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Mineral, vitamin concentrations and sensory properties of artificial and naturally flavoured yoghurts

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***Target Audience:** Animal Scientist, Dairy industry, Dairy Researchers*

Abstract

A study on the mineral, vitamin concentrations and sensory properties of flavoured yoghurt was investigated using twelve litres (12L) fresh milk from Bunaji cows. The milk was clarified, homogenized, pasteurized at 80^0C for 3minutes and 5% sucrose was added as sweetener and thereafter cooled to 42^0C for inoculation. The milk was inoculated and divided into reconstituted commercial strawberry flavour (T1), fruit juices; coconut (T2), orange (T3) and pineapple (T4). Each flavourant was added at 200ml/litre and refrigerated for storage periods of 1, 7 and 14 days, thereafter subjected to evaluations. The completely randomized design in a 4x3 factorial arrangement was adopted. Results obtained showed that storage period had significant ($p<0.05$) effect on the mineral and vitamin concentrations. The mineral and vitamin concentrations were observed to be highest at day 7. Treatment effect revealed that treatments 2 and 4 had the highest phosphorus (0.32mg/100g) and sodium (87.89mg/100g) values respectively. Calcium (2.15mg/100g), Magnesium (1.20mg/100g) were highest in T3. Vitamins C and A were highest (2.13 and 2.85mg/100g) in T1, T2 and T1 respectively. The interaction effect showed significant ($P<0.05$) variations in the mineral and vitamins. The overall acceptability showed that orange and pineapple flavoured yoghurts were preferred by the consumers.

***Key words:** Fermented milk, Nutritive, Sensory attributes, Synthetic, Natural*

Description of Problem

Yoghurt is a coagulated semi fluid milk product that results from the fermentation of lactose in milk by *Lactobacillus bulgaricus* and *Streptococcus thermophilus* and sometimes *Lactobacillus acidophilus.* It is one of the most popular fermented milk products in the world [1] and an excellent source of protein, carbohydrate, vitamin, minerals and calcium [2].

The artificial or synthetic form of strawberry flavourings and aromas are used in producing fruit juice, ice-cream and yoghurt [3]. Coconut (*Cocos nucifera*) is used in confectionaries, bakeries, biscuits and ice cream Industries worldwide to enhance flavour and taste of various products [4]. Coconut milk was reported to be high in minerals and vitamin content [5]. Orange *(Citrus sinensis*) fruits are available in almost all parts of rural Nigeria and many other developing countries at affordable prices and it is a good source of vitamins C, B and A as well as calcium, copper, potassium and fibre [6]. Pineapple is an excellent source of vitamin C and manganese. It is also a very good source of copper, vitamin B1, vitamin B6, dietary fiber [7]. Yoghurt is most often flavoured with synthetic flavours or other ingredients to reduce its natural sourness. Presently, 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 flavouring agent in yoghurt production in place of the synthetic flavours [8]. Fruit juices add colour, flavour, essential vitamins and minerals, in addition to providing phytochemicals which impart health benefits [9]. Orange, coconut and pineapple are fruits that possess these qualities. Consequently, there is need to take advantage of these potentials embedded in these fruits in improving the mineral, vitamin and organoleptic qualities in yoghurt production.

Table 1: Mineral composition (mg/100g) of flavoured yoghurt at different storage periods

Parameters		Phosphorus	Sodium	Calcium	Magnesium
SP					
1		0.26±0.01^{c}	62.50±2.41^{b}	1.99±0.11	0.92±0.05^{b}
7		0.35±0.01^{a}	95.58±3.23^{a}	2.17±0.09	1.07±0.03^{a}
14		0.32±0.01^{b}	93.77±5.25^{a}	2.15±0.11	0.99±0.05^{ab}
Treatment					
T1		0.29±0.02^{b}	84.33±6.67^{b}	2.07±0.13	0.97±0.04
T2		0.32±0.01^{a}	87.69±7.30^{a}	2.08±0.09	0.01±0.05
T3		0.29±0.01^{b}	75.89±5.20^{c}	2.15±0.15	1.20±0.07
T4		0.32±0.01^{a}	87.89±7.17^{a}	2.11±0.12	0.01±0.07
SP*Treatment					
1	T1	0.21±0.01^{f}	67.67±8.69^{e}	2.30±0.01^{b}	1.00±0.01^{c}
7	T1	0.35±0.01^{b}	94.33±8.41^{b}	1.83±0.20^{d}	0.97±0.03^{cd}
14	T1	0.32±0.01^{c}	91.00±13.28^{c}	2.17±0.35^{cd}	0.93±0.14^{d}
1	T2	0.29±0.01^{d}	60.33±3.53^{f}	1.83±0.03^{d}	0.87±0.03^{e}
7	T2	0.37±0.01^{a}	92.00±4.16^{c}	2.23±0.23^{c}	1.17±0.09^{a}
14	T2	0.31±0.01^{c}	110.73±7.22^{a}	2.17±0.09^{d}	0.97±0.07^{cd}
1	T3	0.24±0.01^{e}	60.00±0.58^{f}	1.77±0.28^{e}	0.83±0.12^{e}
7	T3	0.32±0.01^{c}	91.33±7.53^{c}	2.40±0.01^{a}	1.10±0.06^{ab}
14	T3	0.34±0.01^{b}	79.33±4.70^{d}	2.30±0.26^{b}	1.13±0.09^{ab}
1	T4	0.28±0.01^{d}	62.00±4.58^{ef}	2.07±0.32^{e}	1.00±0. 07^{c}
7	T4	0.37±0.01^{a}	104.64±5.17^{b}	2.20±0.15^{c}	1.07±0.07^{b}
14	T4	0.31±0.01^{c}	97.00±7.23^{ab}	2.07±0.24^{e}	0.93±0.14^{cd}

^{abcdef}Means along the same column with different superscripts are significantly ($p<0.05$) different.

Materials and Methods

The study was conducted at the sheep and goats unit of the Teaching and Research Farm, Federal University of Technology, Akure, Ondo State. Akure is located on longitude 4.944055^{o}E and 5.82864^{o}E, and latitude 7.491780^{o}N with annual rainfall ranging between 1300mm and 1650mm average maximum and minimum daily temperature of 38^{o}C and 27^{o}C respectively [10]

Fresh milk from White Fulani cows was obtained from the Fulani cattle herdsmen in Akure, Ondo State Nigeria. The starter culture, strawberry flavourant and sugar were purchased from reputable stores in Akure. Ripe oranges, pineapple and coconut were sourced from the main markets in Akure, Ondo State.

Preparation of commercial (synthetic) and fruit flavourants

The commercial (synthetic) strawberry flavour was reconstituted with distilled water at a ratio of 1:2 v/v. The coconut, oranges and pineapple were washed properly. The oranges were cut, squeezed to obtain the juice; the pineapple pulp was cut into parts and blended,

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. The pH value of the fruit juices and the reconstituted synthetic flavour were determined using a digital pH tester (Model pH107). All the juices obtained were pasteurized at 80°C for 3 minutes and then cooled to room temperature [11]

Preparation of flavoured yoghurt

Fresh cow's milk (13 L) was collected from lactating Bunaji cows and clarified to remove dirt and debris. Thereafter, the milk was homogenized and pasteurized at 80°C for 3 minutes and sucrose (5%) was then added as sweetener. The milk was thereafter cooled to freeze-dried starter culture (Yogourmet®, mixture of *Lactobacillus bulgaricus* and *Streptococcus thermophillus*) was added to 12 litres of processed milk. Thereafter, the inoculated milk was divided into 12 parts (1 litre each).The fruit juices (coconut, orange, and pineapple) and the reconstituted commercial strawberry flavour were then added at 200ml into 1L 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 sensory evaluations.

Table 2: Vitamin composition (mg/100g) of flavoured yoghurt at different storage periods

Parameters		Vitamin C	Vitamin A
SP			
1		1.59±0.06^{c}	2.33±0.11^{b}
7		2.78±0.02^{a}	2.75±0.15^{a}
14		2.27±0.09^{b}	1.88±0.01^{c}
Treatment			
T1		2.13±0.11^{a}	2.85±0.18^{a}
T2		2.13±0.19^{a}	2.45±0.16^{b}
T3		2.04±0.14^{b}	1.99±0.05^{c}
T4		1.74±0.19^{c}	2.01±0.06^{c}
SP*Treatment			
1	T1	2.01±0.01^{f}	3.20±0.13^{b}
7	T1	2.38±0.23^{d}	3.07±0.24^{c}
14	T1	2.84±0.01^{a}	1.91±0.04^{e}
1	T2	1.53±0.06^{i}	2.31±0.04^{d}
7	T2	2.62±0.11^{c}	3.32±0.12^{a}
14	T2	2.84±0.01^{a}	1.87±0.02^{f}
1	T3	1.64±0.02^{h}	1.90±0.02^{e}
7	T3	2.18±0.06^{e}	2.35±0.03^{d}
14	T3	2.73±0.02^{b}	1.89±0.01^{ef}
1	T4	1.17±0.06^{j}	1.90±0.02^{e}
7	T4	1.92±0.06^{g}	2.35±0.03^{d}
14	T4	2.70±0.01^{b}	1.89±0.01^{ef}

^{abcdef}Means along the same column with different superscripts are significantly ($p<0.05$)

Orange flavoured yoghurt, T4= Pineapple flavoured yoghurt.

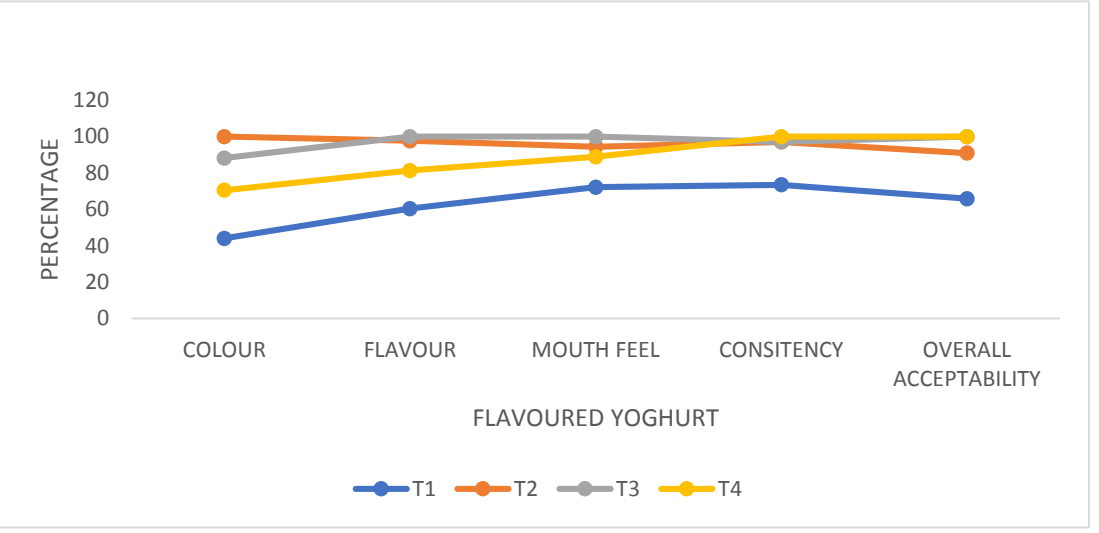

Figure 1: Sensory attributes of flavoured yoghurt
T1= synthetic strawberry flavoured yoghurt, T2= Coconut flavoured yoghurt, T3= Orange flavoured yoghurt, T4= Pineapple flavoured yoghurt.

Analytical procedures of minerals and vitamins

The calcium, phosphorus, sodium, and magnesium contents of the flavoured yoghurt sample were determined by absorption spectrometer according to [12]. The (Vitamin C) content was determined using the method described by [13]. Vitamin A was determined according to [14].

Sensory evaluation

Samples of the product were evaluated using hedonic method and overall acceptability by a 16 panellists drawn from student and staff of the Department of Animal Production and Health, Federal University of Technology, Akure. They were served coded samples of the product and were asked to compare for color, aroma, texture, taste, and overall acceptability using a 9-point hedonic scale described by [15].

Experimental design and statistical analysis

The experimental design was completely randomized design (CRD) in a 4x3 factorial arrangement (4 juice types x 3 storage periods of 1, 7 and 14 days). Data obtained were subjected to two-way analysis of variance and significant means were separated using Duncan's multiple range test using the [16]

Results and Discussion

The mineral compositions of yoghurt made from different flavourants and stored at 1, 7 and 14 days is shown in Table 1. Storage period had significant ($p<0.05$) effect on the phosphorus, sodium, magnesium and vitamins A and C concentrations of the yoghurt. At 7 day storage period, the highest values of Phosphorus (0.35mg/100g), Sodium (95.58 mg/100g), Magnesium (1.07 mg/100g) were observed. However, no significant difference ($P>0.05$) was observed for calcium throughout these storage periods. Among the minerals, only Phosphorus and Sodium showed significant ($P<0.05$) differences with Pineapple flavoured yoghurt T4 and Coconut flavoured

yoghurt T2 having the highest content of Phosphorus (0.22 mg/100g) and highest T2 and 87.89 mg/100g in T4 respectively.

Shown in Table 2 is the vitamin concentration yoghurt made from different flavourant stored at 1, 7 and 14 days. Vitamins C (2.78 ± 0.02^{a}) and A (2.75 ± 0.15^{a}) were significantly ($P<0.05$) higher at day 7 of storage. The interaction between storage periods and treatments had significant effect ($p<0.05$) on the mineral contents of the flavoured yoghurts. The highest nutrient values obtained at day 7 suggests that naturally flavoured yoghurt is better consumed at day 7 for optimum benefit. This result is at variance with the report of [17] who reported decrease in mineral composition for yoghurt and pineapple juice at day 7. The higher nutrient concentrations in coconut and pineapple flavoured yoghurts showed that they are good sources of phosphorus and sodium.

Figure 1 shows the sensory attributes of the flavoured yoghurt. The acceptance of yoghurt as a healthy food constituent has been connected to its sensual features. Flavour in yogurt is formed by action of yogurt starter bacteria and originated from biochemical changes in carbohydrates, lipids, and proteins. [18]. Colour appears to be a very important criterion for the initial acceptability of food product [19]. It was observed that as the storage time increased, no significant ($P>0.05$) colour change was observed in all the samples. The highest flavour score for orange flavoured yoghurt observed disagrees with the observation of [20] who reported that strawberry had significant effect on yoghurt quality than other flavours, in the evaluation of yoghurt quality with different fruit flavours (pineapple, orange, vanilla and strawberry). Both T3 and T4 had the highest overall acceptability revealing a considerable acceptance for orange and pineapple flavoured yoghurt by consumers. .

Conclusion and Application

1. Storage period and addition of flavours to yoghurt had significant effect on the nutritional quality and acceptance by consumers
2. The higher mineral concentration observed in the flavoured yoghurts at 7 days period of storage, suggests that for optimum nutritional benefit, naturally flavoured yoghurt may not be stored beyond day 7.
3. The addition of tropical flavours can be adopted by yoghurt producers in order to improve the nutritional quality as well as serve as supplementary drinks to nutritionally deficit individuals.

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