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Sensory and Physicochemical Characteristics of Naturally Flavoured *Borassus aethiopum* Syrups for Potential Applications in Food Products

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Abstract

The study explored the possibility of using sap from the fruit pulp of *Borassus aethiopum* in developing a fruit syrup with acceptable sensory, nutritional and physicochemical properties for technological application in food products. *B. aethiopum* syrup with its original flavour was developed alongside 2 other *B. aethiopum* syrup products infused with the flavouring agents- ginger and tamarind. Although sensory evaluation of the three syrup products by 98 untrained panelist showed non-significant difference (P>0.05), they were all rated highly. The flavoured products were rated slightly higher than the unflavoured syrup for all sensory attributes. Proximate and physicochemial analysis of the highly rated *B. aethiopum* syrup product obtained through sensory evaluation indicated that the syrup has a protein content of 1.17, fat content of 4.67, carbohydrate content of 72.93, ash content of 2.19, moisture content of 17.71, pH of 4.56 and titratable acidity of 0.87. This suggests that underutilized tropical fruits from *B. aethiopum* can be used for the manufacture of syrups to impart desirable natural sweetness, flavours and colours to food products.

Keywords: *Borassus aethiopum*, syrup, sensory, physicochemical

1. Introduction

Borassus aethiopum (African fan palm) is a widespread wild plant found in most West African countries such as Ghana, Nigeria, Togo and Guinea (Bolade and Bello, 2006). The African fan palm is found in various regions in Ghana; in the Volta region the palm is called "agoteku' and can be found in Adaklu, North Tongue, Kpetoe-Ziope and Akatsi North. The fruits are consumed as food or in the form of food supplements (Ali *et al*., 2010). It is either consumed in its raw state or the sap cooked and eaten. Juice from the pulp can also be extracted and used for the production of fruit juice and wine. The soft kernel of the fruit is edible and the germinating nuts provide a good source of starch (Barminas *et al*., 2008).

Borassus palm tree has been exploited by the construction and craft industry for the production of roofing, mat and rope (Sambou *et al*., 2002). The fibre properties of the cellulosic pulp is used as an alternative raw material for the manufacture of paper. The plant is also important for its medicinal uses in the treatment of gonorrhea, dysentery and respiratory infections (Barminas *et al*., 2008). Nutritionally the pulp of the juicy matured fruit, an orange to yellow fibrous tissue is rich in sugar, vitamin A, B and C (Nilugin and Mahendran, 2010).

Notwithstanding the multiple immerse benefits of *Borassus aethiopum,* the full potential of the plant for other food applications is yet to be exploited. The plant is therefore among the underutilized plants in West Africa. Tropical fruits like the *Borassus* fruit can be used for the manufacture of syrups to impart desirable natural sweetness, flavours and colours to food products. Sap from a matured *Borassus aethiopum* fruit pulp has a sweet taste, bright orange colour and an intense unique flavour which can be concentrated and exploited for the production of a fruit syrup. Fruit syrups are viscous preparations consisting of fruit sap and water boiled with sugar. Syrups developed from natural products are more beneficial and appeal to most consumers because they are economical, readily available and non-toxic. A variety of flavoured syrups can be made by infusing simple syrups with flavouring agents during the process of cooking. This study explored the use of sap from the pulp of *Borassus aethiopum* in the development of a syrup product. *Borassus aethiopum* fruit syrups were also infused with the flavouring agents- ginger and tamarind to produce different naturally flavoured syrups which can be used in the food industry as natural sweetening, flavouring and colouring agents. The study further characterized the proximate, physicochemical and sensory attributes of the naturally flavoured *Borassus aethiopum* fruit pulp syrup developed.

2. Material and methods

2.1 Materials

Borassus aethiopum fruits were obtained from Adaklu in the Volta region where the plant grows in the wild. Care was taken to ensure that good quality matured fruits were selected. Ginger and Tamarind used as flavouring agents were purchased from the Ho central market, Volta region, Ghana.

2.2 Syrup preparation

Ingredients used in formulating the syrup products consisted of sap from the *B. aethiopum* fruit, sugar, water with/without the flavouring agents (ginger and tamarind) (Table 1). The fruits used were matured and had no evidence of spoilage or pest destruction. The fruits were washed, peeled and the pulp blended with water. Sugar and the flavouring agents were added to the strained juice which was subsequently cooked (100^{o}C) to develop the syrup. The palm sap was concentrated by using an open pan method (Naknean *et al*., 2013) until the total soluble solids reached 70^{o}Brix to obtain the syrup products. The different *B. aethiopum* syrups were developed using the method described in Figure 1.

2.3 Sensory evaluation

Samples of the three (3) different syrup products (*B. aethiopum* syrup, Ginger flavoured *B. aethiopum* syrup and Tamarind flavoured *B. aethiopum* syrup) were analyzed for appearance/color, mouth feel, flavour and overall acceptability after overnight storage at ~5 °C. A total of ninety eight (98) untrained panelists were recruited from among students in Ho Polytechnic, Ho. The criteria for recruitment were that they were familiar with the quality characteristics of syrups and willing to participate in the test. The test was carried out in a well illuminated room free of environmental factors that could interfere with the normal perception of consumers. Panelists were asked to evaluate the 3 randomly coded samples on a 9-point hedonic scale (1 – like extremely, 5 – neither like nor dislike and 9 – dislike extremely) in an experiment.

2.4 Analytical methods

2.4.1 Proximate characterization

Proximate analysis was done on the tamarind flavoured *B. aethiopum* syrup (syrup rated highly although statistically not significant; $p>0.05$). Total solids, total nitrogen, fibre and ash were determined by AOAC (1990) methods. Protein was calculated from total nitrogen using the conversion factor 6.25. Fat content was determined by soxhlet extraction method (AOAC, 1990). Carbohydrate was determined by difference.

2.4.2 Physicochemical characteristics

2.4.2.1 Titratable acidity and pH

Titratable acidity was determined using AOAC method 947.05 (AOAC, 1990) by titration with 0.1N NaOH solution while the pH of the sample was measured using a pH meter (Hanna Instrument pH 210, microprocessor pH meter, Duisburg, Germany).

2.4.2.2 Brix (TSS)

B. aethiopum syrup solution at 1% concentration (1g/100ml) was prepared for brix determination. A dropper was used to take sample of the solution and transferred into the refractometer for direct reading of Brix values.

2.5 Statistical analysis

Data was analysed using analyses of variance (ANOVA). Individual consumer preference scores from panellists were averaged and data analyzed using SPSS 17.0.1. Statistical significance was set at a level of 95% confidence interval.

3. Results and discussions

3.1 Sensory characteristic of naturally flavoured B. aethiopum syrups

Consumers expect quality in food purchased and thus define quality in terms of cost, nutrition, health, wholesomeness and organoleptic appeal. Sensory evaluation is critical in product development since products targeted at consumers must appeal to them. Sensory attributes evaluated included colour, taste, flavour, mouth feel and overall acceptability. A summary of the mean sensory scores for the sensory attributes is shown in Table 2.

Although consumer sensory evaluation of the syrup products showed no statistically significant difference ($P>0.05$) by a sensory panelist consisting of 98 students, the flavoured products (GBS- Ginger Flavoured *B. aethiopum* Syrup and TBS- Tamarind Flavoured *B. aethiopum* Syrup) were slightly preferred in terms of all

sensory attributes relative to the unflavoured syrup (BS- *B. aethiopum* Syrup). Flavouring of syrup can be used to induce slight preference for a syrup product and also provide consumers with an array of syrup products to select from based on their unique flavours.

3.2 Proximate and physicochemical characteristics of B. aethiopum palm syrup

Results for the proximate and physicochemical characteristics of the *B. aethiopum* syrup product have been shown in Table 3. The moisture content of palm sugar syrups can be used to evaluate the microbiological characteristics of sugar based products (Naknean *et al*., 2013). The microbial load, shelf life, consistency, aroma and smell of fruit syrups are significantly influenced by moisture content and water activity (Tortoe *et al*., 2013). The moisture content of the *Borassus aethiopum* palm syrup (17.71) was lower than that observed in a *Borassus flabellifer* palm sugar syrup (25.07 – 25.91) (Naknean *et al*., 2013) and pineapple syrup (29.67 – 34.49) (Tortoe *et al*., 2013). *B. aethiopum* syrup has good keeping quality since its low moisture content will ensure syrup quality loss in terms of ability to ferment, lose flavor and spoil. The pH, total sugar and total solids of the *B. aethiopum* syrup were higher than the pH (3.12-3.17), total sugar (16.6 – 21.9%) and TSS (15.0) observed in a beverage from palmyrah fruit pulp (Nilugin and Mahendran, 2012). pH and total sugar content of pineapple fruit syrup was 3.44 and 61.02 (Tortoe *et al*., 2013) while that for a syrup prepared from sap of R. hookeri was 3.96 and 82.55 respectively (Mintah *et al*., 2013). The fat and ash contents (Table 3) of the *B. aethiopum* palm syrups were also higher than values observed for- syrups from *R. hookeri* (fat 0%, ash 1.70%) (Mintah *et al*., 2013); and syrups from pineapple (fat-0.85, ash-1.65) (Tortoe *et al*., 2013). However the protein content (1.17) of *B. aethiopum* palm syrup was lower than that of pineapple syrup (1.49) but higher than the protein content (0.14%) of *R. hookeri* syrup (Mintah *et al*., 2013).

4. Conclusion

Sensory evaluation of the three syrup products showed non-significant difference (P>0.05) for all sensory attributes. Nonetheless, the highly rated sensory characteristics attributed to all three syrups suggest that underutilized tropical fruits from the *B. aethiopum* can be used for the manufacture of syrups to impart desirable natural sweetness, flavours and colours to food products. Proximate and physicochemial analysis of the highly rated *B. aethiopum* syrup product obtained through sensory evaluation indicated that the syrup has a protein content of 1.17, fat content of 4.67, carbohydrate content of 72.93, ash content of 2.19, moisture content of 17.71, pH of 4.56 and titratable acidity of 0.87. Moisture, titratable acidity, fat and ash values recorded for *Borassus aethiopum* compared favourably to syrups developed from *Borassus flabellifer*, pineapple and *R. hookeri*.

Declaration of interest

The authors have no conflict of interest and are responsible for the content of the manuscript.

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Table 1: Proportion of ingredient used for *B. aethiopum* syrup

Ingredient	Quantity
Borassus fruit pulp	2700g
Sugar	450g
Water	7350ml
Ginger/Tamarind (for products flavoured)	15g

Table 2: Sensory mean consumer scores of *B. aethiopum* syrups

Treatment	Apperance	Taste	Aroma	Aftertaste	Consistency	Overall Acceptability
BS	6.71±1.95	6.26±2.16	6.12±2.31	6.16±2.22	6.45±2.11	6.97±1.99
GBS	6.68±1.98	6.38±2.13	6.32±2.13	6.32±2.31	6.93±1.84	7.14±1.99
TBS	7.20±1.979	6.42±2.35	6.44±2.22	6.39±2.43	7.05±1.82	7.16±1.57

BS- *B. aethiopum* Syrup; GBS- Ginger Flavoured *B. aethiopum* Syrup; TBS- Tamarind Flavoured *B. aethiopum* Syrup. A 9-point hedonic scale was used (1-dislike extremely, 6-like slightly and 9-like extremely). Means for all sensory attributes were non-significant (P>0.05)

Table 3: Proximate and physicochemical characteristics of *B. aethiopum* syrup

Proximate/Physicochemical Characteristic (%)	**Mean (SD)**
Moisture	17.71 (0.17)
Protein	1.17(0.02)
Fat	4.62(0.03)
Carbohydrate	72.93 (0.26)
Fibre	1.39 (0.04)
Ash	2.19 (0.11)
pH	4.56 (0.01)
Titratable acidity	0.87 (0.06)

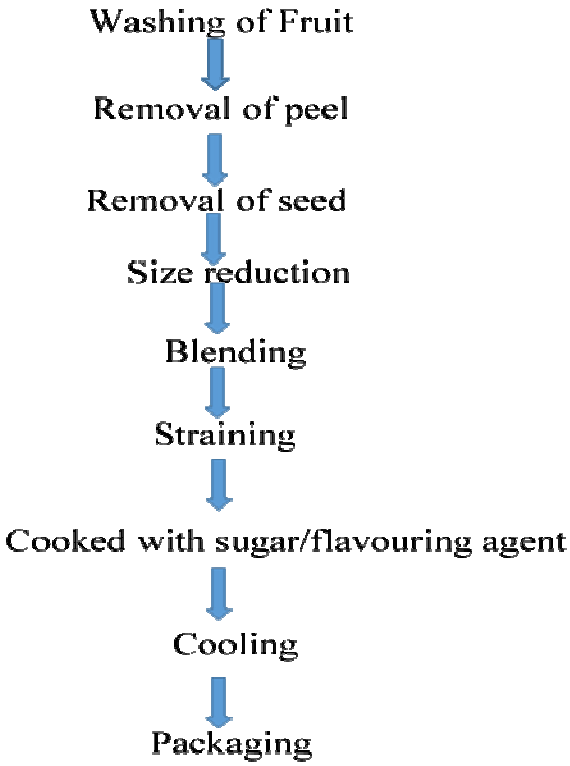

Figure 1. Preparation of *B. aethiopum* syrup/flavoured *B. aethiopum* syrup