

APR -14

### Storage Effect on Chemical and Rheological Qualities of Synthetic and Naturally Flavored Yoghurt

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#### Abstract

Fresh cow's milk was obtained from White Fulani cows and clarified, homogenized and pasteurized at 80°C for 3 minutes. Sucrose (5%) was then added as sweetener. The milk was thereafter cooled to 42°C for inoculation. Commercial freeze-dried starter culture was added to 12 litres of the milk. Reconstituted commercial strawberry flavour (T1), fruit juices (coconut (T2), orange (T3) and pineapple (T4) were then added at 200ml into 1 litre each of the inoculated milk. The inoculated and flavoured milk was incubated at 43°C for 14 hours in an incubator. Each flavoured yoghurt produced was replicated thrice, and 250ml of each product was refrigerated for storage periods of 1, 7 and 14 days. The yoghurt for each of the storage periods was then subjected to chemical and rheological evaluations. The completely randomized design in a 4x3 factorial arrangement was adopted. The results of the analysis indicated that storage period had significant ( $p < 0.05$ ) effect on the parameters investigated. Storage period had significant ( $p < 0.05$ ) effect on Total Titratable Acidity (TTA), pH, viscosity, and free fatty acid (FFA). However, there was no significant ( $p > 0.05$ ) difference in the Peroxide value (PV). The storage and treatment effect showed that T2 had the highest values of pH (5.00) at day 7, viscosity (4.73dPas) at day 14 and TTA of 0.05mg/100g. However, T3 and T4 had the highest FFA (17.72mg/100g) at day 14 respectively. It was generally observed that viscosity, pH of the yoghurt samples improved with storage period, the FFA also increased with storage time.

**Key words:** Chemical, natural, rheological, synthetic, yoghurt

#### Introduction

Yoghurt is one of the most popular fermented milk products in the world (Wiley *et al.*, 2008). Yoghurt can be defined as a coagulated milk product that results from the fermentation of lactose in milk by *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Bouriloux and Pochart, 1988). Other lactic acid bacteria such as *Lactococcus* and *Leuconostoc* are also frequently used to produce yoghurt with a unique characteristic (Adolfsson *et al.*, 2004). It is a nutritious milk product and cherished by many people. Yoghurt is most often flavoured with synthetic flavours or other ingredients to reduce its natural sourness. Commercially sold yoghurt is flavoured with synthetic ingredient and exotic fruits such as strawberry, peach and raspberry. However, there are some underutilized tropical fruits such as coconut, orange and pineapple that could be used as flavoring agent in yoghurt production in place of the synthetic flavours (Onyibe *et al.*, 2010). Fruit juices add colour, flavour, essential vitamins and minerals, in addition to providing phytochemicals which impart health benefits (Con *et al.*, 1996). However, most tropical fruits have not been extensively explored for these benefits. Meanwhile, orange, coconut and pineapple are fruits that demonstrate these properties.

Therefore, based on the beneficial properties of coconut, orange and pineapple there is need to explore their potentials in improving the chemical and rheological qualities in yoghurt production.

#### Materials and Method

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. The 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 distilled water at a ratio of 1:5 (w/v), blended with a juice blender and filtered with a cheese cloth to obtain the juice from the pulp. All fruit extracts were pasteurized at 80°C for 3 minutes and cooled to room temperature. Fresh cow's milk (13L) was collected and clarified using a cheese cloth. The milk was homogenized and then pasteurized at 80°C for 3 minutes. Sucrose (5%) was then added as sweetener. The milk was thereafter cooled to 42°C for inoculation. A 60g of commercial freeze-dried starter culture (Yogourmet™) was added to 12 litres of the pasteurized milk. Thereafter, the inoculated milk was divided into 12 parts (1 litre each). The fruit extracts and the reconstituted commercial strawberry flavour were then added at 200ml into 1litre each of the inoculated milk. The inoculated and flavoured milk was incubated at 43°C for 14 hours in an incubator. Each flavoured yoghurt produced was replicated thrice, and 250ml of each product was refrigerated and desired parameters were investigated at storage periods of 1, 7 and 14 days.

The free fatty acid, total titratable acidity and peroxide value of the flavoured yoghurt were determined (AOAC, 2010). Vitamins A and C were determined using the methods of Rutkowski and Grzegorzcyk (2007) and Osborne and Voogt (1978) respectively. pH was determined using a digital pH tester (Model pH107). Viscosity was measured using a rotational

viscometer (Fungilab, ALPHA H, Spain) at the speed of 100 rpm at 30 second with spindle 7 and Lactose was determined according to the method of (Kirk and Sawyer, 1991).

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 chemical and rheological properties of flavoured yoghurt at 1, 7 and 14 days storage periods. Storage period had significant ( $p < 0.05$ ) effect on Total Titratable Acidity (TTA), pH, viscosity and free fatty acid (FFA). However, there was no significant ( $p > 0.05$ ) difference in the Peroxide value (PV) for the storage periods, treatments and their interactions. At 14 days storage period, the highest value of TTA (0.04mg/100g) was recorded while 0.03mg/100g was recorded for 1 and 7 days respectively. The pH value for day 1 was 2.22 but increased at days 7 and 14 to 4.92 and 4.83 respectively. Viscosity was highest in yoghurt stored for 14 days with a value of 4.77 dPa.s but was least 0.76 dPa.s at day 1 of storage and day 7 had a value of 3.08 dPa.s. The FFA at 7 and 14 days storage periods recorded 15.24mg/100g and 15.89mg/100g respectively while 2.46mg/100g was recorded for a day period of storage. Treatment effect showed that viscosity was highest in T4 (2.69dPa.s) while T3, T2 and T1 had 2.52, 2.24 and 1.92dPa.s respectively. The FFA for T3 and T4 (9.98 and 9.95mg/100g) were significantly ( $p < 0.05$ ) higher than the values (7.99 and 8.12mg/100g) recorded for T2 and T1 respectively. However, there was no significant ( $p > 0.05$ ) difference in the TTA and pH value across the treatments. The interaction between storage periods and treatments revealed significant effect ( $p < 0.05$ ) on parameters investigated. The T2 (Coconut flavoured yoghurt) stored for 14 days, strawberry flavoured yoghurt (T1) stored for 14 days and T3 (Orange flavoured yoghurt) stored for 7 days recorded the highest TTA value of 0.04mg/100g while 0.03mg/100g was recorded for T1, T2 and T4 at day 1 storage period. The pH was significantly ( $p < 0.05$ ) higher in T2 stored for 7 days. Viscosity was significantly ( $p < 0.05$ ) higher in T3, T4 which recorded 4.85dPa.s respectively. Increase in the TTA as storage period increased observed in this study agrees with the findings of Abdel Moneim *et al.* (2011), El Owni and Mahgoub (2012).

Table 1: Chemical and rheological properties of synthetic and naturally Flavoured Yoghurt

| Parameters          | Total Titratable Acidity mg/100g) | pH                      | Viscosity (dPa.s)       | Peroxide Value(mEq/kg) | Free fatty acid (mg/100g) |
|---------------------|-----------------------------------|-------------------------|-------------------------|------------------------|---------------------------|
| Storage period (SP) |                                   |                         |                         |                        |                           |
| 1                   | 0.03±0.01 <sup>b</sup>            | 2.22±0.46 <sup>b</sup>  | 0.76±0.17 <sup>c</sup>  | 0.01±0.01              | 2.46±0.53 <sup>b</sup>    |
| 7                   | 0.03±0.01 <sup>b</sup>            | 4.92±0.02 <sup>a</sup>  | 3.08±0.29 <sup>b</sup>  | 0.01±0.01              | 15.24±0.75 <sup>a</sup>   |
| 14                  | 0.04±0.01 <sup>a</sup>            | 4.83±0.01 <sup>a</sup>  | 4.77±0.03 <sup>a</sup>  | 0.01±0.01              | 15.89±0.39 <sup>a</sup>   |
| Treatments          |                                   |                         |                         |                        |                           |
| T1                  | 0.02±0.01                         | 3.59±0.63 <sup>a</sup>  | 1.92±0.53 <sup>b</sup>  | 0.01±0.01              | 7.99±1.84 <sup>b</sup>    |
| T2                  | 0.03±0.01                         | 3.56±0.62 <sup>a</sup>  | 2.24±0.51 <sup>b</sup>  | 0.01±0.01              | 8.12±1.82 <sup>b</sup>    |
| T3                  | 0.03±0.01                         | 3.52±0.61 <sup>a</sup>  | 2.52±0.59 <sup>ab</sup> | 0.01±0.01              | 9.98±2.26 <sup>a</sup>    |
| T4                  | 0.03±0.01                         | 3.52±0.62 <sup>a</sup>  | 2.69±0.57 <sup>a</sup>  | 0.01±0.01              | 9.95±2.31 <sup>a</sup>    |
| SP*Treatments       |                                   |                         |                         |                        |                           |
| 1 T1                | 0.03±0.01 <sup>b</sup>            | 2.28±1.02 <sup>d</sup>  | 0.43±0.19 <sup>h</sup>  | 0.01±0.01              | 2.14±1.04 <sup>f</sup>    |
| 7 T1                | 0.02±0.01 <sup>c</sup>            | 4.93±0.03 <sup>ab</sup> | 2.14±0.01 <sup>e</sup>  | 0.01±0.01              | 12.99±0.17 <sup>d</sup>   |
| 14 T1               | 0.04±0.01 <sup>a</sup>            | 4.87±0.03 <sup>c</sup>  | 4.67±0.07 <sup>b</sup>  | 0.01±0.01              | 14.68±0.43 <sup>c</sup>   |
| 1 T2                | 0.03±0.01 <sup>b</sup>            | 2.22 ±0.99 <sup>d</sup> | 1.05±0.47 <sup>f</sup>  | 0.01±0.01              | 2.39±1.07 <sup>e</sup>    |
| 7 T2                | 0.02±0.01 <sup>c</sup>            | 5.00±0.01 <sup>a</sup>  | 2.14±0.01 <sup>e</sup>  | 0.01±0.01              | 12.56±0.22 <sup>d</sup>   |
| 14 T2               | 0.05±0.01 <sup>a</sup>            | 4.80±0.01 <sup>c</sup>  | 4.73±0.09 <sup>a</sup>  | 0.01±0.01              | 15.15±0.23 <sup>b</sup>   |
| 1 T3                | 0.02±0.01 <sup>c</sup>            | 2.18±0.98 <sup>e</sup>  | 0.62±0.42 <sup>f</sup>  | 0.01±0.01              | 2.52±1.13 <sup>e</sup>    |
| 7 T3                | 0.04±0.01 <sup>a</sup>            | 4.90±0.01 <sup>b</sup>  | 3.99±0.04 <sup>c</sup>  | 0.01±0.01              | 17.52±0.18 <sup>a</sup>   |
| 14 T3               | 0.03±0.01 <sup>b</sup>            | 4.83±0.03 <sup>c</sup>  | 4.85±0.02 <sup>a</sup>  | 0.01±0.01              | 17.72±0.42 <sup>a</sup>   |
| 1 T4                | 0.03±0.01 <sup>b</sup>            | 2.18±0.98 <sup>e</sup>  | 0.93±0.42 <sup>f</sup>  | 0.01±0.01              | 2.52±1.13 <sup>e</sup>    |
| 7 T4                | 0.03±0.01 <sup>b</sup>            | 4.90±0.01 <sup>b</sup>  | 4.07±0.04 <sup>c</sup>  | 0.01±0.01              | 17.52±0.18 <sup>a</sup>   |
| 14 T4               | 0.03±0.01 <sup>b</sup>            | 4.83±0.03 <sup>c</sup>  | 4.84±0.02 <sup>a</sup>  | 0.01±0.01              | 17.72±0.42 <sup>a</sup>   |

<sup>abcdeh</sup>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.

The pH plays important role in acceptability and shelf life of foods. The pH value increased from day one today seven. The increase in the pH content may cause the product to taste less sour thereby causing it to increase its acceptability by the

consumers. This findings was similar with the findings of Osundahunsi *et al.* (2007) who reported increase in pH value as storage period increased. However, drop in pH observed from 7 days to 14 days of storage could be due to the action of microorganisms or increase in the hydrogen ion concentration resulting from protein-protein interaction or changes in composition (Romeih *et al.*, 2014). The low pH could limit microbial activity thereby extending the shelf life of the products. The lower the pH of a food material, the fewer the types of microorganisms that can thrive in that food (Fatiha *et al.*, 2016). The FFA content increased throughout the storage period. High FFA values are due to triacylglycerol hydrolysis that takes place upon release of water from the food. Hydrolysis of triglycerides and oxidation of FFA can result in the development of desirable flavour and aroma in stored or aged foods. Viscosity content of the flavoured-yoghurt increased from day one till the fourteenth day of storage. This is in tandem with the findings of Arslan and Bayrakçi (2016) who reported an increase in viscosity of yoghurt on the seventh day till the end of the storage period.

## Conclusion

It can therefore be concluded that treatment effect showed a reduction in the pH of naturally flavoured yoghurt suggesting their better stability to microbial activities and improved viscosity. The treatment and storage effect revealed improvement in the yoghurt quality.

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