were picked and purified on Nutrient Agar plates. The number of colony-forming units per gram (cfu/g) of food was calculated by multiplying the number of bacteria by the dilution.

Isolation and identification of Enterobacteriaceae

For the isolation and identification of Enterobacteriaceae, the buffered peptone water was decanted and centrifuged at 11 000 rpm for 30 minutes in a refrigerated centrifuge. The deposit was streaked on Salmonella/Shigella agar (CM99), xylose-lysine deoxycholate agar (Oxoid CM469) and MacConkey agar (Oxoid CM7) for the detection of *Salmonella*, *Shigella*, *E. coli*, and other Enterobacteriaceae. All incubations were at 37°C under aerobic conditions. Suspected colonies were identified using standard biochemical methods.

Data analysis

The data were analyzed using SPSS version 10.0. The participants were the unit of analysis. Microbial counts were expressed as number of colony forming units (cfu) per hand. The values obtained for cfu/hand were transformed into log₁₀ values.

RESULTS

Food handlers from formally registered

food services centers (restaurants and hotels) and informal establishments (streets) within Abeokuta metropolis were used for this study. Based on the type of vending site, the vendors were grouped into six categories: hawkers, roadside, open air, roofed/closed canteen, restaurants and hotels.

The categories and number of vendors sampled in each category are presented in Table 1.

Twenty one (24.14%) of the food handlers sampled operated in roofed/closed canteen while 15 (17.24%) operated as hawkers (Table 1).

With the exception of the hawkers who are mobile, all the other food handlers are stationary. The hawkers prepared their foods at home and sell by moving from place to place. The road side food handlers and the open air vendors are similar except that the former operated by the road side while the latter operated at different places like schools, mechanic villages, hospitals and motor parks. Some of them prepare the food from home while others prepare the food at the open air vending site. Food handlers in closed canteens operated in closed wooden structures with roofs. They usually prepare the food and sell at the vending site. They have chairs and tables for customers who want to eat in. In hotels, apart from meals, lodging facilities are usually available.

Table 1 also shows the percentages of food handlers with or without health certificate. All (100%) of the food handlers from the hotels had their health certificate which showed that they have undergone the routine medical check-up for the year. None of the hawkers studied had ever done the routine medical checkup. Two (15.4%) out of

the 13 road side food handlers had the health certificate while 10 (47.6%) of the 21 roofed/closed canteen handlers had the certificate. On the whole, out of the 87 food handlers sampled, only 38 (43.7%) had the health certificate while 49 (56.3%) had never done the annual routine medical check hence they could not present the certificate.

Table 2 presents the level of microbial contamination on the palms of food handlers at the time of sampling. The mean total aerobic plate counts ranged from 1.4 ± 0.1 log cfu/g on the hands of food handlers operating in hotels to 7.2 ± 0.7 log cfu/g in hawkers.

There were no significance difference in the mean aerobic plate counts between food handlers in roofed/closed canteen and the hawkers. However, mean aerobic counts obtained for food handlers in hotels was

significantly ($p < 0.05$) lower than that of the other food handlers. Enterobacteriaceae counts ranged from 2.6 ± 1.2 log cfu/g (hotels) to 5.0 ± 1.1 log cfu/g (open air) while *S. aureus* counts ranged from 1.3 ± 0.4 log cfu/g (hotels) to 6.1 ± 1.1 log cfu/g (roadside). Generally, the mean microbial counts of food handlers operating in hotels was significantly ($p < 0.05$) lower than that of the other category of food handlers sampled.

Table 3 shows the microbial profile of the palms of the different category of food handlers sampled. The bacteria isolated from the palm of the food handlers include *Staphylococcus aureus*, *S. epidermidis*, *Vibrio* sp. *Alcaligenes* spp. *Flavobacterium* spp. *Shigella sonnei*, *Pseudomonas fluorescens*, *Proteus vulgaris*, *Serratia marcescens*, *Lactobacillus acidophilus*, *Enterobacter* spp, *Escherichia coli* and *Klebsiella aerogenes*. The fungi isolated were mainly *Rhizopus* sp, *Aspergillus niger* and *Saccharomyces* spp.

Table 1: Numbers and percentages of food handlers with and without medical certificate

Category of Food handlers	n	Vendors with health certificate	Vendors without certificate
Hawkers	15	0 (0)*	15 (100.0)*
Roadside	13	2 (15.4)	11 (84.6)
Open air	15	7 (46.7)	8 (53.3)
Roofed/closed canteen	21	10 (47.6)	11 (52.4)
Restaurants	12	8 (66.7)	4 (33.3)
Hotels	11	11 (100)	0 (0)
Total	87	38 (43.7)	49(56.3)

n- number sampled

*Values in parenthesis represent percentage of occurrence

Table 2: Mean (log cfu/g) level of microbial contamination on the palm of food handlers

Category of food handlers	n	Total counts log cfu + SD*	Enterobacteriaceae log cfu + SD *	S. aureus log cfu + SD*	Bacillus sp log cfu + SD *
Hawkers	15	7.2 + 0.7	4.5 + 1.2	5.2 + 1.2	3.4 + 0.1
Roadside	13	6.3 + 1.6	4.2 + 1.7	6.1 + 1.1	3.6 + 0.05
Open air	15	6.8 + 0.6	5.0 + 1.1	4.5 + 1.2	3.2 + 0.02
Roofed/ closed can- teen	21	7.0 + 0.7	4.7 + 1.2	4.7 + 1.3	1.6 + 0.9
Restaurants	12	2.2 + 0.05	2.7 + 0.09	2.7 + 0.2	0.3 + 0.01
Hotels	11	1.4 + 0.1	2.6 + 1.2	1.3 + 0.4	<1.0

n- number sampled

* mean of triplicate readings \pm standard deviation**Table 3: Microorganisms isolated from the palms of food handlers in Abeokuta**

Category of food vendor	Bacteria	Mold and yeasts
Hawkers	<i>Staphylococcus aureus</i> , <i>S. epidermidis</i> , <i>Vibrio sp.</i> <i>Klebsiella aerogenes</i> , <i>Alcaligenes spp.</i> and <i>Proteus vulgaris</i>	<i>Saccharomyces sp.</i>
Road side	<i>Staphylococcus aureus</i> , <i>S. epidermidis</i> , <i>Vibrio sp.</i> <i>Klebsiella aerogenes</i> , <i>Alcaligenes spp.</i> <i>Proteus vulgaris</i> , <i>Flavobacterium spp.</i> <i>Shigella sonnei</i> ,	<i>Saccharomyces sp.</i> <i>Rhizopus sp.</i>
Open-air canteen	<i>S. aureus</i> , <i>S. epidermidis</i> , <i>Vibrio sp.</i> <i>Alcaligenes spp.</i> <i>Flavobacterium spp.</i> <i>Shigella sonnei</i> , <i>Pseudomonas fluorescens</i>	<i>Saccharomyces sp.</i> <i>Rhizopus sp.</i>
Closed canteen	<i>S. aureus</i> , <i>S. epidermidis</i> , <i>Vibrio sp.</i> <i>Flavobacterium spp.</i> <i>P. fluorescens</i> , <i>Proteus vulgaris.</i> , <i>Serratia marcescens</i> , <i>Lactobacillus acidophilus</i> , <i>Listeria spp.</i> <i>Enterobacter spp.</i> <i>Escherichia coli</i> , <i>Klebsiella aerogenes</i> ,	<i>Rhizopus sp.</i> , <i>Aspergillus niger</i>
Restaurants	<i>S. aureus</i> , <i>S. epidermidis</i> , <i>Alcaligenes spp.</i> <i>Flavobacterium spp.</i> <i>P. fluorescens</i> , <i>Proteus vulgaris</i> , <i>Serratia marcescens</i>	<i>Saccharomyces sp.</i>
Hotels	<i>S. aureus</i> , <i>Alcaligenes spp.</i> <i>Pseudomonas fluorescens</i>	

Table 4: The distribution and prevalence of microflora on the palm of the food handlers sampled

Isolates	hawkers	Road side	Open air	Roofed canteen	Restaurants	Hotel	Total (%) *
<i>Alcaligenes spp.</i>	-	2	1	8	2	1	14 (12.2)
<i>Bacillus subtilis</i>	-	-	-	2	-	-	2 (1.7)
<i>Corynebacterium sp.</i>	-	-	-	1	-	-	1 (0.9)
<i>Enterobacter spp.</i>	-	-	-	1	-	-	1(0.9)
<i>Escherichia coli</i>	-	-	-	1	-	-	1(0.9)
<i>Flavobacterium spp.</i>	-	1	2	4	1	-	8 (6.7)
<i>Klebsiella aerogenes</i>	-	1	-	2	-	-	3 (2.61)
<i>Lactobacillus acidophilus</i>	-	-	-	2	-	-	2 (1.2)
<i>Listeria spp.</i>	-	-	-	4	-	-	4 (2.2)
<i>Proteus vulgaris</i>	-	1	-	-	1	-	2 (1.2)
<i>Pseudomonas fluorescens</i>	-	-	2	4	2	2	10 (8.7)
<i>Serratia marcescens</i>	-	-	-	4	1	-	4 (2.4)
<i>Staphylococcus aureus</i>	2	1	4	25	5	1	38 (33.1)
<i>S. epidermidis</i>	1	2	2	12	1	-	18 (15.7)
<i>Shigella sonnei</i>	-	-	-	1	-	-	1(0.9)
<i>Vibrio sp.</i>	2	1	2	4	2	-	11(9.6)

•- values in parenthesis represent percentage of occurrence of each microorganism on the palm of the vendors sampled.

DISCUSSION

The result of this study showed that majority (56.3%) of the food handlers sampled did not undergo the annual medical routine check up. None of the hawkers sampled in this study did the annual routine medical checkup probably due to illiteracy and ignorance while all the hotel food operators sampled had undergone the medical checkup because it is compulsory under the Federal Government of Nigeria Law for establishing hotels. Many of the food ven-

dors without the checkup considered the annual routine checkup as unnecessary until they are conspicuously sick and need medical attention. Periodic medical examination of food vendors would probably have revealed any disease situation needing treatment or withdrawal from being a food vendor for a period of time (Ali, 2001).

The low microbial population found on the palms of the food handlers in the restaurants and hotels as compared to the other food

vendors sampled may be attributed to the clean environment in which they operate and the presence of toilet facilities, running water and hand washing facilities within the vending site. However, in the other vending sites (roofed and open air) sampled, running water and toilet facilities are not readily available; vendors are forced to use secluded areas in place of a public toilet. Often the vendors are not able to wash their hands properly afterwards. Such conditions and practices are likely to lead to cross-contamination of cooked foods (Dawson and Canet, 1991; Ekanem, 1998). Some of the microorganisms isolated from the palms of food handlers in this study were resident microorganisms on the skin while the others were transients. Resident microorganisms are considered as permanent inhabitants of the skin of most people and are found on the superficial skin surface (epidermis). They include the coagulase-negative staphylococci; members of the *Corynebacterium*, *Propionibacterium*, and *Acinetobacter* species; and certain members of the *Enterobacteriaceae* family. *Corynebacteria* and oxygen-requiring coagulase-negative staphylococci comprise the majority of the resident microflora (Garner and Favero, 1986). Types and numbers of resident microorganisms vary from individual to individual, and in different regions of the body. Most resident microflora do not cause food borne illness.

Escherichia coli, *Salmonella* spp. *Shigella* spp. *Vibrio cholerae* and *Clostridium perfringens* found on the palms of some of the food handlers are transient microorganisms. Transient floras are microorganisms isolated from the skin but not demonstrated to be consistently present in the majority of persons (Paulson, 1992; Larson, 1995). Transient microfloras are of concern in health

care settings and food operations because of the likely transmission of this type of microflora by hands (Larson *et al.*, 1986; Larson, 1995). Unless transient microorganisms are removed from hands by washing with soap and water using mechanical friction, or reduced by the application of some antiseptic hand rub, it can result in the spread of pathogenic and food spoilage microorganisms.

The presence of the coliforms (*Enterobacter* sp. *E. coli*, *Klebsiella aerogenes*, *Proteus vulgaris* and *Shigella sonnei*) on the palms of some of the food handlers is an indication of faecal contamination. Faecal contamination on the palm of the food handlers may be as a result of inadequate washing of hands after using the toilet, changing diapers, or from contact with contaminated raw products (e.g. raw meat, poultry, fish, unwashed fruits and vegetables) as reported earlier (Larson, 1995).

The results of this study show that the prevalence of *S. aureus* on the palm of the food handlers exceeds that of the other microorganisms isolated. *Staphylococcus aureus* (cause of staphylococcal food poisoning) is the only true pathogenic organism included in the resident microflora group of skin. About 35% of normal adults carry *S. aureus* in the anterior nostrils of the nose and are particularly susceptible to infection when the normal protective skin barrier is broken (Redway *et al.*, 1994).

Kerr *et al.* (1993) reported that frequent hand washing represents an important element of hygiene that may interrupt transmission of these organisms. Kerr *et al.* (1993) carried out a study on the prevalence of *Listeria* spp. on the hands of food workers; of the 87 food workers found not to carry *Listeria* spp. on

their hands, 54 (62%) were considered to have used adequate hand washing. Of the 12 people carrying *Listeria* spp. on their hands, only one individual was believed to have washed the hands adequately. Good hand washing technique should be emphasized for food workers, particularly in establishments where raw food and cooked/ready-to-eat products are handled.

During this study, it was established that many food vendors especially those on the streets did not undergo the annual medical check up as required by the State Ministry of health. It is recommended that proper policing be done because these illegal vendors did not submit themselves to the required physical and medical examinations. Also, there is a need to educate food handlers on the proper hand washing technique to prevent cross contamination of pathogens from food handlers to the food.

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