Sachets of various brands of yoghurt were randomly purchased from different retail outlets within Omoku schools and its pH and microbiological quality were determined using standard method. Total bacterial count (TBC) and Coliform count were done using standard plate count method after making serial dilutions of yoghurt samples. Nutrient agar (NA) was used for enumeration of TBC. NA plates were incubated at 37°C for 48 h. Coliform count was carried out using MacConkey agar (MCA) incubated at 37°C for 48 h. Total fungi were determined by using potato dextrose agar (PDA) and the plates were incubated at room temperature for 5-7 days. The pH of yoghurt samples ranged from 2.38±0.81 to 3.2±0.08, TBC ranged from 3.1 x 10^5 to 5.1x 10^5 cfu/mL. Total fungi count ranged from 3.2 x 10^3 to 4.9 x 10^3 cfu/mL. Total coliform count ranged from 0 to 1.0 cfu/mL. There was no significant difference in TBC and total coliform counts (p>0.05), but there was significant differences in total fungi counts (p<0.05). Results indicate that yoghurt sold in Omoku schools is of poor microbiological quality and thus their production and sale should be closely monitored in order to protect students and pupils and the general public from food-borne infection.

**Key words:** Contaminated, total bacteria count, total coliform, total fungi, bacteria, pathogens, yoghurt.

**INTRODUCTION**

Yoghurt is a sour milk beverage made by blending fermented milk with various ingredients that provide flavour and colour. Although, it is a traditional beverage in the Balkans and Middle East (Ghandge et al., 2008), yoghurt is consumed by all people of all nations. Yoghurt is produced by symbiotic actions of two lactic acid bacteria, namely *Streptococcus thermophilus* and *Lactobacillus bulgaricus* which ferment lactose to lactic acid, which gives it its sour taste (Steinkraus, 1997; Tamine and Robinson, 2004; Kumar and Mishra, 2004; WDC, 2014). Yoghurt can serve as food and plays an important role in human nutrition, health maintaining, therapeutic and dietetic functions (Younus et al., 2002; Khan et al., 2008).

The nutritional quality of yoghurt has been reported and is known to contain high-quality protein, calcium and phosphorous. Its carbohydrate can be utilized easily by those intolerant to lactose (Younus et al., 2002; Alakali et
It is also believed that yoghurt has valuable therapeutic properties and helps in curing gastrointestinal disorders (Athar, 1986; Wolinsky, 2000; Younus et al., 2002; Vasiljevic and Shah, 2008). Yoghurt also serves as a medium for the growth of microorganisms due to its high nutritional content hence it is liable to contamination. Moulds and yeast are the primary contaminants in yoghurt. Fungi growing in yoghurt utilize some of the acid, which will invariably reduce the acidity and hence favour the growth of putrefactive bacteria (Oyeleke, 2009) or other pathogenic organisms such as Staphylococcus aureus (Ifaeniyi et al., 2013; De et al., 2014; Makut et al., 2014). Evaluation of the bacterial quality of yoghurt is necessary due to the high risk associated with consuming sub-standard or unhygienic yoghurt containing pathogenic organisms. Although, there are reports of qualities of yoghurt sold in some parts of Nigeria, no research has been done for yoghurts sold in the oil producing community of Obga/Egbema/Ndoni local government area (ONELGA). Analyzing yoghurt for its quality is therefore required in order to create awareness among ONELGA people about the existing situation and hence protect the consumers’ health from food-borne epidemic.

MATERIALS AND METHODS

Sample collection and preparation

Eight sachets of four different brands of yoghurt samples (names withheld) were purchased randomly from retail outlets within schools in Omoku and transported to the Integrated Science Laboratory of Federal College of Education (Technical) Omoku for analyses.

pH analysis

The pH values of the samples were analyzed using a Jenway 3505 pH meter (Camlab, UK).

Total bacterial count

Total bacterial count was carried out by pour plate technique as described by Kawo et al. (2006). Briefly, one mL of 10^3 dilution series of yoghurt samples was plated on Nutrient agar (Oxoid) and incubated aerobically at 37°C for 24-48 h. Colonies that developed were counted and expressed in colony forming units per milliliter (cfu/mL).

Total coliform count

Coliform count was carried out using MacConkey agar (Oxoid). One milliliter of the diluted yoghurt sample was transferred into well labeled Petri-dishes. Fifteen millimeter of the sterile melted agar at 45°C was poured and then swirled to mix with the agar thoroughly. This was allowed to solidify before incubation at 37°C for 48 h. Colonies obtained were counted.

Total fungi count

Total fungi were determined by plating the diluted yoghurt samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total bacteria</th>
<th>Total coliform</th>
<th>Total fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1</td>
<td>3.1 x 10^5 ± 0.45</td>
<td>1.0 ± 0.50</td>
<td>3.2 x 10^3 ± 0.26</td>
</tr>
<tr>
<td>Y2</td>
<td>4.1 x 10^5 ± 0.71</td>
<td>1.0 ± 0.50</td>
<td>3.4 x 10^3 ± 0.59</td>
</tr>
<tr>
<td>Y3</td>
<td>4.9 x 10^5 ± 0.10</td>
<td>0.0 ± 0.00</td>
<td>4.0 x 10^3 ± 1.25</td>
</tr>
<tr>
<td>Y4</td>
<td>5.1 x 10^5 ± 1.20</td>
<td>1.0 ± 0.00</td>
<td>4.9 x 10^3 ± 1.24</td>
</tr>
</tbody>
</table>

Values are presented as mean and standard deviation.

RESULTS AND DISCUSSION

The pH of yoghurt samples is shown in Table 1 and ranged from 2.38 ± 0.81 to 3.2 ± 0.08. The pH recorded is within the range of 2.35 ± 3.18 reported by Makut et al. (2014) but lower than the ranges reported by Ifeanyi et al. (2013) which is from 3.93 ± 4.50 and Digbabul et al. (2014) which is from 4.73 ± 5.11. This low acidity tended to inhibit coliform and favour the growth of acidophilic yoghurt bacteria as well as yeast and moulds hence their presence in the product.

Total bacteria count in yoghurt sold in public schools in Omoku is shown in Table 2 and ranged from 3.1 x 10^5 ± 0.45 to 5.1 x 10^5 ± 1.20 cfu/mL. High bacteria count is expected because of the presence of starter cultures, which are mainly lactic acid bacteria. The count obtained is comparable to the values obtained in yoghurts from Abuja (Okpalugo et al., 2008), Onitsa (Ifeanyi et al., 2013) and Makurdi (Digbabul et al., 2014). The standard count is 106-107 cfu/mL (Codex Alimentarius, 2003; Rodrigues et al., 2010). Very high count however is used as an indication of post-pasteurization contamination (Tamine and Robinson, 2004).

Total fungi count ranged from 3.2 x 10^3 ± 0.26 to 4.9 x 10^3 ± 1.24 (Table 2). These values are above the limits stipulated (Codex Alimentarius, 2003; Tamine and Robinson, 2004). High counts of yeast and mould have also been reported in yoghurts (Okpalugo et al., 2008; Ifeanyi et al., 2013; De et al., 2014; Digbabul et al., 2014). The presence of yeast and mould is attributed to
Table 3. One-way ANOVA statistics.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>F-Statistic</th>
<th>p value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Bacteria Count</td>
<td>F=4.47</td>
<td>p=0.102</td>
<td>NS</td>
</tr>
<tr>
<td>Total Fungi</td>
<td>F=0.50</td>
<td>p=0.518</td>
<td>NS</td>
</tr>
<tr>
<td>Total yeast and mould</td>
<td>F=8.72</td>
<td>p=0.042</td>
<td>S</td>
</tr>
<tr>
<td>pH</td>
<td>F=2.16</td>
<td>p=0.172</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS, not significant; S, significant at p=0.05.

poor handling and production (Kawo et al., 2006; Oyeleke, 2009; Amakoromo et al., 2012; Ifeanyi et al., 2013).

Total coliform count ranged from 0.0 to 1.0 x 10^6 ±0.50 cfu/mL (Table 2). The low level is attributed to acidity of yoghurt and/or heat treatment (Jay, 1992). Coliform was reported in some yoghurts produced locally at Kampala (Mukisa and Kyoshabire, 2010) and Keffi (Makut et al., 2014) but not in yoghurt sold at Ibadan (Ali et al., 2010) and Makurdi (Digbabul et al., 2014), although they contained yeast. The presence of coliform bacteria indicates unhygienic practices during handling of the product (Montagana et al., 1998). *Escherichia coli* in particular indicates failure in general manufacturing practices (FAO, 1998; Tamine and Robinson, 2004). Singh and Prakash (2008) also noted that the presence of *E. coli* in a milk product indicates presence of other enteropathogenic microorganisms which constitute a public health hazard.

One-way analysis of variance indicated that there was no significant difference in pH, total bacteria and total coliform counts (p>0.05), but there was significant differences in total fungi counts (p<0.05) (Table 3). Similar results have been obtained for yoghurt samples sold in Onitsha in which no significant difference in coliform but significant difference was observed in total bacteria count (Ifeanyi et al., 2013).

Conclusion

Although no attempt was made to isolate any organisms in this study, related researches have shown that most yoghurt sold in Nigerian markets are contaminated with pathogenic bacteria such as *E. coli*, *Staphylococcus aureus*, *Bacillus* sp. and moulds, such as *Rhizopus* sp., *Aspergillus* sp. etc. The presence of coliform in the yoghurt samples in this study confirms the unhygienic standards under which it is produced as also observed by other researchers. The implication of the findings is that consumption of contaminated yoghurt may contribute to high prevalence of gastroenteritis in the area. The high fungi count is equally disturbing because some moulds have the potential to produce aflatoxins, which are known to cause food intoxication and some type of cancer.

Therefore, sanitary inspection of production premises as well as consumer protection is hereby advocated.

Conflict of interests

The authors did not declare any conflict of interest.

REFERENCES


