MICROBIOLOGICAL QUALITY ASSESSMENT OF COMMERCIALLY PREPARED YOGHURT RETAILED IN SOKOTO STATE, NORTHWESTERN NIGERIA

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ABSTRACT

Physico-chemical and microbiological quality of six brands (18 samples) of yoghurt sampled from retail outlets in Sokoto, Northwestern Nigeria were evaluated for the level of quality measures used by the producers and their wholesomeness for human consumption. The mean pH value of the yoghurt samples ranges from 3.69-4.50. The mean total aerobic plate count (TPAC) was 3.37×10^4 cfu/ml while the range was 2.66×10^4 to 1.13×10^4 cfu/ml of yoghurt. There was no significant difference ($P>0.05$) in the cfu/ml between the six yoghurt brands analysed. The aerobic plate mesophilic bacteria isolated were *Lactobacillus spp* and *Streptococcus spp* while E. *coli* an indicator for coliforms was not detected in any of the samples. The findings of this study indicates that the bacterial load of commercially produced yoghurt sold in Sokoto were within the recommended safe limits of $1.0 - 3.5 \times 10^4$ cfu/ml for human consumption.

Key words: aerobic plate count, coliform, yoghurt, pH.

INTRODUCTION

Yogurt is one of the most popular fermented dairy products widely consumed all over the world. It is obtained by lactic acid fermentation of milk by the action of a starter culture containing *Streptococcus thermophilus* and *Lactobacillus delbruckii* spp. *bulgaricus*. The role of these two genera in yogurt manufacturing can be summarized as milk acidification and synthesis of aromatic compounds (Serra *et al*., 2009). Yogurt has also been described as a notoriously balanced food containing almost all the nutrients present in milk but in a more assimilable form and they can be produced from skimmed or whole milk and there is a large range of flavours available commercially (Anthar, 1986; Oyeleke *et al*., 2009). People who are moderately lactose intolerant can consume yoghurt without ill-effect because much of the lactose in the milk precursor is converted to lactic acid by the bacterial culture (Alayande, 2008). In Nigeria, it is a popular drink due to its nutritional, probiotic, vulvovaginal and organoleptic characteristics. Fermented milks, like the fresh milk from which they are produced, are liable to microbial contamination and be a risk to human health. Moulds and yeast are the primary contaminants in yogurt produced commercially in Nigeria (Suriyarachchi and Fleet, 1981; Oyeleke *et al*., 2009; De *et al*., 2014). Though bottled yogurt is a popular drink in Sokoto Metropolis, Sokoto state, Nigeria, limited research was done on its microbiological quality.

MATERIALS AND METHODS

Study area

The study was conducted within Sokoto metropolis, Sokoto state, Nigeria. It is located at the extreme Northwest of Nigeria within the Sudan savannah between Latitude 12°N and 13°58'N and Longitude 4°8'E and 6°54'E. There were six (6) commercial yoghurt producers within the study area. The study was conducted between August–November, 2011.

Sample collection

Commercially - prepared yogurt products packaged in plastic containers were purchased from retailers. A total of eighteen (18) samples were aseptically collected, three samples each from the six (6) available commercial yoghurt producers. The information, on their claim forms were recorded e.g., National Agency for Food, Drug, Administration and Control, NAFDAC registration number, manufactured and expiry date, address of producers and batch number. Samples were immediately transported to the microbiology laboratory for analysis.

Sample analysis

Data generated was analysed using one way analysis of variance (ANOVA).

Physio-chemical characteristics of yoghurt samples

All the samples of yoghurt purchased were white in colour, semi solid in nature and had pH ranging from 3.69 – 4.50.

Isolation, characterization and identification of isolates

Citrate medium, EMB agar, Nutrient agar, MacConkey agar, Ureas medium, MR-VP medium and Indole medium were prepared according to the manufacturer's instruction. The samples of the yogurt products were shaken vigorously to suspend the microbial content. These samples were separately inoculated into different culture media, which include Mac Conkey agar, Nutrient agar. Serial dilutions up to 10^{-3} were made and 1 ml of each suspension was introduced onto agar medium using streak method. The plates were incubated aerobically at 37° C for 24 h to bacteria colonies. Discrete colonies were isolated and reinoculated onto appropriate medium in order to obtain pure isolates. These pure isolates were then kept at 4°C for identification purpose (Michaylova, 2007): Bacterial isolates were characterized based on microscopic appearance, colonial morphology and biochemical tests. The isolates were identified by comparing their characteristics with those of known taxa (Cheesbrough, 2003; Oyeleke and Manga, 2008). Colonies were counted and plates with less than 10 and greater than 300 colonies were not considered (Cheesbrough, 2003). The colony forming unit (CFU) per ml was obtained by multiplying the number of colonies on the end point plate by the dilution factor (Henry *et al.*, 1982)

Coliform indicator isolates

E.coli, a coliform indicator was absent in all the samples analysed.

RESULTS

Table 1 showed the results of evaluation of yogurt companies with manufacturing ethics. It showed that all the different brands except sample II had NAFDAC's registration number similarly, they all indicated name and address, volume, manufacturing and expiry dates. Unlike others, sample II did not indicate batch number on the label. Table 2 showed total aerobic bacterial plate count of all yoghurt samples analysed with a mean aerobic plate count (TAPC) ranging from $2.66 \times 10^4 \pm 8.3 \times 10^4$cfu/ml to $1.13 \times 10^4 \pm 1.17 \times 10^4$cfu/ml. Sample V had the highest bacterial count of 1.13×10^5cfu/ml and sample VI had the lowest bacterial count of 2.66×10^4cfu/ml. There was no significant statistical difference observed in the cfu/ml of the eighteen (18) yoghurt samples analysed P (> 0.05). Table 3 showed bacterial isolates from yoghurt samples in Sokoto. Aerobic mesophilic bacterial organisms identified were *Lactobacillus spp.* and *Streptococcus spp.* which are also referred to as bacterial cultures used in the fermentation process. E.coli, a coliform indicator was not present in all the samples.

Table 1: Physical examination of container for labeling compliance in Sokoto

S/no	Name	Nafdac reg. No	Name & address	Volume	Man. Date	Exp. Date	Batch no
1	Sample I	+	+	+	+	+	+
2	Sample II	-	+	+	+	+	-
3	Sample III	+	+	+	+	+	+
4	Sample IV	+	+	+	+	+	+
5	Sample V	+	+	+	+	+	+
6	Sample VI	+	+	+	+	+	+

+ = present, - = not present, **MAN.** = manufacturing date **EXP.** = expiry date.

Table 2: Total bacterial plate count (TBAPC) of yoghurt.

Weekly samples	Commercial Producers.					
	I	II	III	IV	V	VI
First week	$6.4x10^4$	$4.8x10^4$	$9.6x10^4$	$4.0x10^4$	$6.0x10^4$	$2.0x10^4$
Second week	$4.4x10^4$	$4.0x10^4$	$1.2x10^4$	$3.6x10^4$	$3.2x10^4$	$2.4x10^4$
Third week	$2.4x10^4$	$8.8x10^4$	$4.8x10^4$	$2.24x10^4$	$2.48x10^4$	$3.6x10^4$
Mean	$4.4x10^4$	$5.86x10^4$	$1.0x10^4$	$5.2x10^4$	$1.13x10^4$	$2.66x10^4$
SD	$2.0x10^4$	$2.5x10^4$	$4.21x10^4$	$1.07x10^4$	$1.17x10^4$	$.3x10^4$

Samples I, II, III, IV, V and VI

Table 3: Isolated organisms from yoghurt in Sokoto

Organisms	I	II	III	IV	V	VI
Streptococcus spp	+	+	+	+	+	+
Lactobacillus spp	+	+	+	+	+	+
Escherichia coli	-	-	-	-	-	-

+ = present, - = absent

DISCUSSION

The total aerobic plate count often signifies the sanitary condition of food production processes. The result of this study revealed that significant level of sanitary measures are being put in place throughout the process of production by the commercially available yoghurt producers within the study area. Regulations by NAFDAC, requires that food labelling should be informative and accurate. The minimum labelling requirements for regulated items involve a declaration of the production brand, name, address of the manufacturer, product's batch number, manufacturing and expiry date, volume and most importantly NAFDA registration number. Of the total six (6) brands analysed in this research, five (5) met the requirements of NAFDAC including batch numbers were displayed on the products' container and the remaining one displayed neither NAFDAC registration number nor batch number. Lack of displaying these NAFDAC requirements could be of great public health concern as to the difficulty it will pose in identifying a specific batch found to be harmful should there be an emergency. The mean total aerobic plate count detected in this research work ranges from $2.66 \times 10^4 \pm 8.3 \times 10^4$cfu/ml to $1.13 \times 10^4 \pm 1.17 \times 10^4$cfu/ml. Coliforms were not identified in the analysed samples which could be due to the significant level of sanitary measures implored by the various processing procedures (Peter *et al*, 2010). The absence of these organisms in the samples does not mean they will be absent even at the consumer level as there is possibility of contamination along the chain of distribution. Statistical comparison revealed that the cfu/ml of analysed samples falls within the standard. Thus they were not contaminated and fit for consumption.

Conclusion and Recommendation

This study evaluated the amount of sanitary measures employed by commercial yoghurt producers within the study area (Sokoto) by calculating the total aerobic plate count of each sample from the finished products and determining the source of contamination through identification of micro-organisms in the sample(s). This therefore shows that, expected sanitary measures are being put in place because the total aerobic plate count falls within the standard of $1.0 - 3.0 \times 10^4$ cfu/ml (NAFDAC, 2005), thus fit for human consumption. The samples with the highest and lowest aerobic plate count are 1.13×10^4cfu/ml and 2.66×10^4cfu/ml respectively, and two (2) mesophilic bacterial organisms *Streptococcus spp.* and *Lactobaccilus spp.* were isolated. The result revealed that yoghurt commercially produced in Sokoto is of good quality; in line with Oyeleke (2009) all effort should be made to sustain the standard and existing regulations of NAFDAC in relation to food quality should be strictly adhered to.

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