PROXIMATE AND MICROBIOLOGICAL QUALITIES OF FUNCTIONAL FRUIT JUICE FLAVOURED YOGHURT MADE FROM BOVINE MILK

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ABSTRACT
Yoghurt is a highly relished dairy product with wide global acceptance. In the production of yoghurt, synthetic flavourants are often used in improving its taste and flavour, however, this has created a lot of health concerns to the consumers. This study was conducted to investigated the quality of yoghurt produced using fruit juices as natural flavourants. Fresh cow's milk was pasteurized at 80°C for 3 minutes. The milk was thereafter cooled to 42^{0}C for inoculation. Reconstituted commercial strawberry flavour (T1) (synthetic flavour as control), fruit [coconut (T2), orange (T3) and pineapple (T4)] juices were added at 200mL in 1L each of the inoculated milk and incubated at 43°C for 14 hours, and refrigerated for 14 days. The yoghurt samples were evaluated for physical and microbiological qualities at days 1, 7 and 14. Treatment effect indicated that moisture (84.27%), carbohydrate (9.66%) were highest in (T1) at day 1. Sample T4 had the highest fat (4.64%) and protein (6.83%) contents. It was generally observed that the microbial load count for yoghurt samples were at optimum (266.3-291.7 x10^3 cfu/mL) at day 1 of storage. The nutritional quality of yoghurt significantly (p<0.05) improved and microbial count observed was lower than the maximum international standard suggesting its wholesomeness for consumption.
Keywords : Nutritional, synthetic, yoghurt, storage, natural, fruits

INTRODUCTION

In the dairy industry, most foods are fortified with synthetic additives to improve their sensory and nutritional qualities. In recent times, this poses a great concern to consumers which has led to the consumers increasing demand for natural and beneficial foods in order to improve their well-being. During the processing of milk to other products, strains of lactic acid-producing microorganisms are added to milk resulting in the production of various fermented milk products. Among such fermented milk products is yoghurt. Yoghurt is one of the most popular fermented milk products in the world (Wiley *et al.,* 2008), it is a nutritious milk product with a unique characteristic and cherished by many people. It is believed that yoghurt has valuable therapeutic properties and helps curing gastrointestinal disorders (Buhattarai and Das, 2016). It is produced by the synergestic action between *Streptococus thermophiles* and *Lactobacillus bulgaricus* which breakdown the carbohydrate (lactose) in the milk to lactic acid thereby coagulating and forming a gel (yoghurt). Some fruits have been reported to add nutritional value to yoghurt quality (Mbaeyi-Nwaoha and Ekere, 2014, Ibhaze *et al.,* 2021). However, there is paucity of information on the inclusion of coconut, orange and pineapple extracts in yoghurt production. Coconut, orange and pineapple are affordable, available and rich in minerals, vitamins and antioxidants. Based on the beneficial properties of these tropical fruits, this study aimed at exploring their potentials in yoghurt production in terms of nutrient concentrations and the microbial quality of the yoghurt produced.

MATERIALS AND METHODS

Fresh oranges were cut, squeezed to obtain the juice, the pineapple pulp was cut into parts and blended, the juice was extracted using a cheese cloth. The endocarp of the coconut was diced and mixed with clean water at a ratio of 1:5 (w/v), blended with a juice blender and filtered with a cheese cloth to obtain the juice. All fruit extracts were pasteurized at 80°C for 3 min and allowed to cool. The commercial (synthetic) strawberry flavour was reconstituted with distilled water at a ratio of 1:2 v/v in order to get the desired taste. Fresh milk (12 L) obtained from the white Fulani cow was clarified using a cheese cloth to remove foreign materials, homogenized and then pasteurized at 80°C for 3 minutes. Sucrose (5 %) was added as sweetener. The milk was thereafter cooled to 42^{0}C for inoculation. A 60 g of commercial freeze-dried starter culture was added to 12 litres of the pasteurized milk. The fruit extracts and the reconstituted commercial strawberry flavour were then added at 200 ml into 1litre each of the inoculated milk. The inoculated and flavoured milk was incubated at 43ºC for 14 hours in an incubator. Parameters were investigated at storage periods of 1, 7 and 14 days. The proximate composition was determined as described by (AOAC, 2010) and the bacterial count was carried out using the pour plate technique as described by the International Dairy Federation (IDF, 2002) using nutrient agar.

Experimental design and statistical analysis

The experimental design was completely randomized design in a 4 x 3 factorial arrangement. Data obtained were subjected to two-way analysis of variance and significant means were separated using Duncan's multiple range test using the SAS (2012) version 9.2 software.

RESULTS AND DISCUSSION

Presented in table 1 is the proximate composition of yoghurt made from different flavourants at 1, 7 and 14 days storage periods. Storage period showed significant ($p<0.05$) increase in moisture, ash, and protein concentrations as storage increased. Carbohydrate and fat concentrations were highest (8.56 and 3.51 %) respectively at day 1 of storage. Treatment effect showed that synthetic strawberry flavoured yoghurt (T1) recorded the highest moisture 84.27 % and carbohydrate (9.66 %) contents. Fat (4.64 %) and protein (6.83 %) concentrations were highest in Pineapple flavoured yoghurt. Orange flavoured yoghurt (T3) had the highest (0.49 %) ash content. The microbial load count of flavoured-yoghurt presented in Figure 1. The highest microbial load count was observed in all the treatments at day 1 and thereafter, a decline from 291.70-56.70 x 10^3 cfu/ml was observed throughout the storage period in the synthetic strawberry flavoured yoghurt (T1) only. However, a contrary trend was observed in all the juice flavoured yoghurt as the microbial load depreciated at day 7 and then elevated at day 14. The moisture content is used to assess the storability of a product and provides a measure of the water content (Aremu *et al*., 2006). Abdulkadir and Danjuma (2015) also reported similar increase in moisture content due to long period of storage. The observed increase in protein content as the storage period progressed agrees with the report of Kiestanti and Romziah (2008) who reported that during fermentation process, the *Lactobacillus bulgaricus* and *Streptococcus thermophiles* microbe biomass increases, thus increasing the sum of microbe protein, that led to increased protein in the yoghurt. Conversely, carbohydrate and fat contents decreased as the storage period increased. The reduction in the carbohydrate as the storage period increased could be that the lactic acid bacteria present in the yoghurt could have used the carbohydrate as source of energy for their survival, thereby causing a reduction in the carbohydrate. Also the reduction in carbohydrate (lactose) observed suggest the action of *Lactobacillus bulgaricus* which is capable of breaking down lactose into galactose and glucose in the absence of oxygen. Similarly, Ihemeje *et al*. (2015) reported decrease in carbohydrate as storage period increased in carrot and pineapple flavoured yoghurt. The decline in fat content observed as storage period increased may be as a result of aerobic mesophilic bacteria utilizing lipids for the synthesis of cell membrane and other cellular organelles in order to increase their population (Omola *et al.,* 2014). Also, the result is in tandem with the report of Matter *et al.* (2016) who showed decrease in fat (from 2.92 -2.50%) as storage period increased in papaya yoghurt and cactus pear flavoured yoghurt. However, according to FAO standard, fat content of 0.5-10 is good but fat content of 3.0 is the best (Omola *et al.* 2014). The variations in the treatment effect on proximate composition of the flavoured yoghurts could be attributed to the difference in nutrient concentration inherent in the flavourants used. The higher concentration of bacteria in all samples at day 1 could have been due to the rapid multiplication of the Lactic acid bacteria used in the fermentation at this stage and the freshness of the samples. However, the fruit flavoured yoghurt samples had the least values in day 7 which then elevated at day 14. This may be due to the nutritional constituents of the fruit juices which could have encouraged proliferation of the microbes. This is consistent with the findings of Bristone *et al.* (2016). This therefore suggests that fruit flavoured yoghurt may not be stored beyond 7 days for optimum health benefits. Although, the reverse condition was observed in T1 (synthetic strawberry flavoured yoghurt) with a consistent decline in microbial load count as storage progressed. However, findings fell within the acceptable limit of 10^3 to 10^4as in the guidelines for the microbiological quality of ready to eat food sampled at point of sale (El-Diasty and El Kaseh, 2009). Moreso, the results obtained from this study are lower than those reported by Osundahunsi *et al*. (2007), who reported total bacteria count of 288 x 10^6 and 354 x 10^6 cfu/mL of yoghurt due to the microorganisms present in the inoculum. However, very high count in dairy products is an indication of post pasteurisation contamination which could be due to inadequate hygienic measures during production. Application of good hygiene practices rules would help to reduce disease risk related to the presence of pathogenic germs (Soncy *et al.,* 2015).

Table 1: Proximate composition (%) of fruit flavoured Yoghurt

Parameters	Moisture	Ash	Fat	Protein	Carbohydrate
Storage Periods (SP)					
1	81.92±0.19^{c}	0.39±0.03	3.51±0.40^{a}	5.68±0.19^{a}	8.56±0.43^{a}
7	82.46±0.28^{b}	0.41±0.03	3.38±0.38^{b}	5.84±0.13^{b}	7.92±0.22^{b}
14	83.30±0.34^{a}	0.41±0.03	3.35±0.38^{b}	5.91±0.13^{a}	7.14±0.18^{c}
Treatments (T)					
T1	84.27±0.37^{a}	0.37±0.02^{b}	0.19±0.00^{d}	5.51±0.10^{b}	9.66±0.41^{a}
T2	81.97±0.23^{c}	0.34±0.03^{b}	4.26±0.03^{c}	5.49±0.11^{b}	8.10±0.14^{b}
T3	82.59±0.11^{b}	0.49±0.04^{a}	4.54±0.06^{b}	5.32±0.01^{b}	7.07±0.16^{c}
T4	81.42±0.15^{d}	0.42±0.04^{ab}	4.64±0.04^{a}	6.83±0.14^{a}	6.65±0.21^{c}

Means along the same column with different superscripts are significantly ($p<0.05$) different. T1= synthetic strawberry flavoured yoghurt, T2= Coconut flavoured yoghurt, T3= Orange flavoured yoghurt, T4= Pineapple flavoured yoghurt

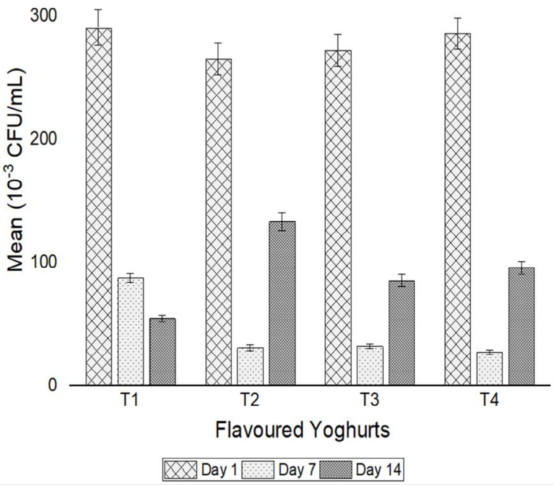

Fig. 1. Showing microbial load count of fruit juice flavoured yoghurt

T1= synthetic strawberry flavoured yoghurt, T2= Coconut flavoured yoghurt, T3= Orange flavoured yoghurt, T4= Pineapple flavoured yoghurt

CONCLUSION

From this study, it can be deduced that the health concerns by consumers with the use of synthetic flavourants in yoghurt production can be assuaged with the use of natural fruits. The low microbial count observed indicates that stringent hygienic condition was not compromised. In addition, for optimum health benefits, natural fruit fortified yoghurt should not be stored beyond seven days as there would be tendency in increase of the microbial load.

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