Development of bambangan (*Mangifera pajang*) carbonated drink

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Abstract. *Mangifera pajang* Kostermans or bambangan is a popular fruit among Sabahan due to its health and economic values. However, the fruit is not fully commercialized since it is usually been used as traditional cuisine by local people. Thus, development of bambangan fruit into carbonated drink was conducted to produce new product concept. The objectives of this study were to conceptualize, formulate, evaluate consumer acceptance, and determine physicochemical properties and nutritional composition of the accepted product. Method used in conceptualising the product was based on questionnaire. The consumer acceptance was evaluated based on descriptive and affective tests with four product formulations tested. The physicochemical properties on carbon dioxide volume, colour, pH, total acidity, total soluble solid (TSS) and viscosity were highlighted, meanwhile nutritional composition on fat, protein, carbohydrates and energy content were determined. About 77% respondents gave positive feedback, and 69% respondents decided this product is within their budget. The formulation of 5% bambangan pulp, 70% water, 25% sugar and 0.2% citric acid was highly accepted in descriptive and affective tests with 4.4 and 6.39 mean scores, respectively. The physicochemical properties and nutritional composition of the acceptance product were in optimum value except for colour, total acidity and TSS. Overall, this study showed that the product has high potential to be commercialized as new product concept, and heritage of indigenous people can be preserved when this fruit is known regionally.

1. Introduction

*Mangifera pajang* Kostermans is endemic to the lowland rain forests of Borneo Island consisting Sabah, Sarawak, Brunei and Kalimantan [1]. Commonly referred as the Bornean mango, this endemic mango species is locally known as bambangan in Sabah and Brunei, mawang in Sarawak, and embang in Kalimantan [1]. In Malaysia, consumers prefer ripe bambangan fruit with a brown colour. Using bambangan fruit, there are various types of food preparations can be prepared such as pickles, dehydrated fruits, minimally processed fruits, or juices. Fermented *M. pajang* fruit or typically ‘jeruk bambangan’ is a popular traditional food among Kadazan-Dusun people in Sabah [2].

In the past decade, interest in the study of *M. pajang* has increased. Ibrahim *et al.* [3] conducted study on the proximate composition and antioxidant activities of *M. pajang* pulp. The study showed that the protein, carbohydrate, ascorbic acid and ash content were high in *M. pajang* juice powder. Furthermore, *M. pajang* pulp was rich in fibre, gross energy, phenolic and carotene content. Moreover,
the authors claimed that *M. pajang* juice powder could be used as a good source for the preparation of a health drink because of its high antioxidant activity, ascorbic acid, protein and carbohydrate content. The flesh and peel of *M. pajang* have been analysed for the phenolic, flavonoid and anthocyanin content [2, 4]. Hence, this study aimed to conceptualize, formulate, evaluate consumer acceptance, and determine physicochemical properties and nutritional composition of the carbonated bambangan drink.

2. Materials and Method

2.1. Conceptualising product
Conceptualising product was conducted via structured questionnaire form. The questionnaire was distributed to 100 respondents in two different regions as 50 respondents at Kota Kinabalu, Sabah and the other 50 respondents at Universiti Tun Hussein Onn Malaysia (UTHM), Pagoh Campus, Johor.

2.2. Product formulation
The ingredients used to make bambangan drink were adapted from Thongrote *et al.* [5] that studied about mango carbonated drink. To make bambangan flavoured drink, 1000 g of bambangan puree was homogenously mixed with 3500 g of distilled water, 500 g of sugar, 10 g of citric acid and 6 g of salt. Then, the mixed substances were blended together using the blender (Khind, Malaysia). Total of four formulations were established for sensory test. For carbonation process, carbonated beverage filling machine (Triowin, China) was used.

2.3. Sensory analysis
The structured question with 5- point hedonic scale (Likert scale) was used to evaluate the sweetness, sourness, colour, odour, sparkling sensation and overall acceptance of the sample in sensory evaluation for descriptive test. The test was done by 10 trained panelists of undergraduate students from UTHM. A set of questionnaire consisting of 9-point hedonic scales was prepared in which 9 was represented for extremely like, while 1 was represented extremely dislike [6] for affective test. The test was conducted on 100 untrained panelists of undergraduate students from UTHM.

2.4. Physicochemical analyses
The physicochemical properties for bambangan carbonated drink were analysed and determined based on the carbon dioxide (CO₂) volume, colour, pH, total acidity, TSS and viscosity. The volume of CO₂ in the sample was analysed using a thermometer (SK Sato, Japan) and a pressure gauge (Aschroft, USA). The colour of the sample was analysed using colorimeter (MiniScan EZ, USA). To determine the pH value, about 3 ml of sample was put into a beaker measured by pH meter (Eutech pH 700, India). Total acidity of the sample was analysed by a titration method. TSS for the sample expressed in brix (°Bx) was determined using a digital refractometer (Atago 0–32 °Bx, Japan). To determine the viscosity, about 7 ml of sample was put into the concentric cylinder of Rheometer (Ares-G2, USA).

2.5. Nutritional composition
The nutritional composition such as protein, fat, carbohydrate and energy content of bambangan carbonated drink were also analysed and determined. The Kjeldahl method was used to determine the protein content of the sample [7]. To analyse the fat content, the method used was acid hydrolysis method. The total carbohydrate content of the sample was calculated using the proximate formula. The protein, fat, moisture and ash contents of the samples were determined first. Then, the carbohydrate content was determined. In order to determine the energy content of the sample, the total content of protein, fats and carbohydrates were converted into energy in different quantities. Then, the total energy content of the sample was obtained by sum up all of the values.
3. Results and Discussion

![First reactions towards the new product.](image1)

**Figure 3.1** First reactions towards the new product.

![Tendency to buy the product.](image2)

**Figure 3.2** Tendency to buy the product.

Figure 3.1 shows the percentage of the reaction of the respondents. About 77 respondents gave positive feedback towards the product which 30 of them think that it is an excellent product (30%) while the other 47 respondents think that the product is good (47%). On the other hand, 16 respondents gave a fair opinion since they are unsure with the product concept idea (16%). However, about 7 respondents gave negative feedback as 4 of them think that it is a poor product (4%), while the other 3 respondents think that the product is very poor (3%). Figure 3.2 shows the percentage of the tendency to buy the product. It shows that 24 respondents would definitely buy the product (24%). Meanwhile, about 45 respondents think that they would probably buy the product (45%). About 26 respondents think they might buy or might not buy the product (26%). Nevertheless, about 2 and 3 respondents would probably not buy (2%) and definitely not buy (3%) the product, respectively.
Table 3.1 Mean scores for each sensory attributes in descriptive test.

| Attributes            | Sample |
|-----------------------|--------|
|                       | 123    | 234    | 345    | 456    |
| Sweetness             | 3.1    | 3.5    | 3.1    | 4.5    |
| Sourness              | 2.2    | 3.1    | 2.7    | 4.4    |
| Colour                | 3.6    | 4.3    | 3.1    | 3.0    |
| Odour                 | 2.4    | 3.7    | 3.1    | 3.3    |
| Sparkling sensation   | 2.3    | 3.3    | 2.7    | 3.4    |
| Overall acceptance    | 3.3    | 3.9    | 3.2    | 4.4    |

Table 3.2 Mean scores for each sensory attributes in affective test.

| Attributes            | Sample |
|-----------------------|--------|
|                       | 234    | 456    |
| Sweetness             | 5.91   | 6.34   |
| Sourness              | 5.44   | 5.41   |
| Colour                | 5.61   | 5.69   |
| Odour                 | 5.11   | 5.19   |
| Sparkling sensation   | 5.28   | 5.30   |
| Overall acceptance    | 6.10   | 6.39   |

Based on Table 3.1, the overall acceptance for the sample coded 456 among the highest of all four samples with the total of 4.4 mean score. The second highest was sample coded 234 with the total of 3.9 mean score. However, sample coded 123 and 345 were less favourable by panelists with the mean score of 3.3 and 3.2, respectively. To conclude the result, sample coded 234 and 456 were selected and tested in affective test. In affective test, the overall acceptance for the sample coded 456 was higher compared to sample coded 234 with the total of 6.39 mean score as shown in Table 3.2. Sample coded 234 had a total of 6.10 mean score. To conclude the result, mostly youth consumers love sweet beverages such as soft drink [8] in which the sample coded 456 contributed about 25% of sugar composition, thus it became an ideal product for the final product development among youth consumers. The sample then was tested for physicochemical analyses and nutritional composition.

Table 3.3 Physicochemical properties for sample coded 456.

| Sample               | Result                        |
|----------------------|-------------------------------|
| CO₂ volume (m³)      | 3.0 ± 0.00                    |
| L*                   | $= 30.52 ± 0.40^a$            |
| Colour               | $a^* = 1.73 ± 0.16^b$         |
|                      | $b^* = 8.09 ± 0.51^c$         |
| pH                   | 2.34 ± 0.08                   |
| Total acidity (%)    | 2.1 ± 0.00                    |
| TSS (°Bx %)          | 16.22 ± 0.01                  |
| Viscosity (Pa.s)     | 0.02613 ± 0.003936            |

^a Luminous/lightness.
^b Positive value for reddish and negative value for greenish.
^c Positive value for yellowish and negative value for bluish.
Table 3.4 Nutritional composition for sample coded 456.

| Sample            | Result |
|-------------------|--------|
| Protein (g/100g)  | 0.0    |
| Fat (g/100g)      | 0.0    |
| Carbohydrate (g/100g) | 9.4  |
| Energy content (kJ/100g) | 38   |

Table 3.3 shows the summary of physicochemical properties and nutritional composition. High colour values of the drink could affect the physicochemical properties of the subsequent drink in terms of attributes and evaluation on consumer’s acceptance [9]. The value of pH 2.34 was observed in bambangan carbonated drink which showed higher value as compared to that of carbonated ginger drink with 2.80 in pH value [10]. An increasing of pH value is correlated with the total acidity of carbonated drink [10]. Total of 0.27% of acidity value is the lowest and ideal for carbonated drink [10]. Amount of 16.22% of °Bx was found in bambangan carbonated drink. This could be noticed that added ingredient of sugar causes high total soluble solid [11]. Carbonated soft drinks usually have low viscosity and are free flowing [12]. The value obtained in this study for viscosity content was low as the total percentage of water was 70% that diluted the liquid content.

For nutritional composition in Table 3.4 the result showed that bambangan carbonated drink did not contain protein and fat. High content of carbohydrates associated with high carbon dioxide content [11]. This could be that the water absorption in the sample was aided for CO₂ absorption. Amount of 38 kJ/100 g of bambangan carbonated drink was composed as energy content since the sample contains of 70% of sugar. High energy content usually correlated with the sugar consumption since high sucrose used in soft drink [13].

4. Conclusion
From the result obtained in questionnaire based on conceptualising product, most of the respondents gave positives feedback towards this product. For the affective test, the result shows that the product was acceptable for the sample coded 456 by untrained panelists. The nutritional composition and physicochemical analyses of the bambangan carbonated drink were in optimum value except for colour, total acidity and TSS. The recommendation for the future research is deep study on the shelf life and stability of the product. Besides that, the suitable packaging material for the product can be investigated and proposed. The suitable preservative agent for the product can be studied in order to increase the stability of the products.

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