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Full Length Research

Mineral and Vitamin Composition of Yoghurt Flavoured with Banana and Pineapple

Okoroafor, C. N[1]; Nwachukwu, C. N[2]; Obinwa, E. P[1]and Okusun, C.J[3]

[1]Department of Human Nutrition and Dietetics, Faculty of life Science, Ambrose Alli University Ekpoma, Edo State, Nigeria.
2Department of Food Science and Technology, Imo State University Owerri, Imo State, Nigeria
[3]Department of Vocational and Technical Education, Ambrose Alli University Ekpoma, Edo State Nigeria

***Corresponding Author's Email:** okoroaforclara01@gmail.com Tel +234 803 441 3776

ABSTRACT

This study was conducted to evaluate the mineral and vitamin composition of yoghurt flavoured with locally available fruits, banana and pineapple added both before and after fermentation. The mineral analysis of the plain yoghurt revealed baseline concentrations of calcium (175 mg/100g), phosphorus (160 mg/100g), magnesium (164.50 mg/100g), sodium (110 mg/100g), potassium (119 mg/100g), and iron (reported at 175%). The incorporation of banana and pineapple resulted in an increase in mineral content, particularly calcium, magnesium, and potassium, with the most significant improvement observed when fruits were added after fermentation. Sodium levels remained unchanged in all the minerals analyzed 110.0mg/100g. For vitamin composition, plain yoghurt contained vitamin A (4.98 IU), vitamin C (3.28 mg/100g), riboflavin (0.67 mg/100g), thiamine (1.48 mg/100g), and niacin (2.00 mg/100g). The addition of pineapple before and after fermentation led to slight increases in vitamin A (5.02 and 5.01 IU) and vitamin C (5.22 and 5.25 mg/100g). More notably, a statistically significant ($P < 0.05$) increase in both vitamins A and C were observed with the addition of banana added after fermentation (5.86 IU and 5.86 mg/100g, respectively). The findings clearly indicate that banana and pineapple enhance the micronutrient quality of yoghurt without compromising its core characteristics. This suggests a promising approach to developing functional dairy products using locally available fruits to address nutritional deficiencies, particularly in low-resource settings. The study supports the notion that incorporating nutrient-rich fruits into yoghurt not only improves its health benefits but also aligns with consumer preferences for natural, flavourful, and nutritious food options.

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INTRODUCTION

The Turkish phrase for milk curdled with lactic starter is yoghurt (Tamime and Robinson, 2007). A probiotic product is yoghurt. Yoghurt consumption has increased because of its health benefits and probiotic products contain live, active microorganisms that, when consumed in adequate quantities, provide health benefits beyond the basic nourishment that is naturally Dahiru et al. (2022). According to Osundahunsi et al. (2007), yoghurt is made from pasteurized or low-fat milk that has been coagulated to a custard-like consistency using a mixed pure lactic acid culture that contains *Streptococcus thermophiles* and *Lactobacillus bulgaricus*. Although, sometimes yoghurts are consumed in the plain form, but it is most frequently flavoured with fruit preserves or other seasonings. Yoghurt can also be used as ingredients in frozen soft serve, candy bars, and desserts. Products made from yoghurt typically set in weak gel and have a high viscosity. A high solid content is preferred to improve gel formation and raise the final product's viscosity. To raise the solid content, condensed milk or non-fat dry milk is typically used Singh et al. (2016). Vegetable milk (soymilk), powdered milk, and liquid cow milk can all be used as base materials to make yoghurt, a fermented milk product made by souring milk with a mixed pure lactic acid culture Singh et al. (2016). Many people enjoy the flavour of this nutritionally useful product, which is generally regarded as safe.

Commercial yoghurt is made by pasteurizing a milk mixture, cooling it to 450 degrees Celsius, and then inoculating it with starter cultures colonies of bacteria. *Streptococcus thermophiles* and *Lactobacillus bulgaricus* may be used in a 1:1 ratio for the starter culture. They react with lactose to produce lactic acid, which raises the yoghurt's acidity and causes it to gel. The growth of harmful bacteria is inhibited by the pH rise. Additionally, the lactic acid generated gives yoghurt its distinct flavour and taste and contributes to preserving its quality throughout packaging and storage Saint et al. (2006).

The pineapple is a herbaceous perennial which grows to 1.0 to 1.5 meter (3.3 to 4.9ft) long, although sometimes it can be longer. When creating its fruits, it usually produces up to 200 flowers, although some large-fruited cultivars can exceed this. Once its flowers, the individual fruit of the flowers join together to create what is commonly referred to as a pineapple Hossain et al. (2012). Raw pineapples are loaded with vitamin A, vitamin C, minerals (phosphorus, potassium, calcium, manganese) and enzymes which are all important to the health (Marcela, 2012). The potassium in pineapple juice can help maintain proper electrolyte balance to prevent muscle cramps and soreness. This mineral also promotes proper kidney functioning and is important for digestion (Marcela, 2012). A banana is an edible fruit, botanically a berry Nieman et al. (2012). It is produced by several kinds of large herbaceous flowering plants in the genus Musa. In some countries, banana used for cooking may be called plantains). The fruit is variable in size, color and firmness, but is usually elongated and curved, with soft fresh rich in starch. It is covered with a rind which may be green, yellow, red, purple, or brown when ripe. The fruits grow in clusters hanging from the top of the plant.

MATERIALS AND METHODS

Materials

Skim powdered milk, banana, pineapple, gelatin, starter culture (*Lactobacillus* spp.) and granulated sugar were obtained from Eke-ukwu market in Owerri Municipal Council of Imo State, Nigeria.

Equipment Used

Petri-dishes, test tubes, pipettes, flasks and bottles, potato Dextrose Agar, Nutrient Agar, incubator, refrigerator, Kjeldahl distillation apparatus, volumetric flask, dessicator, oven, Whatman filter paper, Soxhlet flux flask, reflux flask, Binaton electric blender, Jenway electronic spectrophotometer, electro thermal heater, extracting flask, aluminum foil, conical flask, non-absorbent coton wool, Bunsen burner, Gallenkamp electronic colony counter, weighing balance, 9-point hedonic scale.

Chemical Used

Selenium catalyst, concentrated H_2SO_4, NaOH solution, Petroleum Ether, sulphuric acid, Dilute HCL, Vanado-Mohybdate coloured reagent, EDTA, Solochrome Dark Blue colour, Ca and Mg complexities, Ammonia Buffer, mentholated spirit.

Methods

Sample processing

The banana and pineapple fruits were washed, peeled and sliced into small sizes, and further blended using Binaton electric blender. The production of flavoured yoghurt was conducted in the food processing laboratory of the Department of Food Science and technology, Federal University of technology, Owerri Imo State and National Root Crop Research Institute Umudike, Abia State. The laboratory

analyses of the yoghurt samples were carried out at the same locations.

Sample preparation

Skim powdered milk of 400g was reconstituted with 1.5L. of water and heated to 80^0C for 15 minutes for pasteurization and then allowed to cool to 42-45^0C before inoculation with starter culture. The sample were divided into five portions, plain (control), pineapple flavoured before fermentation (PFBF), banana flavoured before fermentation (BFBF), banana flavoured after fermentation (BFAF), pineapple flavoured after fermentation (PFAF). The samples were incubated at 35^0C for 10-12 hours (overnight) until a pH of 4.3 – 4.5 was obtained. The yoghurt samples were allowed to cool at 6^0C in the refrigerator before they were analyzed.

Chemical Analysis

Mineral determination

The resulting ash was dissolved in 100mL of dilute hydrochloric acid (HCl) and then diluted to 100mL in volumetric flask using distilled water. The digest so obtained was used for the mineral analysis.

Phosphorus

Phosphorus in the sample was determined by the vanado-mohybdate (yellow) spectrometry described by AOAC (2016). One milliliter (1ml) extract from each sample was dispensed into a test tube. Similarly, the same volume of standard phosphorus solution as well as water was put into other test tubes to serve as standard and blank respectively. The content of each tube was mixed with equal volume of the vanado-mohybdatecoloured reagent. The samples were left to stand for 15 minutes at room

temperature before measuring their absorbance with Jenway electronic spectrophotometer, at a wave length of 420nm.

Calcium and magnesium

Calcium and magnesium contents of the test samples were determined by the EDTA (ethylenediamine tetra acetic acid) complexiometric titration of AOAC (2016). Twenty milliliters (20ml) of ammonia solution of pH 10.0, a pinch of the indicator Erich Rome black was added and the mixture shaked very well, and titrated against 0.02N EDTA solution until a change from mauve color to permanent blue coloration was noticed. Black reagent consisting of 20ml distilled water was also treated as described above. The titration was a reading for combined Ca and Mg complexities in the sample. A separate titration was conducted for calcium alone.

Titration for calcium was repeated as the previous one with slight change. Ten percent (10%) of NaOH solution at pH 12.0 was used in place of ammonia buffer while solochrome dark blue (colour) was used as indicator in place of Erichroma black.

Potassium

Potassium content of the sample was determined by flame photometry. The instrument was set up according to the manufacturer's instruction. The equipment was switched on and allowed to stand for 10min. The gas and air lets were opened and the start knob turned on (AOAC, 2016). The equipment being self-igniting, the flame was adjusted to non-luminous level till the colour-mean. The standard potassium solution was prepared separately and diluted to concentration of 2, 4, and 10 ppm. The appropriate filter was selected and the instrument flushed with distilled water. The highest concentration (10ppm), all the standard solution was sucked into the instrument and caused to spray the non-luminous flame. The readings were recorded and later plotted into a standard curve used to extrapolate the potassium level in the sample digest.

Vitamin Determination

Pro-vitamin A (β-carotene)

The Association of Analytical Chemists (AOAC 2016) technique was used to assess the analysis of vitamin A. Each extracted sample weighed 10 grams, which were then placed in a 250 mL boiling flask. The boiling flask was filled with 95% ethanol, which was roughly four times the volume weight of the sample. After that, a few boiling chips and 10.0–20.0 mL of 20% potassium hydroxide (KOH) were added. This was refluxed at a regulated temperature at a rate of roughly two drips per second. After 30 minutes of reflux heating, the samples were allowed to cool to room temperature. Then, 50 mL of hexane was used to extract the hydrolysate three times, and water was added until the solution was neutral to phenolphthalein.

Anhydrous sodium sulfate was used as a filter to wash the extract. A rotating evaporator was used to lower the extract's volume. The markup point was then updated to include the mobile phase. A 0.45µ membrane filter was used to filter the sample. High Performance Liquid Chromatography was used to analyze the supernatant (HPLC). The HPLC condition was summed up as follows: 20 µL of an aliquot was introduced into the HPLC system after 2 mL of concentrated extracts were evaporated under flowing nitrogen, redissolved in 2 mL of acetone, and passed

through a 0.45 µm Millipore membrane. The methanol, ethyl acetate and acetonitrile (88:10:2 v/v/v) was used as mobile phase at flow rate 1.3 mL/min and detection was carried out at the wavelength of 450 nm.

Vitamin C (Ascorbic Acid)

The method outlined by the Association of Analytical Chemists (AOAC 2016) was used to determine the analysis of vitamin C. A 250 mL conical flask was filled with 10 g of the ground sample, which was weighed. The 200 mL container was then filled with a solution of metaphosphoric acid and acetic acid. A magnetic stirrer was used to homogenize the mixture, and a funnel and filter paper were used to filter it in a 250 mL conical flask. A 100 mL conical flask was filled with 10.0 mL of the sample. Each sample had two replicates made, and the results were ascertained by titrating the filtrate until the solution took on a pink hue.

Vitamin B_1 (Thiamine)

Five (5) grams of sample was homogenized with 50 ml of ethanol sodium hydroxide. It was filtered into 100 ml flask; 10 ml of the filtrate was pipetted, and colour was developed by the addition of 10ml potassium dichromate before reading at 430 nm wavelength in a spectrometer. A standard thiamin solution was prepared and diluted. Ten (10) ml of solution was analyzed. The readings were made with the reagent blank at Zero (Onwuka, 2018).

Vitamin B_2 (Riboflavin)

The riboflavin content of the sample was ascertained using Onwuka's (2018) methodology. 100 mL of a 50% ethanol solution was used to extract five (5) grams of each sample, which was then agitated for an hour and filtered. Equal volumes of a 5% potassium permanganate ($KMnO_4$) solution and 10% hydrogen peroxide (H_2O_2) were added to a ten-milliliter solution. Two milliliters of sodium sulfate (Na_2SO_4) solution were added to the mixture after it had stood on a water bath for thirty minutes. Before being measured in a spectrophotometer at a wavelength of 510 nm, it was diluted to 50 mL with pure water. The reagent blank was used to take the reading at zero.

Vitamin B_3 (Niacin)

The Konig's reaction method as described by (A.O.A.C, 2016) was used.

Two (2) grams of the sample was weighed into a plastic bottle and 100ml of 10% sulphuric acid solution was added, and then place on a shaken (Gallen kamp) and allowed to shake for 30 minutes. The sample was transferred into a centrifuge tube, spine at 3000rpm for 10 minutes, 10ml of supernatant was transferred into a 80ml flask with 10ml of cyanogens bromide solution, then made up to mark with distilled water. The absorbance was measured in a spectrophometer (Jenway Model) at 470mm wavelength after 30minutes.

STATISTICAL ANALYSIS

The data obtained from laboratory analysis and sensory evaluation were analyzed using analysis of variance (ANOVA), according to the method of Iwe (2014) to determine the variance ratio. Sample means were compared to determine treatment effects. The least significant difference was calculated at 95% level of significance using Turkey test (T- test).

RESULTS

The recipe formulation for the production of plain and flavoured yoghurt before and after fermentation is presented in Table 1, where equal ingredients were used for all the samples production.

Table 1: Recipe for the Production of Plain and Flavoured Yoghurt before and after Fermentation

Ingredients	Ply	BFBF	PFBF	PFAF	PFAF
Skim milk	100g	100g	100g	100g	100g
Water	1.5L	1.5L	1.5L	1.5L	1.5L
Starter culture	2g	2g	2g	2g	2g
Sugar	4g	4g	4g	4g	4g
Gelatin	4g	4g	4g	4g	4g
Fruits		5%	5%	5%	5%

Note: Equal ingredients were used for all the samples production.
BFBF: Banana flavored before fermentation; PFBF: Pineapple flavored before fermentation; BFAF: Banana flavored after fermentation; PFAF: Pineapple flavored after fermentation.; PLY: Plain yoghurt.

The mineral analysis of yoghurt samples produced before and after fermentation were presented in Table 2. The addition of banana and pineapple before and after fermentation increased calcium, magnesium and potassium contents of the samples significantly ($P<0.05$). BFAF has the highest calcium content (180.9%), BFAF and PFAF have the highest amount of phosphorus (161.28 %), BFAF has the highest magnesium content (193.40%), BFAF and PFAF have the highest potassium contents (122.19%) and PFAF has the highest Iron content (105.97%) compared to PLY.

Table 2: Mineral analysis of yoghurt samples

Items (%)	Calcium mg/100g	Phosphorous mg/100g	Magnesium mg/100g	Sodium mg/100g	Potassium mg/100g	Iron mg/100g
PLY	175^{a}±1.02	160^{a}±0.10	164.80^{a}±2.88	110^{a}±0.02	119^{a}±2.23	105^{b}±1.02
BFBF	180.40^{c}±1.13	161.00^{a}±0.01	193.25^{b}±0.24	110.9^{a}10.10	122.17^{b}±1. 26	105^{b}±1.02
PFBF	179.75^{b}±0.25	160.04^{a}±0.32	170.00^{a}±0.01	110.10^{a}±0.00	120.00^{a}±0.00	105.09^{b}±0.15
BFAF	180.9^{c}±0.31	161.28^{a}±0.16	193.40^{b}±0.1	110.0^{a}±0.01	122.19^{b}±0.20	104.89^{b}±0.21
PFAF	178.01^{b}±0.24	161.28^{a}±0.16	173.98^{a}±0.1	110.0^{a}±0.01	122.19^{b}±0.20	105.97^{b}±0.20
LSD	2.113	1.510	1.570	2.000	1.871	0.981

Values are means + SD. Values on the same column with different superscripts are significantly different.
BFBF: Banana flavored before fermentation; PFBF: Pineapple flavored before fermentation; BFAF: Banana flavored after fermentation; PFAF: Pineapple flavored after fermentation; PLY: Plain yoghurt
LSD- Least Significant Difference. Values are means of triplicate analysis and standard deviation means with different superscripts in the same column are significantly different.

The vitamin composition analysis of yoghurt samples produced before and after fermentation were presented in Table 3. there are no significant increases in all the samples ($P<0.05$) analyzed, it was recorded that Vitamin C has the highest values in all the samples analyzed (BFBF 5.86%, PFBF 5.22%, BFAF 5.86% and PFAF 5.25%) except in PLY which has vitamin A than C.

Table 3: Vitamin composition of yoghurt sample

Vitamin	PLY	BFBF	PFBF	BFAF	PFAF	LSD
Vitamin A IU	4.98^{a}±0.24	5.26^{b}±0.21	5.02^{a}±0.02	5.27^{b}±0.32	5.01^{a}±0.11	0.260
Vitamin C mg/100g	3.28^{a}±0.94	5.86^{b}±0.14	5.22^{b}±0.0.14	5.86^{b}±0.04	5.25^{b}±0.03	1.34
Riboflavin mg/100g	0.67^{a}±0.11	0.67^{a}±0.01	0.66^{a}±0.12	0.68^{a}±0.01	0.67^{a}±0.10	0.16
Thiamine mg/100g	1.48^{a}±0.23	1.44^{a}±0.02	1.42^{a}±0.34	1.43^{a}±0.1	1.43^{a}±0.25	0.08
Niacin mg/100g	2.00^{a}±0.01	2.00^{a}±0.11	2.14^{a}±0.22	2.0^{a}±0.001	2.12^{a}±0.14	0.162

Values are means + SD. Values on the same column with different superscripts are significantly different. BFBF: Banana flavored before fermentation; FBF: Pineapple flavored before fermentation; BFAF: Banana flavored after fermentation; PFAF: Pineapple flavored after fermentation.; PLY: Plain yoghurt. Values are means of triplicate analysis and standard deviation means with different superscripts in the same column are significantly different.

DISCUSSION

Mineral Analysis of Plain and Flavoured Yoghurts

The mineral composition of plain yoghurt (Table 2) revealed high levels of calcium (175%), phosphorus (160%), magnesium (164.8%), sodium (110%), potassium (119%), and iron (105%), highlighting yoghurt's well-established role as a rich source of essential minerals. This finding supports the assertion by (Hassan et al., 2023) that yoghurt is a highly valuable food product in terms of mineral content, essential for metabolism, bone development, enzymatic activity, and muscle function.

The addition of banana and pineapple, particularly after fermentation, resulted in a statistically significant ($P < 0.05$) increase in calcium, magnesium, and potassium levels compared to plain yoghurt. This is consistent with the findings of (Hassan et al., 2023) who reported that the inclusion of fruits or fruit juices in yoghurt enhances its mineral content, likely due to the naturally high potassium and magnesium content in fruits like banana and pineapple.

It is important to note that yoghurt samples where fruits were added before fermentation (e.g., BFBF, PFBF) exhibited slightly lower mineral concentrations than those where fruits were added after fermentation (e.g., BFAF, PFAF). This reduction may be due to interactions between minerals and fermentation by-products or mineral binding to microbial biomass, which may occur during the fermentation process. Post-fermentation addition, on the other hand, likely preserves the fruit's native mineral content more effectively.

Of particular interest is the case of sodium, where the addition of banana and pineapple did not lead to any significant increase. This is a beneficial observation, as diets high in potassium and low in sodium are known to help reduce the risk of hypertension and cardiovascular diseases, as emphasized by (Muiesan et al., 2023). Therefore, flavoured

yoghurts enhanced with banana and pineapple remain suitable for individuals with heart-related conditions, as they do not contribute to excess sodium intake.

However, the addition of fruits did not significantly improve iron levels in the flavoured yoghurt samples ($P < 0.05$). This might be due to the low iron content in both banana and pineapple, and the presence of compounds like phytates or polyphenols in fruits that may inhibit iron absorption. This finding aligns with previous research indicating that while fruits enhance some mineral contents in dairy products, their impact on iron levels is often minimal or negligible.

In summary, the inclusion of banana and pineapple in yoghurt formulations clearly enhances its nutritional profile with respect to calcium, potassium, and magnesium, which are critical for bone health and cardiovascular function. The lack of increased sodium further strengthens the case for its use in heart-healthy diets. However, future formulations may consider iron fortification or pairing with iron-rich ingredients if improved iron content is a desired goal.

Vitamin Content of Plain and Flavoured Yoghurt

The analysis of the vitamin composition (Table 3) reveals that the addition of banana and pineapple to yoghurt significantly enhances the levels of key vitamins, particularly vitamins A and C. The vitamin content in plain yoghurt showed moderate levels, with vitamin A at 4.98 µg, vitamin C at 3.28 mg, and moderate amounts of B-complex vitamins such as riboflavin (0.67 mg), thiamine (1.48 mg), and niacin (2.00 mg). The addition of pineapple, both before and after fermentation, slightly increased the levels of vitamins A and C. For example, vitamin A increased to 5.02 µg and 5.01 µg, while vitamin C increased more notably to 5.22 mg and 5.25 mg, respectively. This suggests that pineapple, being naturally rich in ascorbic acid (vitamin C), contributes effectively to the ascorbic acid content of the yoghurt. However, the increase in vitamin A with pineapple addition was not statistically significant ($P < 0.05$), indicating a minor influence of pineapple on this nutrient.

In contrast, banana addition showed a more pronounced effect. The inclusion of banana before fermentation raised the vitamin A content to 5.26 µg and 5.27 µg, and after fermentation to 5.86 µg, with a corresponding increase in vitamin C to 5.86 mg. These changes were statistically significant ($P < 0.05$) and reflect the nutrient density of banana, which contains both pro-vitamin A carotenoids and a moderate amount of vitamin C. The greater improvement when banana was added after fermentation may be attributed to the reduced loss of heat-sensitive vitamins like vitamin C, which are vulnerable during fermentation due to acidification and microbial activity.

These results align with earlier studies of Roy et al. (2016), who demonstrated that fruity yoghurts with banana flavour showed enhanced vitamin content, and the works of Cota-López et al. (2023) and Pereira et al. (2024), who also observed increased micronutrient levels in fruit-fortified dairy products. Their studies reinforce the finding that fruit enrichment, particularly with bananas, can significantly boost the nutritional profile of yoghurt, making it a more valuable functional food.

This trend supports the growing interest in nutrient-dense, fruit-based functional dairy products as a strategy to address

micronutrient deficiencies, especially in populations with limited access to a varied diet. It also emphasizes the importance of the timing of fruit addition in the yoghurt production process, as post-fermentation addition appears to preserve more heat-sensitive vitamins.

CONCLUSION

This study investigated the mineral and vitamin composition of yoghurt flavoured with banana and pineapple, aiming to assess the nutritional enhancement provided by the addition of banana and pineapple pulps before and after fermentation. The findings revealed that the incorporation of banana and pineapple pulps significantly improved the micronutrient contents of yoghurt compared to plain yoghurt. This implied that the potency of yoghurt could be improved by addition of fruits rich in vitamins and mineral to aid in combating diseases like scurvy and night blindness. Adequate supply of minerals improves functionality of cells and also supports the body immune system.

REFERENCES

AOAC, (2016). *Official methods of analysis.*20th edition, Association of Official Analytical Chemist. Washinton D.C. USA.

Cota-López, R., Velázquez, G., Méndez-Montealvo, G., Pérez-Ramírez, I. F., Murúa-Pagola, B., Espinoza-Mellado, R., & Hernández-Gama, R. (2023). Development of prebiotic yogurt with addition of green-banana biomass (Musa spp.). Anais da Academia Brasileira de Ciências, 95(Suppl. 1), e20220532. https://doi.org/10.1590/0001-3765202320220532

Dahiru, M., Hamid, M., & Musa, N. (2022). A Comparative Analysis of Admiral Yogurt and Local Yogurts sold at Mayo-Belwa Town, Adamawa State, Nigeria.. *Science Letters, 16*(2), 1-10. doi:10.24191/sl.v16i2.15664

Hassan, A., Okoye, C. O., Ogbuagu, U. D., & Bello, F. A. (2023). Nutritional composition of commonly consumed foods in Nigeria. Heliyon, 9(3), e13845.https://doi.org/10.1016/j.heliyon.2023.e13845

Hossain, M. N., Fakruddin, M., & Islam, M. N. (2012). Quality comparison and acceptability of yoghurt with different fruit pulps. Journal of Food Processing & Technology, 3(8), 171. https://doi.org

Iwe, M. O. (2014). Handbook of current trends in sensory evaluation of foods. Enugu: Rojoint Communication Services Ltd.

Marcela, T. (2012). The health benefits of pineapple. FitnessRX Women. http://www.fitnessrxwomen.com/nutrition/healthy-eating-tips/the-health-benefits-of-pineapples/

Miller, K. C. (2012). Plasma potassium concentration and content changes after banana ingestion in exercised men. Journal of Athletic Training, 47(6), 648–654. https://doi.org/10.4085/1062-6050-47.6.09

Muiesan, M. L., Buso, G., & Agabiti Rosei, E. (2023). Less sodium and more potassium to reduce cardiovascular risk. European Heart Journal Open, 3(5), oead097. https://doi.org/10.1093/ehjopen/oead097

Nieman, D. C., Gillitt, N. D., & Henson, D. A. (2018). Bananas as an energy source during exercise: A metabolomics approach. PLOS ONE, 13(7), e0191027. https://doi.org/10.1371/journal.pone.0191027

Osundahunsi, O. F., Amosu, D., & Ifesan, B. O. T. (2007). Quality evaluation and acceptability of soy-yoghurt with different colours and fruit flavours. American Journal of Food Technology,

2(4),273–280. https://doi.org/10.3923/ajft.2007.273.280

Onwuka, G. I. (2018). Food analysis and instrumentation: Theory and practice (pp. 64–76). Naphtali Prints.

Pereira, C. V., Santos, J. S., Lima, M. A., & Silva, M. R. (2024). Determination of symbiotic mango fruit yogurt and its bioactive peptides for bio-functional properties. *Frontiers in Chemistry, 12*, 1470704. https://doi.org/10.3389/fchem.2024.1470704

Roy, D. K., Saha, T., Akter, M., Hosain, M., Khatun, H., & Roy, M. C. (2016). Quality evaluation of yogurt supplemented with fruit pulp (banana, papaya, and watermelon). *International Journal of Nutrition and Food Sciences, 4*(6), 695–699. https://doi.org/10.11648/j.ijnfs.20150406.25

Saint, A., Juteau, A., Atlan, S., Martin, N., & Souciet, I. (2006). Influence of proteins on the perception of flavoured stirred yoghurts. International Journal of Dairy Technology, 59(1), 30–32. https://doi.org/10.1111/j.1471-0307.2006.00143.x

Singh, B., Singh, J., Kaur, A., & Singh, N. (2016). Bioactive compounds in banana and their associated health benefits. A review.. *Food chemistry*, 206, 1-11 https://doi.org/10.1016/j.foodchem.2016.03.033.

Tamime, A. Y., & Robinson, R. K. (2007). Yoghurt: Science and technology (3rd ed.). Wood-head Publishing

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