ASSESSMENT OF THE MICROBIOLOGICAL STATUS OF SOME COMMERCIAL YOGHURT BRANDS SOLD IN OWERRI METROPOLIS, IMO STATE, NIGERIA

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Abstract: An assessment of the microbiological quality of seven commercial brands of yoghurt drinks sold in Owerri metropolis was determined using standard microbiological procedures. The physical parameters of the brands at time of purchase were also determined. The results showed that the pH values of the samples ranged from 4.29-4.46, while their temperature readings were between 8 and 17°c. While average total heterotrophic counts rang ed from $2.00x10^5$ to $2.04x10^6$cfu/ml, average coliform counts were from 8.0x104 to 2.01xl06cfu/ml and average total fungal counts ranged from $3.5xl0^5$ to $2.5xl0^6$sfu/ml. Four bacterial genera were identified among the isolates and included *Escherichia coli, Staphylococcus aureus, Streptococcus* spp. and *Lactobacillusspp.* The fungal genera identified were *Candida albicans, Aspergillusfumigatus, Aspergillusglaucusand Saccharomyces cerevisiae.Escherichia coli* were isolated from **all** the seven yoghurt brands sampled. The result of this study therefore indicated poor Microbiological standards of commercial yoghurts sold in Owerri metropolis at the time of this research. This result underlines the need for improved hygienic measures in the processing, storage and distribution of these products to avert public health challenges.

Key **words:** Yoghurt, microbiological safety, public health, microbiological status, physical parameters.

Introduction

Fermentation, a classical method of food preservation, can also be applied in the production of a variety of food products, from different raw materials and under varying conditions. Fermented milk has distinct flavours and aromas, depending on the incubation conditions and the microbial inocula used. Milk fermentation is usually carried out by inoculation of the milk with the desired starter culture, incubation at optimum temperature and then stoppage of microbial growth by cooling (Prescott *et al.*, 2008).Yoghurt is a semi-solid fermented product made from a heat-treated standardized milk mix by the activity of a symbiotic blend of *Streptococcus thermophilusand Lactobacillus delbrueckii*sub sp*bulgaris*(Chanden, 2006).

These two genera of bacteria are responsible for milk acidification and synthesis of aromatic compounds in yoghurts (Serra*let al.*, 2009). According to Prescott *et al.* (2008), the special starter culture of these two major bacteria, *Streptococcus thermophilus*and *Lactobacillus bulgaris* are present in a 1:1 ratio. With these two organisms growing together, the *Streptococcus* spp. produces the acid while the aroma components are formed by the *Lactobacillus* (Prescott *et al.*, 2008). All other microorganisms present in yoghurt should be considered as contaminants. Although bacteria can be spoilage organisms, yeasts and filamentous fungi are often involved in the deterioration of yoghurts (Fleet, 1990, 1992).

Adams and Moss (1995) asserted that yoghurts are spoiled by acidoduric organisms like yeasts and moulds. They are responsible for off flavours, loss of texture quality due to gas production and

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packaging swelling and shrinkage (Foschino*et al.*, 1993, Nduka, 2004) and even food poisoning when consumed, thereby posing a risk to human health (Nduka, 2004). Onuorah and Adekeye (1979) however pointed out that it is possible for processed foods to be contaminated right from the raw materials, water used, packaging materials and the food handlers themselves working under unhygienic environments.

Acceptable microbiological conditions for yoghurts include counts that do not exceed 5 x 10^4cfu/ml for mesophiles, 10cfu/ml for coliforms, and 1 mould/ml for fungi according to the International Commission on Microbiological Specification for Food ICMSF (FAO, 1979).

Maintenance of good sanitary conditions and other parameters including control of temperature and pH during process and storage are necessary in order to ensure profitable production, good quality and safety of yoghurt to consumers (Nduka, 2004). According to Taura*et al.* (2005), yoghurt is one of the foods or drinks most commonly packaged and sold in disposable polythene bags, paper packs and / or plastic bottles. Final packaging including the sealing of the content of such drinks is usually done by hand or simple mechanical sealing machines in small and medium scale factories as opposed to the use of automated fillers.

Yoghurt is a popular drink in Nigeria, according to De *et al.* (2014), because of its nutritional, probiotic and organoleptic characteristics. In Owerri like in other parts of Nigeria, they are stored in portable food coolers and hawked in motor packs, on the streets and markets. Due to lack of employment and economic returns and the popularity of yoghurt, production and marketing is no more left for the big companies and manufacturers. There has therefore been a proliferation of different brands of the product in the market, with some of them being produced and stored under conditions that could encourage the growth of spoilage microorganisms.

A number of researchers have studied the microbiological quality of yoghurts from other parts of the country like Kano (Taura*et al.*, 2005), Bauchi (Okpala and Jideani 2006), Onitsha (Ifeanyi*et al.*, 2013) and Kaduna (De *et al.*, 2014), but none as yet in Owerri. This study therefore sought to assess the microbiological quality of yoghurt drinks sold and consumed in Owerri Metropolis, Imo State, Nigeria with a view to also ascertain the presence or otherwise of organisms of public health concern.

Materials and methods

Samples and sample collection

Twenty-one samples of 7 different brands of yoghurt drinks were randomly purchased from hawkers and mobile vendors in Owerri metropolis for the current study. All seven brands were duly registered with their registration numbers approved by the National Agency for Food and Drug Administration and Control (NAFDAC). Four of the brands from their names were deemed to be fruit yoghurts, while the other three didn't have any such designations. The samples were immediately taken to the laboratory in ice containers, under aseptic conditions, where analysis was carried out immediately. These samples were labelled A to G.

Determination of the physical parameters of the samples

The temperatures of the samples were measured at time of purchase using a thermometer. The pH of the samples was also determined using an Orion research pH meter. Other packaging information including expiry dates, nature of packs, volume, colour, of the content as well as NAFDAC registration numbers of the products were also noted.

Microbiological analysis of the samples

The samples were serially diluted and 0.1 ml of 10^6 dilutions was inoculated in triplicates into different media for the growth of the different groups of

microorganisms. Total heterotrophic counts were determined using nutrient agar (NA); total coliform counts were determined using MacConkey agar (MCA) while saboraud dextrose agar (SDA) was used for the enumeration of total fungal counts. All the NA and MCA plates were incubated at 28^{0}C for 18 – 24 hours while SDA plates were incubated at room temperature for 4 – 7 days. Counts of colonies were taken, and then the colonies were picked and sub-cultured by streak method on fresh nutrient agar for purity.

Results and Discussion

Table 1 shows the results of the analysis of the physical parameters of the samples. Temperature readings ranged from 8 to 17^{0}C while pH readings were between 4.29 and 4.46.

Table 2 shows the results of microbiological analysis of the seven yoghurt brands. While average total heterotrophic counts (THC) ranged from 2.0 x 10^5 to 2.04 x 10^6cfu/ml, average total coliform counts (TCC) ranged from 8.0 x 10^4 to 2.01 x 10^6cfu/ml and average total fungal counts (TFC) were between 3.5 x 10^5 and 2.5 x 10^6sfu/ml.

Table 3 shows the different types of microorganisms isolated and identified from the yoghurt samples. Four bacterial genera including *Escherichia coli, Staphylococcus aureus, Streptococcus* spp. and *Lactobacillus* spp.were identified. Also four fungal genera which included *Candida albicans, Aspergillusfumigatus, Aspergillusglaucus,* and *Saccharomyces cerevisiae*were identified.

All the seven yoghurt brands tested failed the microbiological safety test, since their total heterotrophic counts (THC), total coliform counts (TCC) and total fungal counts (TFC) had values far greater than the maximum tolerable limits of 5 x 10^4cfu/ml, 10 cfu/ml and 1 mould /ml for THC, TCC and TFC respectively (FAO, 1979). These results are similar with that of Taura*et al.* (2005), whose analysis of 20 yoghurt brands in Kano, Nigeria showed 40%, 55% and 90% of the samples had counts higher than the acceptable standards for THC, TCC and TFC respectively. However, only 1% of his samples passed all three safety limits. Okpala and Jideani (2006) also reported poor microbiological standards of commercial yoghurts sold in Bauchi, Nigeria. Similarly, Ifeanyi et al., (2013) reported that the microbiological quality of yoghurts sold in Onitsha metropolis fell below the acceptable standards.

Four different bacterial genera were identified amongst the microbial isolates. These included *Escherichia coli, Staphylococcus aureus, Streptococcus* spp. and *Lactobacillus* spp. The presence of *Streptococcus* spp. and *Lactobacillus* spp. in the yoghurt samplesagrees with the assertion that they are the most common bacterial species used in the fermentation of milk into yoghurt (Perdigon*et al.*, 1995). *Escherichia coli* were isolated from all the samples tested, while *S. aureus* were isolated from 71% of the samples. According to Philip (1977), the presence of coliform bacteria in fermented milk is considered undesirable since they indicate unsanitary conditions or practice. Such contaminated foods can cause a serious threat to public health since pathogens such as *Salmonella, Staphylococcus, Shigella and Clostridium* species are known contaminants incriminated in the outbreak of gastroenteritis (Mukhtar*et al.*, 2001). Also four different fungal genera were identified and included *Candida albicans, Aspergillusfumigatus, Aspergillusglaucus,* and *Saccharomyces cerevisiae.* According to Adams and Moss (1995), yoghurts are spoiled by acidoduric organisms like yeasts and moulds. In fruit containing yoghurts, *S. cerevisiae*has been implicated in spoilage, as well as *Mucor, Rhizopus, Aspergillus, Penicillium and Alternaria* (Adams and Moss, 1995). According to Arnott*et al.* (1997), contamination of yoghurts by yeasts or moulds is generally related to the fruits

added for flavour or poor hygienic practices during packaging. *Saccharomyces cerevisiae* was also isolated from yoghurt samples in Brazil (Moreira *et al.*, 2001). Ifeanyi*et al.* (2013) also isolated *E. coli, Aspergillus and Rhizopus* from yoghurt samples sold in Onitsha while De *et al.* (2014) isolated *Staphylococcus* spp. from yoghurt samples sold in Kaduna metropolis.

According to Habibu and Mukhtar (2002) many of the home-based local factories of food and drinks undertake the filling of the packs, polythene bags and bottles carelessly without observing any form of sanitation in the production and packaging of the yoghurt drinks. Frazier and Westhoff (1978) pointed out that this may be another reason for the high counts of heterotrophic bacteria as well as coliform and fungal counts observed in yoghurt sample drinks. Nduka (2004) asserted that unsanitary conditions during processing, handling, marketing and storage was responsible for the introduction of coliforms into foods and these can render the foods unsafe.

The average temperature readings for the yoghurt samples were too high at between 8 and 17^0 C as at the time of purchase. According to Adams and Moss (1995), after the addition of fruits and flavours to yoghurt during production, they are cooled to below 5^{0}C. Under this condition, they are expected to keep for around three weeks. Dispatch is usually at 2 – 4^{0}C. The temperatures recorded therefore are suitable temperatures for yoghurt spoilage and microbial contamination.

Also the pH readings of between 4.29 and 4.46 are somewhat above the high acidity and low pH of between 3.8 and 4.2 expected for yoghurt storage. At this pH of 3.8 – 4.2, yoghurt is not a hospitable medium for pathogens which will not grow and will not survive well either. These poor conditions as reported in this study do not support the delivery of wholesome yoghurt to consumers as asserted by Nduka (2004).

In conclusion, the commercial yoghurts sold in Owerri metropolis at the period of this research were microbiologically unwholesome for human consumption. This calls for measures to monitor the preparation processes, packaging, storage and distribution of yoghurt and its products in Owerri metropolis by the National Agency for Food and Drug Administration and Control (NAFDAC), Nigeria. Efforts to correct these anomalies are also essential to avoid public health diseases, particularly since yoghurt drinks are favourites of many of the citizens.

Table 1: Physical parameters of the yoghurt samples analysed

Sample No.	Average pH values	Average temperature values (^{0}C)
A	4.32	17
B	**4.29**	16
C	**4.35**	8
D	**4.34**	9
E	**4.56**	5
F	**4.42**	16
G	4.46	8

Table 2: Mean total microbiological counts of the yoghurt samples

Sample No.	THC (cfu/ml)	TCC (cfu/ml)	TFC (sfu/ml)
A	2.0×10^5	8.0×10^4	3.5×10^5
B	2.4×10^5	9.0×10^5	1.06×10^6
C	6.3×10^5	1.10×10^6	2.04×10^6
D	1.08×10^6	1.15×10^6	2.20×10^6
E	1.74×10^6	1.24×10^6	2.26×10^6
F	2.02×10^6	1.74×10^6	2.33×10^6
G	2.04×10^6	2.01×10^6	2.48×10^6

Key: THC, total heterotrophic counts; TCC, total coliform counts; TFC, total fungal counts.

Table 3: Microorganisms isolated from the different yoghurt samples

Organism	Samples						
	A	B	C	D	E	F	G
E.coli	+	+	+	+	+	+	+
S. aureus	+	+	+	+	_	_	+
Streptococcus sp	+	+	+	+	+	_	+
L. bulgaricus	+	+	+	+	+	+	_
C. albicans	_	_	+	_	+	_	_
A. fumigatus	_	_	+	_	_	_	-
A. glaucus	_	+	_	_	_	_	_
S. cerevisiae	+	_	_	+	+	_	+

Key: +, present; -, absent

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