Perceptions of mothers on food safety related and the microbiological contamination of complimentary foods – A case study in 2 rural areas in Southwestern Nigeria.

[*1]Omemu A.M, [2]Atanda O.O, [3]Ayinde I.A and [4]Henshaw, F.O.

[*1]Department of Microbiology, University of Agriculture, Abeokuta (UNAAB), PMB, 2240, Nigeria.
[2]. Department of Food services and tourism, UNAAB, Nigeria.
[3]. Department of Agric Economics, UNAAB, Nigeria.
[4]. Department of Food science and Technology, UNAAB Nigeria.
bjomemu@yahoo.com; amomemu@gmail.com; omemuam@unaab.edu.ng.

Abstract: This study aimed to assess the food safety practices of mothers with children under 5 years old and to evaluate the microbiological quality of some traditional complimentary foods used. Quantitative data were collected from respondents (n = 100) using a Knowledge, Attitudes, Beliefs and Practices (KABP) questionnaire and face-to face interview. Only 11% of the mothers are educated up to tertiary level, 13% used tap water as drinking water and 54% used kerosene stoves for cooking. Over 85% wash hands before feeding children, after cleaning childôs stool, eating or cooking food, but usage of soap is very limited. The traditional foods commonly used as complimentary foods include *ogi, amala, rice, beans, eba* and *eko.* The highest microbial count (7.01 ± 0.17log cfu/g) was observed with *eko* while the least count (3.42 ± 0.22 log cfu/g) was observed in *amala.* The microorganisms isolated from the food sampled include *Escherichia coli, Bacillus cereus, Staphylococcus aureus, Enterococcus faecalis*, *Aspergillus niger, Mucor mucedo* and *Penicillium species.* Out of the 240 food samples examined, *Staphylococcus aureus* was isolated from 210 (87.5%) samples; *E.coli* was isolated from 56 food sample while faecal coliform was isolated from 48 samples. To achieve global food safety it is necessary to inform consumers, especially mothers, about fundamental principles of food safety assurance at home, since food safety begins and ends in the home of a consumer.

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1. Introduction

Food elaborated with satisfactory hygienic standards is one of the essential conditions for promoting and preserving health, and inadequate control is one of the factors responsible for the occurrence of food borne disease outbreaks (Oliveira *et al.,* 2003). Illness resulting from food borne disease has become one of the most widespread public health problems in the world today.

The surveillance of food-borne disease outbreaks is fairly established in developed countries but in spite of that only less than 10% are recorded in official statistics. In case of developing countries, it could be even less than 1% (WHO, 2006). International studies have shown that a significant proportion of foodborne diseases arise from practices in the kitchen of a home (Scott, 1996; Bryan, 1988; Redmond and Griffith, 2004). Several studies assessing different kinds of consumer groups identified food prepared in the family home as a major source of food poisoning (Jay *et al.,* 1999; Anderson *et al.,* 2004). Infants and young children are affected mostly, due in part to their immature immune systems (Scheule, 2004). In the developing world, a substantial number of more than 100 million cases of acute diarrhoea in children younger than 5 year old reported yearly resulted from contamination of food. Many children also fall ill on account of hepatitis A, enteric fever, intestinal worms and other infections caused by unhygienic preparation of foods in households and unsafe drinking water (UNICEF, 2004; Motarjemi *et al.,* 1993). Socio-cultural constraints, such as social infrastructure, ignorance, incorrect beliefs and practices, taboos, poverty, insufficient food, lack of safe water and sanitation, and shortage of fuel and time may aggravate the situation (Motarjemi *et al.,* 1993). Many studies have uncovered a lack of food safety knowledge and the need to promote improved food safety behaviors for particular target groups. It is very important to investigate a consumerôs knowledge, behavior and attitudes toward food safety.

Usually people prefer feeding children with food that has been prepared and served from their kitchen, as it is regarded to be warm and free from pathogens. Although this is believed to be so, such foods may not attain temperatures high enough to kill all pathogens.

At times, leftover food that might have had been stored is eaten by children without warming. Other commonly identified mistakes include serving contaminated raw food, having infected persons handle food, as well as practicing poor hygiene or preparing food unsafely (Klontz *et al.,* 1995).

The results of a number of the previously mentioned investigations on consumer food safety showed that the levels of understanding, motivation and trust need to be further cultivated and enhanced in order to maintain an acceptable level of food safety for the whole food chain.Most of the work during the last few years has centered on hazard control in the production sector, but an equal effort was not dedicated to improving the food safety education of consumers (Garayoa *et al.,* 2005). The role of food handlers, usually mothers, in ensuring food safety for infants and children is well accepted. The awareness of women in Nigeria regarding the importance of food safety assurance and their knowledge and practices associated with this aspect of their daily life have not been researched. Identification of educational needs and lacunae in knowledge and perceptions is the first step towards developing educational material (Motarjemi and Moaref, 2000). This study aims to investigate the awareness of selected mothers to food safety issues and to assess the microbiological quality of some complementary foods prepared and fed to children in the selected household.

2. Materials and methods

2.1. Study area.

This study was carried out in Alabata community situated within Odeda local Government area of Ogun state, Nigeria and Ikola Community situated in Lagos state. The two communities are mostly rural however some parts are becoming urbanized. Most urban households in the communities have tap-water or boreholes. The rural households lack basic services, such as running tap-water and electricity. Household refrigerators in the rural settings are rare, even when electricity is available.

2.2. Sample selection.

The study was conducted among the mothers of children aged 4 monthsï 5 years in the two communities. Fifty mothers were selected from each community. Each mother gave verbal consent to participate in the study and also to provide food samples for the study.

2.3. Research methods:

Quantitative research method was used for data collection. For obtaining the quantitative data, a pre-tested Knowledge, Attitudes, Belief and Practices (KABP) questionnaire consisting of 34 closedï ended multiple-choice questions was used. This questionnaire aimed to elicit information on demographic characteristics of respondents, personal hygiene, hygienic practices when handling drinking water, cooked food, and child feeding practices.

The KABP questionnaires were administering in personal interview mode in the residences of the respondents after obtaining informed consent from them.

2.4. Food Sample Collection:

To select the sample households, every fifth mother out of the mothers surveyed was selected and samples of complimentary foods (rice, yam, *akara, ogi, moinmoin,* noodles and beans) were collected from their households. Samples were collected at different times of the day so as to capture the morning and mid-day feeding times. Food samples were collected aseptically, before and after cooking, and after storage at room temperature (> 4 hours).

The item used for sample collection depended on the feeding mode used at the time of sample collection. For instance, if the mother used finger-feeding as the feeding mode, she was asked to use her hand to place the food sample in the sterile tube used for sample collection. Prior to this, the mothers were encouraged to provide food that composed the regular diet of child and not to prepare a special food for this exercise. All samples were placed in sterile tubes with tightly-fitting lids and kept on icepacks in a cooler box. This allowed immediate cooling of hot food samples from the households and reduced bacterial growth while samples were in transit. Samples were transported to the laboratory where they were prepared and analyzed for bacterial populations within a day.

2.5. Enumeration of microorganisms

Approximately 0.2 g of each food sample was weighed in a sterile Bijou bottle and crushed with sterile glass rod, blended in 2mL of sterile saline and serially diluted. For the isolation of the bacteria, duplicate plates of trypticase soy agar (TSA) were inoculated with 0.2 mL of each dilution, and the inoculum spread over the agar surface with a sterile (bent) glass rod. After 24 hours of incubation at 37 ^{o}C, the plates were examined and colonies counted.

For the isolation of yeasts and mould, appropriate dilution was placed on Sabouraud dextrose agar and incubated at 25$\pm$ 2^{o}C for 2-5days.

3.0. Results

Table 1 presents the characteristics of the 100 mothers studied. Most (42%) of the mothers are between the age of 20-30 years, 29% are between 30-

40 years and only 9% are older than 40 years. Majority (53%) of the studied mothers are married. Ten (10%) of the mothers had no formal education, 32% had up to secondary school education while 11% are educated up to tertiary level. Many (32%) of the mothers are civil servants, 30% are traders while 13% are farmers.

Results presented in Table 2 shows the facilities available in the household studied. Thirty six of the mothers had a kitchen for cooking while 35% used their open veranda as kitchen. None of the household drink river or stream water, 38% and 34% drink water from covered well and bore holes respectively while 13% used tap water as drinking water. Most (54%) of the household used kerosene stoves for cooking while 25% and 13% used firewood and charcoal respectively. Some (45%) of the mothers introduced at least one complimentary food to the babies at four month while majority (55%) introduced at least one complimentary food by 6 months. The facilities used to store cooked food include food warmers, bowls and refrigerators.

The places of purchase by mothers include shop, market and farm depending on the foodstuffs they wished to buy. Milk products, raw meat, fresh ýsh, fruits, yam, gari, yam flour are mainly bought in shops or open markets. Food-stuffs that are most commonly self-grown or self-produced include vegetables, eggs and poultry. Respondents were asked about their food handling practices at home. None of the mothers had a formal training on food preparation or food safety. More than half (53.8%) of the respondents learned cooking practices from their parents and 21.7% learned by practising (data not shown).

Figure 1 presents the hand washing practices among mothers before and after undertaking various activities. Results show that irrespective of the activities, majority of the mothers wash their hands without soap. Most of the mothers (88%) washed their hands if they will be using hands to feed their babies and out of this, only 5% used soap to wash the hands.

The traditional food commonly used as complimentary foods in the selected households include *ogi, eko*, rice, beans, yam, eba, amala and moin moin (Table 3). All the mothers (100%) used *ogi* as one of the complimentary foods, 92% used eko, 67% used *amala* while only 32% used *eba* as one of the complimentary food.

The number of food samples found to be contaminated with microorganisms and the mean total plate count is presented in Table 4. Thirty samples of each food type were analysed. The highest microbial count (7.01 $\pm$ 0.17log cfu/g) was observed with *eko* while the least count (3.42 $\pm$ 0.22 log cfu/g) was observed in *amala.* Eighty seven percent of the rice samples had bacterial contamination with mean bacterial contamination of 6.62 $\pm$ 0.22. Amala had the least number of samples contaminated and it also had the least mean bacterial population of 3.42 $\pm$ 0.22.

Figure 2 shows the bacterial contamination in relation to the food type. Out of the 80 freshly cooked foods sampled, only 23.2% were contaminated with bacteria while 40.8% and 57.6% of the reheated food and stored unheated foods respectively were contaminated.

Table 5 show the different microorganisms isolated from the complimentary foods and their frequency of occurrence. The microorganisms isolated from the food sampled include *Escherichia coli, Bacillus cereus, Staphylococcus aureus, Enterococcus faecalis*, mold and yeasts. The molds isolated include *Aspergillus niger, Mucor mucedo, Penicillium species*

Out of the 240 food samples examined, *Staphylococcus aureus* was isolated from 210 (87.5%) samples. This was followed by *Bacillus cereus* which occurred in 50.4% of the food sampled. *E.coli* was isolated from 56 food sample while faecal coliform was isolated from 48 samples. Yeasts were isolated from 41 (17%) food samples while moulds were isolated from 35(14.6%) food samples.

Table 1: Characteristics of mothers surveyed. (n=100)

Characteristics	Frequency (%)
Age (years)	
Below 20	20 (20%)
20-30	42 (42%)
30-40	29 (29%)
>40	9 (9%)
Religious preference	
Islam	50 (50%)
Christianity	46 (46%)
Others	4 (4%)
Marital status	
Married	53 (53%)
Single/ Divorced	28 (28%)
Widowed	19 (19%)
Education	
No school	10 (10%)
Primary school	47 (47%)
Secondary school	32 (32%)
Tertiary institution	11 (11%)
Occupation	
Civil servants	32 (32%)
Housewives	12 (12%)
Farmers	13 (13%)
Traders	30 (30%)
Others	13 (13%)

Table 2: Facilities available in the household studied (N=100)

Facilities	Number (%) of household having it
Type of house	
Face to face	61 (61%)
Flat	39 (39%)
Place of cooking	
Kitchen	36 (36%)
Open veranda	35(35%)
Common place	29 (29%)
Source of drinking water	
Borehole	34(34%)
River/ stream	0 (0%)
Tap	13 (13%)
Open well	15 (15%)
Covered well	38 (38%)
Type of toilet	
Water-flush toilet	57 (57%)
latrine	31(31%)
bush	12 (12%)
Mode of cooking	
Kerosene Stove	58 (58%)
Fire wood	25 (25%)
Charcoal	13 (13%)
Others	4 (4%)
Facilities to store cooked food	
Refrigerator	14 (14%)
Food warmer	74 (74%)
Bowls	12 (12%)

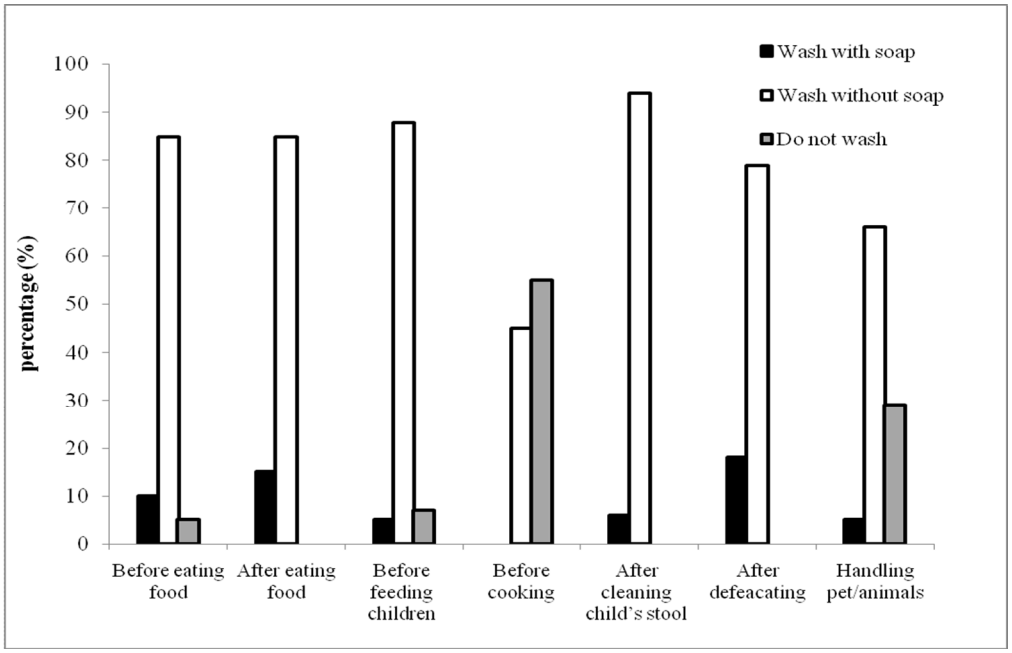

Fig 1: Hand washing practices among mothers (%) before and after undertaking various activities.

Table 3: Description of the common traditional complimentary foods used in studied households

Food	N	Description	Cooking method	Handling after cooking	Serving/eating method
Ogi	100	Fermented maize	Boiling	Served with spoon	Sweetened with sugar/ milk. Eaten with akara/moin moin
Eko	92	Fermented maize	Boiling	Wrapped in leaves/ polyethylene nylon	Eaten alone with akara/vegetable
Moin moin	87	Milled beans	Boiling	Wrapped in leaves/ nylon	Eaten alone /with ogi/eko
Rice	90	Boiled rice	Boiling	Dished into bowls; eaten with spoon or hands	Eaten with soup/ stew/ vegetable
Yam	81	Boiled or fried yam	Boiling or frying	Served hot with spoon/fork	Eaten with soup/ stew/ vegetable
Amala	67	Yam flour	Boiling	Dished into bowls and eaten with hands	Eaten with soup/ vegetable
Eba	32	Fermented cassava	Boiling	Served with wooden spoon	Eaten with soup/ vegetable

N= number of household using the food as complimentary food

Table 4: Microbial contamination of the complimentary food sampled

Type of food	Number of sample contaminated (%)	Mean microbial population (log cfu/g/ml)
Ogi	18 (60)	6.12 ± 0.22
Eko	14 (47)	7.01 ± 0.17
Moin moin	20 (67)	5.14 ± 0.25
Rice	26 (87)	6.62 ± 0.22
Yam	15 (50)	4.31 ± 0.22
Amala	5 (17)	3.42 ± 0.22
Eba	20(66)	5.62 ± 0.22
Others	25 (84)	5.11 ± 0.22

n=30 for each food sample.

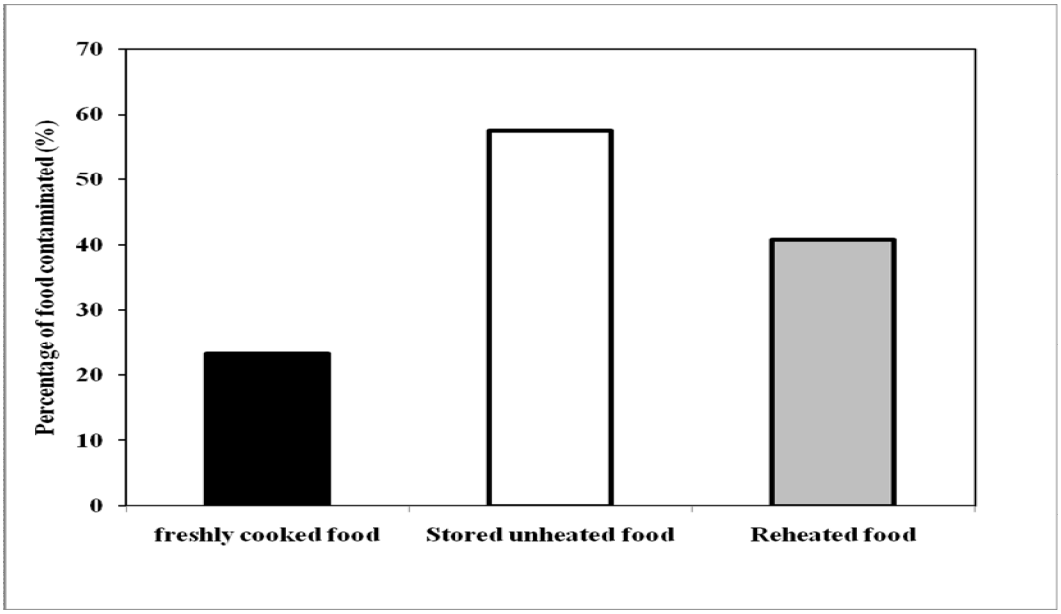

Fig 2: Microbial contamination in relation to food type
Freshly cooked food (n=80); stored unheated foods (n=80); Reheated food (n=80)

Table 5: Type of microorganisms isolated from food and the frequency of occurrence of the microorganism.

Type of microorganisms	Frequency of occurrence
Faecal coliform	48 (20)
Escherichia coli	56 (23.3)
Enterococcus faecalis	94 (39.1)
Bacillus cereus	121 (50.4)
Staphylococcus aureus	210 (87.5)
Mold	35 (14.6)
Yeasts	41(17)

N=240

4.0. Discussion

The relationship between household socio-economic characteristics, education of mothers and childhood diarrhoea has been amply demonstrated in the literature (Ehiri, 1993; Alam, 1995). For example, using educational level of the mothers and availability of household amenities as proxies for socio economic status, it is apparent that most of the households are poor. Of the 100 mothers studied, 10% had no school education, and 47% had only attended primary school. This has significant implications for child health in general and for food hygiene behaviour in particular (Togunde, 1999; Cerritti, 2000). Education is also related to employment and income, which influence access to household amenities and facilities, including those related to food hygiene and environmental health (Ehiri, 1993).

Cooking fuel and cooking practices are important in food hygiene since cooking and reheating temperatures are often critical control points. In situations where fuel for cooking is in short supply, households may, in a bid to save energy, prepare large quantities of food in advance and then store it until needed (Ehiri *et al.,* 2001). In the present study, more than 50% of the respondents were using conventional cooking fuels (like wood, kerosene and coal).

Factors of food hygiene include handling, preparation, and storage practices, and these are generally evaluated from the level of bacterial contamination. In this work, microbial count was adopted as a measure of hygiene standard of food given to the children. Overall, some of the foods given to the children are contaminated especially after prolonged storage and this probably increases the risk of diarrhoea. Results of this study show that the level of contamination does not depend on the type of food; rather it depends largely on preparation and storage. Thus, counts in foods stored and reheated were significantly higher than in freshly-cooked. In all the households it was common practice to prepare sufficient food in the morning for both breakfast and lunch. This resulted in the prolonged storage of cooked food at ambient temperature, even where there was access to a refrigerator. The ambient temperature in the food-storage areas averaged 30.5 °C and the mean duration of storage was 3 to 6 hours. The foods and the environmental conditions were ideal for the proliferation of most foodborne pathogens and spoilage bacteria.

Some of the complementary foods observed in the study communities were often cooked to temperatures capable of destroying vegetative pathogens and would therefore pose a minimal hazard to the child if consumed immediately after cooking. However, foods were typically stored either in cupboards or covered pots for an average of six hours, and often overnight. The benefits that should accrue to the few households with refrigerated storage were negated by constant and often prolonged failures in the power supply. Epidemiological evidence also shows that undue delay between cooking and consumption of food is a major contributing factor to most outbreaks of foodborne diseases (Davey, 1985; Bryan, 1988).

The low level of bacterial counts observed in *amala* may be as result of the fact that *amala* is eaten when hot and is rarely stored. In contrast, the high bacterial load observed in eko may be as a result of long storage. *Eko* (also known as agidi) is a popular and inexpensive cold food made of boiled fermented maize meal. As the preparation is arduous, *eko* is rarely prepared in households rather it is purchased from local processors and it can be stored for 4-7days at room temperature.

Ideally, foods should be prepared hygienically and eaten at one sitting or stored safely until consumption. Boiling water and re-heating foods before consumption can also considerably reduce the risk of illness. These are recommendations which are easy to prescribe but difficult for a poor and busy mother to practice. One of the limitations to this recommendation is the cost of cooking fuel. The fuel cost for re-heating will have to compete for the limited resources available for other vital activities.

The role of hands in transmission of diseases has been established because they can be an important source of microbial contamination of foods (Emery,

1990; Rebecca, Chen and Schaffner, 2001). Poor hand washing practices have been implicated as the source of foodborne disease outbreaks (Guzewich and Ross, 1999). Curtis and Cairncross (2003) reported that washing hands with soap can reduce the risk of diarrhoeal diseases by 42ï 47% and that interventions to promote hand washing might save a million lives. This study shows that most mothers do wash their hands, but only few wash with soap. This may be as a result of ignorance or poverty. The results of this study definitely suggest a need for education on childcare and food hygiene to mothers. Home food preparers need to take many precautions to minimize pathogenic contamination of home-prepared foods because they may be the final line of defense against food-borne illnesses.

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Correspondence author:
bjomemu@yahoo.com; amomemu@gmail.com; omemuam@unaab.edu.ng

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