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Total Microbial Count and Nutritional Analysis of Four Weaning Foods Sold in Benin City

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ABSTRACT: *Four (4) different weaning food samples purchased from Oba market located in Benin City, Edo State, Nigeria encoded A, B, C and Ogi (Nigerian indigenous weaning food) respectively were analyzed for their microbial and nutritional content in this study. Enumeration of total aerobic viable count was done using Nutrient agar. Eosin methylene blue (EMB) agar was used for coliform count, Salmonella - Shigella agar was used for Salmonella and Shigella count, mannitol salt agar for staphylococcal count and Sabouraud dextrose agar for mould and yeast counts. Total aerobic counts of organisms in weaning food C (21 ± 1.4 ×10^3 cfu g^{-1}) was significantly (P< 0.05) higher while weaning B and A had lowest aerobic count of 0.5 ± 0.04 ×10^3 cfu g^{-1} and 0.5 ± 0.07 ×10^3 cfu g^{-1} respectively. Ogi has a total aerobic count of 1.0 x 10^4. No Salmonella - Shigella count was observed in all weaning foods sampled. Coliform count and fungi and mould counts were only observed in Ogi and weaning food C. High percentage carbohydrate (73.75 ± 0.61) and moisture (9.3 ± 0.8) was observed in ogi.*

Keywords: Total aerobic counts, Weaning food, Microbial analysis, Nutritional analysis, coliform.

Introduction

The term ñto weanò means ñto accustomò and it describes the process by which the infant gradually becomes accustomed to the full adult diet (1). Weaning period is the period in which a baby is gradually introduced to foods other than milk and is recommended for between the 4th and 6th months after birth (2).

Nutritional status in children is most critical during the weaning stages when both macro and micronutrients may be insufficient to maintain growth and development. Baby foods rich in carbohydrates and proteins are usually produced from cereal and leguminous foods/grains. The manufacture of baby foods is based on dried cereals like maize, rice, millet, sorghum, wheat and oats. The quality of weaning foods used to feed a baby has been found to be very crucial to mental development of the baby (3). The most rapid growth of the brain occurs from 5 months before birth to 10 months after birth (4). At the end of the first year of life, the brain which is the first organ to attain full development would have achieved 70% of its adult weight (4).

When an infant is on breast milk, the bacterial flora of the gastrointestinal tract (GIT) is almost exclusively gram positive anaerobic rods of the genus, *Bifidobacterium* (5). Other bacteria, including coliforms become prominent only after the infant begins to eat other foods, or from the start, on the occasion that he is bottle fed. The numbers and types of intestinal flora can be influenced by the infantôs feed (5). Contaminated weaning foods have been implicated in quite a large number of diarrhoeal diseases among infants and young children in developing countries. There is evidence of increased diarrhoeal morbidity at the transition from exclusive breast feeding to a mixed diet as a result of food contamination (6). Children of tropical countries and developing world when being weaned, experience an estimated 1.3 billion episodes of acute diarrheal diseases annually and 0.5% of these have a fatal outcome (7) (8). Food contamination is believed to be a major source of this infection (9).

The increased risk of diarrhoea that is observed with the introduction of weaning foods suggests that these weaning foods are an important vehicle for the transmission of enteric pathogens. Due to the high fatality rate of such food infections caused by enteric pathogens amongst infants, particularly in developing countries, this study was therefore aimed at evaluating the microorganisms associated with some commercially and traditionally available weaning foods and to also determine the nutritional content of the different weaning foods.

Materials and Methods

Source of weaning food samples

Four different weaning food samples were purchased from Oba market located in Benin City, Edo State, Nigeria. Weaning food samples purchased were coded A, B, C and Ogi (Nigerian indigenous weaning food) respectively. All food samples were purchased in duplicate.

Microbial analysis

Serial dilutions of all the samples were carried out and 1ml each of selected dilutions was plated using the pour plate method (10). Enumeration of total aerobic viable count was done using Nutrient agar. Eosin methylene blue (EMB) agar was used for coliform count, *Salmonella - Shigella* agar was used for *Salmonella* and *Shigella* count, mannitol salt agar for staphylococcal count and Sabouraud dextrose agar for mould and yeast counts. All cultures were incubated in duplicate at 37ºC for 24 hours except for coliform organism(s) which were incubated at 37ºC and 44ºC for 24 hours while yeasts and mould were incubated at 25ºC for 72 hours. All media used were prepared according to the manufacturersô instructions.

Determination of moisture content

Three samples of 50 g each were taken from each food sample and put on an aluminium foil dish. These were dried in an oven at 110ºC for 24 hours, and reweighed thrice and the mean weight taken (11, 12). The moisture content of each sample was expressed as the average percentage of weight loss of the three replicates.

Proximate Analyses

Proximate analyses of all weaning food samples were carried out using standard methods (13).

Analysis of Data

Data were analysed using the SPSS software version 16. Least Significance difference (LSD) & Duncan multiple range test were used to ascertain the difference at Ŭ= 0.05 (95% confidence limit)

Results

Total aerobic count of organisms in Custard samples was (21 ± 1.4 ×10^3 cfu g^{-1}). This figure was observed to be significantly (P< 0.05) higher than those of other weaning foods. Nutrend and Cerelac had low aerobic count of 0.5 ± 0.04 ×10^3 cfu g^{-1} and 0.5 ± 0.07 ×10^3 cfu g^{-1} respectively. Custard had highest coliform counts of 5 ± 1.2 ×10^3 cfu g^{-1} while lower counts of 3 ± 0.54 ×10^3 cfu g^{-1} was observed in ogi. Ogi samples had Staphylococcal and

fungi counts of 1.5 ± 1.5 ×10^3 cfu g^{-1} and 2 ± 0.4 ×10^3 cfu g^{-1} respectively. However, Nutrend and Cerelac samples did not show any growth for Coliform, *Salmonella - Shigella* and Fungi counts (Table 1).

Figure 1 shows the percentage frequency of occurrence of the bacterial isolates from weaning food samples. *Bacillus* sp had the highest percentage of occurrence (5%) while *Staphylococcus* had the lowest percentage of occurrence (1%). The percentage frequency of occurrence of moulds and fungi present in the weaning foods is presented in Figure 2. Yeast had the highest percentage of occurrence while *Penicillium* had the lowest percentage of occurrence.

Table 1: Mean counts of organisms in weaning foods (cfu g^{-1}).

Weaning Foods	Total aerobic Count ×10^3	Coliform Count ×10^3	Staphylococcal Count ×10^3	*Salmonella* and *Shigella* Count ×10^3	Fungi and Mould Count ×10^3
Nutrend	0.5 ± 0.04^{d}	NG	NG	NG	NG
Cerelac	0.5 ± 0.07^{d}	NG	NG	NG	NG
Ogi	10 ± 0.87^{e}	3 ± 0.54^{a}	1.5 ± 1.5	NG	2 ± 0.4^{c}
Custard	21± 1.40^{e}	5 ± 1.2^{b}	NG	NG	1.4 ± 0.5^{c}

Values are means ±SD of Triplicate determinations; Values in the same column with different superscript are significant (P< 0.05). NG = No Growth

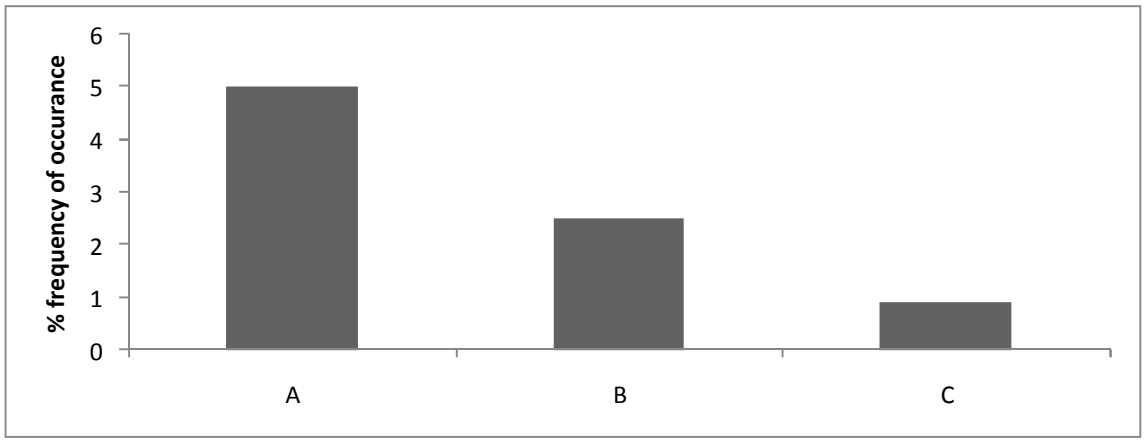

Figure 1: Percentage frequency of occurrence of the bacterial isolates from the weaning foods.
Key: A- *Bacillus* sp, B- *E. coli*, C- *Staphylococcus* sp

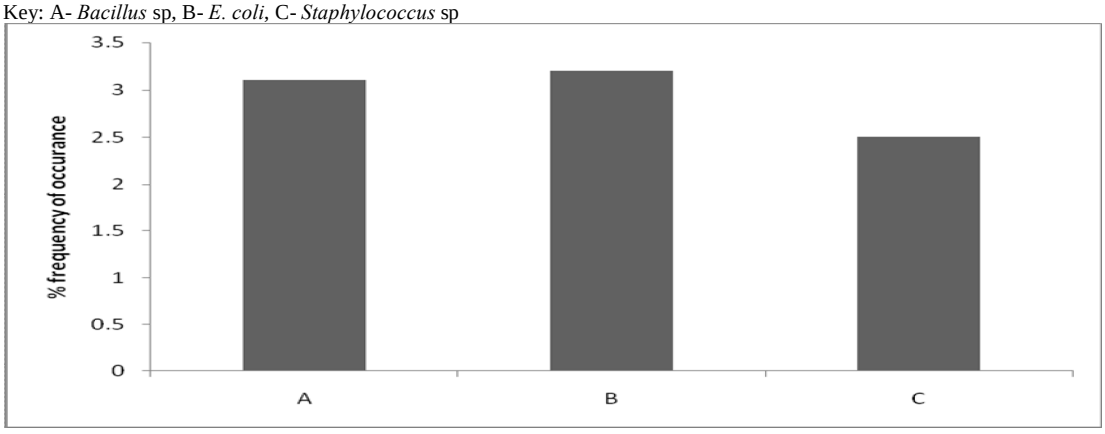

Figure 2: Percentage frequency of fungal and mould occurrence of the weaning foods
Key: A- *Aspergillus* sp, **B**- Yeast, **C**-*Penicillium* sp

Percentage Carbohydrate and Moisture present in Ogi was significantly (P< 0.05) higher with 73.35 ± 0.61 and 9.3± 0.8 respectively, while Nutrend had highest percentage Protein of 14.1 ± 0.07. Highest fiber content was observed in Cerelac samples (7.0 ± 0.5).However, custard had the lowest percentage moisture of 1.8 ± 0.3 (Table 2)

Table 2: Mean nutritional analysis of weaning foods (%).

Weaning foods	Carbohydrate	Protein	Fibre	Ash	Moisture
Cerelac	62.5 ± 0.30^{a}	13.2 ± 0.14^{a}	7.0 ± 0.5^{c}	1.6 ± 0.3^{a}	2.5 ± 0.1^{a}
Nutrend	65.15 ± 0.82^{a}	14.1 ± 0.07^{a}	2.0 ± 0.3^{a}	2.1 ± 0.2^{a}	2.0 ± 0.3^{a}
Ogi	73.35 ± 0.61^{b}	9.8 ± 0.42^{c}	3.0 ± 0.8^{a}	0.2 ± 0.5^{b}	9.3 ± 0.8^{c}
Custard	66.05 ± 0.45^{a}	13.5 ± 0.35^{a}	2.1 ± 0.7^{a}	2.2 ± 0.1^{a}	1.8 ± 0.3^{a}

Values are means ±SD of Triplicate determinations; Values in the same column with different superscript are significant ($P < 0.05$).

Discussion

The weaning period is the most critical stage in child development because it is the time that the child is gradually introduced to solid diet. At this time the immunity is still developing and most children exposed to unhygienic conditions frequently suffer from infantile diarrhoea (7). The main factors which determine food hygiene include handling, preparation techniques and storage practices. These are generally evaluated from the level of bacterial contamination present.

The very low microbial counts observed in Nutrend and Cerelac are suggestive of the strict adherence of the manufacturers to the prescribed quality control practices and Good Manufacturing Practices (GMP) necessary for the production of the food products. The permissible limits of total aerobic count is 10000(10^4) as specified in ICMSF, 1996 and only custard samples was observed to have exceeded this limit. Similar findings have been reported by (14) and (15).

Substantial numbers of coliforms especially *E. coli* indicates directly or indirectly fecal contamination and it implies a general lack of cleanliness in handling and improper storage. However, the presence of *E. coli* in almost all types of weaning food samples has also been reported by (16). The presence of Staphylococci in ogi indicates cross contamination, poor preparation and handling practices. Staphylococcal presence in ogi can result in food poisoning with symptoms like nausea and vomiting. This result agrees with the findings of (17) who reported that *E. coli* and *Staphylococcus aureus* grew and survived in Ogi. All food samples were free from *Salmonella and Shigella* which can cause food borne illness. This result agrees with (18) who reported weaning food samples to be free from *Salmonella and Shigella.*

The presence of moulds and yeast in Ogi and Custard is not desirable. Although Aflatoxin test was not carried out, *Aspergillus* sp has been found to produce toxins and cause spoilage of foods. This result agrees with the findings of (19) who reported that *Aspergillus, Penicillium, Fusarium* and *Cladosporium* were the most common genera in wheat, barley, corn and sorghum weaning foods. Similarly, *Aspergillius* were reported from different cereal grains (20, 21) and Yeasts have been isolated frequently from corn snacks (22).

High moisture content in weaning foods especially in Ogi could be a factor that encouraged microbial growth. The low moisture content in Nutrend and Cerelac would therefore indicate low storage problems or fungal growth. Ash content in Ogi was observed to be lower compared to other weaning foods. Similar ash contents have been reported by (23).

Conclusively, although commercially prepared weaning foods are preferred and used by most mothers to feed their infants due to their higher nutritional value and ease of preparation, locally produced foods are cheaper and give the same nutrient value. It is advisable that Good Manufacturing Process (GMP) and food safety programmes be encouraged in order to produce safe foods.

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