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Afr. J. Biomed. Res. Vol.16 (September 2013); 163 - 166

Full Length Research Paper

Microbiological Quality of Street-Vended Foods and Ready-To-Eat Vegetables in Some Nigeria Cities

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ABSTRACT

Microbiological quality and safety of street foods and ready-to-eat vegetables were assessed in some cities in Nigeria in order to ascertain their hygienic status. The foods include cooked rice, boiled and roasted maize, plantain chips, puff-puff, lettuce, cabbage, spring onions, cucumber, carrot and tomatoes. Standard microbiological procedures and techniques were used to enumerate, isolate, identify and characterize the different microorganisms associated with the foods assessed. The average holding temperature (^{0}C) of foods sold hot ranged from 51^{0}C – 70^{0}C, and for foods sold cold ranged from 25^{0}C – 35^{0}C. Average aerobic bacteria for hot foods ranged between 2.4 x 10^4 – 2.0 x 10^6 while cold foods ranged between 2.2 - 5.5 x 10^5. Enterobacteriaceae counts for hot foods ranged between 1.1 x 10^3 – 2.0 x 10^5; for cold foods 2.4 x 10^3 – 1.6 x 10^6. The yeast and mould count for hot food samples ranged from 1.1 x 10^3 – 3.0 x 10^5; for cold foods 1.4 x 10^3 – 2.0 x 10^5. Organisms isolated were *Micrococcus* spp., *Pseudomonas* spp; *Bacillus* spp., *Staphylococcus aureus, Escherichia coli, Rhizopus* sp; *Aspergillus* spp; *Penicillium* spp. and *Mucor* spp. The isolation of food-borne pathogens may constitute potential health hazard to consumers. Need for routine monitoring of street vended foods and ready-to-eat vegetables by health agencies are advocated.

Keywords: Street foods, ready-to-eat foods, microbiological quality, hygienic status, health hazard.

INTRODUCTION

Food-borne illness is a major international health problem and an important cause of reduced economic growth (Frenzen *et al*., 2005). The problems of food safety in industrialized world differ considerably from those faced by developing countries. In developing countries, traditional methods are used for marketing fresh produce while in developed countries, food processing and packaging are the norm. In developing countries, a large proportion of ready-to-eat food is sold on the streets.

Street-vended foods are those foods prepared on the street and ready-to-eat or prepared at home and consumed on the street without further preparation (Martins and Anelich, 2000). Due to faltering economic development, street vended foods have become increasingly important in the economics of many African countries. The street food vending business is thought to contribute significant income to many householders. Some of the foods sold on the streets are rice, noodle based meals, food snacks, cakes, pastry soups, porridges, fruits, vegetables, fried plantain chips, poultry, fish, seafood, eggs, cereal and soy products. Furthermore, street foods are a source of inexpensive, notorious meal (Mosupye and VonHoly, 1999).

Consumption of street food is common in many African countries where unemployment is high, salaries

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Date Received: July 2012
Date Accepted: , May 2013

Abstracted by:
Bioline International, African Journals online (AJOL), Index Copernicus, African Index Medicus (WHO), Excerpta medica (EMBASE), CAB Abstracts, SCOPUS, Global Health Abstracts, Asian Science Index, Index Veterinarius, , African Journals online

low and work opportunities and social programmes are limited and where urbanization is taking place (World Health Organization, 2002). In selling snacks, complete meals and refreshments at relatively low prices, street food vendors provide essential services to workers, shoppers, travelers and people on low incomes. People who depend on such food are often more interested in its convenience than in questions of its safety, quality and hygiene (World Health Organization, 2002).

The hygiene of street foods is a major concern for food control officers (Mensah *et al*., 2002). Vending stands are often crude structures and running water, washing facilities and toilets may not be available.
Microbiological quality is of particular concern since street foods are thought to cause many of the food borne infections in both developed and developing countries (Simpoulous and Bhat, 2002). Street foods are exposed to abundant microorganisms during preparation, transport, preservation and distribution of foods as well as the personal hygiene of food vendors.

The main objective of this work is to assess the microbiological quality of street-vended foods and ready-to-eat fruits and vegetables by isolating, enumerating and characterizing of different microorganisms associated with them.

MATERIALS AND METHODS

Collection of samples

Food samples bought from food vendors included cooked rice, boiled and roasted maize, plantain chips, puff-puff, lettuce, cabbage, spring onions, cucumber, carrot and tomatoes. The samples collected were wrapped aseptically in sterile polythene bags and transported to the laboratory. Apart from fruits and vegetables, hot food samples were collected between 10 a.m.-12 noon while cold samples were collected between 2 – 4p.m. Temperature of the various foods at the point of collection were noted and recorded.

Microbiological Analysis

Milled samples of the various food items were serially diluted and the pour plate technique was used for culturing on nutrient agar plates for total viable count; MacConkey agar plates for coliforms and yeast and mould count was done on Sabouraud Dextrose Agar plates. The plates were incubated at appropriate incubation temperatures (28^{o}C) for 24h and colony forming unit per gram (cfu/g) were estimated. Bacteria colonies were further confirmed by standard biochemical tests. Isolated fungi sp. were stained with cotton blue lactophenol and visualized under x40. Identification was done with reference to international standards used in identifying moulds (Klich, 2002).

Statistical analysis

Microbial counts were analyzed using both analysis of variance and Duncan Multiple Range Test to compare means.

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RESULTS

The results of microbial load of some street-vended foods from four cities are presented below. Counts (microbial) from the four cities were below10^6 cfu/g (Tables 1, 3 and 4) except one sample from Lagos (Table 2).

Table 1:
Microbial populations and temperature of street-vended foods sold in Ibadan, Nigeria

Sample	Average holding temperature (^{0}C)	Total viable count (cfu/g)	Coliform count (cfu/g)	Yeast and mould count
Hot Puff-Puff	68	60 x 10^4	1.4 x 10^3	1.1 x 10^3
Cold Puff-Puff	31	2.2 x 10^5	2.4 x 10^3	1.7 x 10^3
Hot Plantain Chips	54	6.0 x 10^4	1.1 x 10^3	1.3 x 10^3
Cold Plantain Chips	30	5.6 x 10^5	4.3 x 10^3	1.5 x 10^3
Hot Roasted Corn	51	1.4 x 10^5	2.5 x 10^3	1.2 x 10^3
Cold Roasted Corn	33	4.0 x 10^5	3.2 x 10^4	1.4 x 10^3
Cooked Hot Rice	70	2.7 x 10^4	1.5 x 10^4	1.8 x 10^3
Cooked Cold Rice	32	4.3 x 10^5	2.6 x 10^5	8.0 x 10^3

Table 2:
Microbial populations and temperature of street-vended foods sold in Lagos, Nigeria

Sample	Average holding temperature (^{0}C)	Total viable count (cfu/g)	Coliform count (cfu/g)	Yeast and mould count
Cold Puff-Puff	30^{0}C	60 x 10^4	1.0 x 10^5	1.0 x 10^5
Hot Puff-Puff	70^{0}C	3.0 x 10^4	1.0 x 10^3	2.0 x 10^4
Cold Boiled Rice	25^{0}C	1.0 x 10^6	1.6 x 10^6	2.0 x 10^5
Hot Boiled Rice	62^{0}C	4.0 x 10^4	8.0 x 10^4	2.0 x 10^5
Cold Plantain Chips	35^{0}C	2.0 x 10^4	2.0 x 10^5	1.0 x 10^5
Hot Plantain Chips	70^{0}C	3.0 x 10^5	2.0 x 10^5	2.0 x 10^4
Cold Boiled Corn	34^{0}C	5.1 x 10^5	5.0 x 10^5	3.0 x 10^4
Hot Boiled Corn	75^{0}C	1.5 x 10^5	1.2 x 10^5	3.0 x 10^5

Table 3:
Microbial populations and temperature of street-vended foods sold in Oshogbo, Nigeria

Sample	Average holding temperature (^{0}C)	Total viable count (cfu/g)	Coliform count (cfu/g)	Yeast and mould count
HPP	76	6.1 x 10^3	2.2 x 10^3	4.0 x 10^3
CPP	33	6.8 x 10^4	1.2 x 10^3	5.6 x 10^3
HPL	66	1.9 x 10^4	7.0 x 10^4	1.3 x 10^3
CPL	33	6.8 x 10^4	1.2 x 10^3	5.6 x 10^3
HRC	66	1.9 x 10^4	7.0 x 10^4	1.3 x 10^3
CRC	35	3.7 x 10^4	7.6 x 10^3	5.1 x 10^3
HBR	60	6.1 x 10^4	2.7 x 10^3	8.0 x 10^3
CBR	31	4.5 x 10^4	8.0 x 10^3	2.0 x 10^3

Table 4:
Microbial populations of ready-to-eat vegetables

Sample	Total viable count (cfu/g)	Coliform count (cfu/g)	Yeast and mould count
Lettuce	3.0 x 10^3	1 x 10^3	4.0 x 10^4
Cabbage	3.0 x 10^3	3.0 x 10^3	3.0 x 10^4
Spring onion	1.0 x 10^3	1.0 x 10^3	2.0 x 10^4
Cucumber	2.0 x 10^3	3.0 x 10^3	3.0 x 10^4
Carrot	3.0 x 10^3	3.0 x 10^3	1.0 x 10^4
Tomato	1.0 x 10^3	2.0 x 10^3	4.0 x 10^4

DISCUSSION

Microorganisms are ubiquitous and are therefore found in air, soil, water, foods and on humans. It is only when large numbers of microorganisms are present that they become hazardous.

Results obtained from microbiological assessment of street-vended foods and ready-to-eat vegetables showed that most foods fell within the limit for satisfactory and acceptable microbiological quality as specified by Sagoo *et al*. (2003). However, some samples collected from Lagos were slightly high (Table 2).

The high counts recorded in this city might be attributed to some factors such as poor storage facilities, the personal hygiene of vendors, and lack of adequate refuse disposal facilities and sanitation (Steele and Odumeru, 2004).

Microbiological quality of foods might be directly related to the quality of the water available to vendors to prepare foods. Access to a safe water supply goes a long way towards promoting food safety while the locations in which street foods are prepared and sold significantly affect their safety (Vanselow *et al*., 2005).

Foods held at ambient temperature had higher microbial counts than hot foods. This is in agreement with the findings of WHO (2012) that foods that are cooked immediately prior to consumption are safer than those that have been cooked and stored at ambient temperature. Time and temperature abuse of a food product contaminated with enterotoxigenic staphylococci can result in formation of enterotoxin which can produce foodborne illness when the product is ingested. This enterotoxin can withstand cooking temperatures (Bernett, 2005).

Mosupye and von Holy (1999) were of the opinion that foods prepared in advance and kept at ambient temperatures (20 – 46^{0}C) for a long period of time (4 hours or more) show massive increase in bacterial count. Coliform counts in all samples except Lagos were low (Tables 1, 3, 4). Coliform counts in Table 2 were higher for acceptable microbiological quality and therefore unsatisfactory (PHLS, 2004). Substantial number of *Escherichia coli* in food suggests a general lack of cleanliness in handling and improper storage condition, inadequate processing or contamination due to cross contamination by raw materials(Numm er *et al*., 2004; Smith *et al*., 2005; Keller *et al*., 2002; Mestrel *et al*., 2004; Clarence *et al*., 2009)

Sanitary handling of street foods varies greatly and can be a contributory factor in samples with unacceptable levels of microorganisms. Therefore, the detection of viable microorganisms could be connected with inadequate cooking (Keller *et al*., 2002; Mestrel *et al*., 2004, Hamilton, 2010).

Effective packaging of some street-vended foods might have played a contributory role in the low counts of microorganisms recorded especially the fried plantain chips. This finding is similar to the findings of Aguayo *et al*. (2003)

In conclusion, improved safety of street foods can be achieved through awareness programme involving several partners such as local authorities, food vendors, government agencies, consumer organization, standard setting bodies and non-governmental organizations. Regular routine sampling should be conducted by regulatory agencies.

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