Physicochemical Characteristics of Belimbing Dayak (*Baccaurea angulata*) Juice Beverages

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Abstract

This study was conducted to evaluate some physicochemical parameters of underutilized tropical fruit namely belimbing dayak (Baccaurea angulata). Several parameters were identified including pH, total soluble solid (TSS), titratable acidity (TA), sugar-acid-ratio (TSS:TA), ash and calcium composition at different concentrations and conditions of belimbing dayak juice. The conditions are juices without addition of sugar and juices added with sugar. These juices were prepared at concentrations of low (LC), medium (MC) and high (HC). The highest pH was observed in LC added with sugar (3.43) while the lowest pH can be detected at HC with sugar (3.03). The TSS value vary widely where the highest TSS value for juices without sugar was 1.05°Brix while for the juices with sugar the highest TSS value was 7.95°Brix. TA readings pattern was observed to be increase as the concentration increasing for both conditions. From the analysis of ash, the content for both conditions are the same where the reading for LC and MC was 0.02g/100ml of juice and for HC the value was 0.05g/100ml of juice. Most of the parameters interested showed statistically difference ($p<0.05$). The calcium content was ranging from 4.88 to 10.96mg/L. The results contribute to the important information on physicochemical properties of belimbing dayak.

Keywords: *Baccaurea angulata,* physicochemical, fruit juices, concentration

1.0 Introduction

Current years are observing the trend of changes in beverages sectors. The fruit juice industry is one of the beverage industries that are rapidly growing. Apart from having raw fruits, the Malaysian consumers can

also get benefited from the fruit juice as this is supported by two different studies where there were no significant differences between the consumption of fruits and fruit juices as both have similarities in composition (Ruxton et al. 2006; Landon 2007). This is also supported by Kris-Etherton et al. (2002) where antioxidant activities are presence in fruit juice just like the whole fruit.

Fruit juice should meet the sensory expectations of the customers as this may act as a predominant factor in consumers' satisfaction in which will determine the acceptance of tropical fruit juices (Sabbe, Verbeke & Van Damme, n.d). Therefore, it is very important to identify the physical and chemical properties of *Baccaurea angulata* juice and so as the preferable concentration of this juice, so that people attracted to consume the juice due to the organoleptic properties that possessed by the juice drink other than considering the benefits in terms of antioxidant activities that contains within it.

2.0 Materials and Methodology

2.1 Raw materials

Samples of belimbing dayak (*Baccaurea angulata*) which is originally came from Bau, Sarawak were collected from International Islamic Universiti Malaysia. The samples were collected and packed in aseptic aluminium and were stored at the temperature of -40°C until analyzed. Once opened, the extract was then transferred into 1000 ml glass bottle for each and was restored in under the temperature of -40°C until analyzed.

2.2 Formulation of belimbing dayak (*Baccaurea angulata*) beverage

Baccaurea angulata beverage was prepared at three different concentration; low, medium and high concentration by adding water. For each concentration, it was further prepared into two different condition where the first sample which is low concentration (5%) in 1 L consist of 50ml of belimbing dayak (*Baccaurea angulata*) extract mix with UV-treated water and the second solution for the same concentration was a mixture between 50ml of belimbing dayak (*Baccaurea angulata*) extract, UV-treated water and sugar. The same procedure goes to the preparation of medium and high concentration of belimbing dayak (*Baccaurea angulata*) extract except for the volume of belimbing dayak (*Baccaurea angulata*) extract was increased to 100 ml (for medium concentration, 10%) and 200ml for high concentrated (10%) juice. The amount of sugar that was added into those 3 concentrations is 91g/L. Each of the concentration and condition were prepared in triplicate.

2.3 Physicochemical analysis

2.3.1 Determination of Total Soluble Solids (TSS)

The TSS content of belimbing dayak (*Baccaurea angulata*) beverages was determined by using Atago hand-held manual analog refractometer which were corrected for temperature. A few drops of belimbing dayak (*Baccaurea angulata*) beverages were placed onto the stage of refractometer and the °Brix readings were recorded. The °Brix readings were obtained from the refractometer was corrected and the final figures were recorded. For the next reading, the stage of the refractometer and the lid were cleaned with distilled water and dried. This was done between each samples and the baseline was checked is set to zero. Replication was done in triplicate for each method.

2.3.2 Determination of pH

The pH was determined by using Martini pH bench meter with temperature probe for each concentration and triplicate where the temperature measured was 20° C and the pH meter was calibrated with pH 4.0 and 7.0 buffers. Replication was done in triplicate for each method.

2.3.3 Determination of Titratable Acidity

TA was estimated by titration with 0.5 M sodium hydroxide (NaOH) using phenolphthalein as indicator. 10 ml of belimbing dayak (*Baccaurea angulata*) beverage was poured into a conical flask. 3 drops of phenolphthalein solution was added. A burette was filled with 50 ml of 0.1 M sodium hydroxide (NaOH) and was added slowly drop by drop into the flask and was swirled until the colour goes a persistent pink for at least 30 seconds. The amount of NaOH solution used was recorded. Replication was done in triplicate for each method. Acidity was determined by using the following formula

Acidity (g/L) = volume of NaOH x 0.064

2.3.4 Determination of TSS:TA

Determination of sugar acid ratio (TSS:TA) was done by using a formula

Sugar acid ratio = °Brix value/ concentration of acid (g/L acid)

2.3.5 Determination of Mineral Metals

Mineral metal determination will be done according to the method by Niu at al. (2008). 20.00 g of juice was put into the acid washed glass digestion tube and was weighed. The digestion liquid (DL) was prepared by forming a mixture of redistilled concentrated nitric acid/perchloric acids (4:1, v/v). 12 mL of DL was poured into the tube and it was then set in a temperature control digestion oven at room temperature overnight. The tube was then heated and more DL was added until the digest was completely clear. After that, 50 mL of acid-washed volumetric flask was used in which the digest was transferred into it and conditioned. Determination of calcium, potassium and magnesium was done by diluting this solution with deionized water and the determination of other elements was done through the use of the remaining undiluted digest. Three water blanks were run with each batch of samples.

Atomic absorption spectrophotometer (AAS) was used in this analysis and stock solution (1 mg/Ml, 3% HNO_3) was used to make mixed (multi-element) working standard solutions. Three concentrations (range of metal concentration) within orange juice digest were prepared for AAS (mg/L levels).

2.3.6 Determination of Ash

Determination of ash was done by following the AOAC method (1990). A shallow porcelain dish will be dried by using oven at temperature of 105°C for 3 hours. Dessicator will be used to cool it. Once it has attains the room temperature, it will be weighed immediately. 5 g of the homogenized sample (powder) will be put into porcelain dish and being weighed.

The dried sample will be gently charred over a Bunsen burner until it has ceased smoking. The dish will be place in the muffle furnace and it will be heated at 550°C for 1 hour. The sample will be ashed until a whitish or grayish ash is obtained. The dish will be removed, cool in the dessicator and it will be weighed

soon after it has achieved room temperature. After that, it will be replaced in muffle furnace and heating process will be continued until a consistent weight is obtained. Replication was done in triplicate for each method.

The total ash content of the sample can be calculated by using the following formula:

g of ash per 100g of the total sample = weight of ash (g)/ weight of sample (g) x 100

2.4 Statistical Analysis

Juices samples from different concentration will be considered as a source of variation. The results will be statistically evaluated by one-way analysis of variance (ANOVA). Statistical differences with *P*- values under 0.05 will be considered as significant. In order to compare the averages, Tukey's test will be used.

3.0 Results and Discussion

3.1 pH

As the concentration increase, the pH of the belimbing dayak (*Baccaurea angulata*) juice is decreasing. This pattern was applied to both of the condition of the juice either without sugar or with sugar. The pH among the concentrations is varied from 3.03 to 3.43 (Fig 1a). The lowest pH was found in belimbing dayak (*Baccaurea angulata*) juice with sugar at the highest concentration (HC) with the reading of 3.03. The highest pH was found in belimbing dayak (*Baccaurea angulata*) juice with sugar at the concentration of 5% of extract (LC). This may be due to the duration of storage before the analysis being conducted. The presence of microbial activity might also occur and influence the reading.

3.2 Total Soluble Solids (TSS)

The lowest TSS value can be observed at LCns and MCns where the Brix value is the same, 0.65 while the highest TSS value can be observed at HCs, 7.95 °Brix (Fig 1b). There was a wide gap among the reading of the juice without sugar and juice with sugar. This is greatly influenced by the addition of sucrose into the LCs, MCs and HCs. Apart from sugar, other constituents may also influence the reading such as organic acids, proteins and vitamins. According to Mahajan (1994), the duration of storage also influences the rise in the TSS value.

3.3 Titratable Acidity (TA)

The titratable acidity for belimbing dayak (*Baccaurea angulata*) juice at different concentrations and conditions is significant $p<0.05$). As the concentration increased, the values for TA are also increased too (Figure 1c). The highest value for TA was recorded at the highest concentration of belimbing dayak (*Baccaurea angulata*) juice with sugar in which the mean value is 0.24g/L and the lowest value was 0.06g/L which can be detected in low concentration of belimbing dayak juice without sugar.

3.4 TSS:TA

As the concentration increase, the sugar-acid-ratios were decreased (Fig 1 d). The sugar-acid-ratio for LCns juice is higher (10.8:1) compared to the ratio in HCns (5.3:1). This was also the same to the condition of without sugar. The juice without sugar contains a higher ratio (94.4:1) compared to low concentration without sugar (33.1:1). There is a wide difference in the ratio between the two conditions in which the TSS-

TA ratio in juice with sugar is higher compared to those without sugar. This is greatly influenced by the addition of table sugar into the formulation. Potter and Hotchkiss (1995) stated that "the higher the brix, the greater the sugar concentration in juice; the higher the sugar acid ratio, the sweeter and less tart is the juice" (p.430).

3.5 Ash

The amount of ash present in the belimbing dayak (*Baccaurea angulata*) juice did not vary (Fig 1e). The amount of ash that was present in LCns and MCns is 0.02%. This is also the same goes to the condition with sugar at the same concentration which is LCs and MCs. At a higher concentration the value for ash is 0.05% for both of conditions. The amount of ash obtained indicates the amount of fruit contents in the drinks (Akhter, Masood, Jadoon Ahmad & Ullah,2012).The lower the ash content the higher amount of fruit used in the product and vice versa. From this study, the amount of the ash that was obtained was the same for both conditions at the same concentration and this parameter vary significantly. The minerals are not categorized as volatile compound and therefore they are not destroyed by heating. According to Hussain (1993), this parameter is influenced by the duration of storage and temperature.

3.6 Calcium

From the analysis, it was found that as the concentration of the juice increase, the amount of the mineral metal which is Ca decreased (Fig 1f). The amount of Ca present was higher in LC for both conditions either without sugar or with sugar, 9.95mg/L and 10.96mg/L respectively. The lowest amount of calcium detected was within HCs in which the amount was 4.88mg/L. However, error possibly occurred during the analysis due to the absence of lanthanum which is used as matrix modifier. The determination of calcium will be difficult due to the reaction with phosphate (Udoh, 2000) and forming non-volatile salt in the absence of lanthanum. Therefore, lanthanum is needed to be used in order to release calcium in the form of ion.

5.0 Conclusion

From this study, it was found that as the concentration of belimbing dayak (*Baccaurea angulata*) beverage increased, the pH value for both conditions were decreased, which indicate acidic condition. TSS reading for HCs is the highest and the TSS/TA ratio for the LCs was the highest. Ash content is the same for both of the conditions and at the same concentration. The amount of calcium present in the juice beverage range from 4.88-10.96 mg/L.

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References

Akhter S., Masood S., Jadoon H. S., Ahmad I. & Ullah S.(2012). Quality evaluation of different brands of Tetra Pak mango juices available in market. *Pakistan Journal of Food Science 22*(2), 96-100.

Hussain, S., M.1. Siddique, N. Parveen & N.Z. Parwaz.(1993). Effect of packaging on the quality of fruit juice based drinks. JAPS. 3 (1-2): 15-18.

Kris- Etherton PM et al (2002). Bioactive ompounds in foods : their role in the prevention

of cardiovascular disease and cancer. *American Journal of Medicine,* 113 Suppl 9B: 71S-88S

Mahajan, V.V.C. (1994). Biochemical and enzymatic changes in apple during cold storage. *Journal of Food Science and Technology Mysore*. 31 (92): 142-144.

Potter N. N. & Hotchkiss J. H.(1995).Food Science (5th ed.).Gaithersburg, Maryland, USA: Aspen.

Ruxton C. H., Gardner E. J., Walker D.(2006). Can pure fruit and vegetable juices protect against cancer and cardiovascular disease too? A review of the evidence. *International Journal of Food Science and Nutrition*, 57:249-272.

Sabbe S., Verbeke W., Deliza R. , Matta V. & Van Damme P (2009d). Consumer liking of fruit juices with different acai (*Euterpe oleracea* Mart.) concentrations. Journal of Food Science, 74,S171-S176

Udoh A. P.(2000). Atomic Absorption Spectrometric Determination of Calcium and other Metallic Elements in Some Animal Protein Sources.*Talanta 52*(6), 749-754.

Table 1: Parameters of pH, TSS, TA, TSS/TA, ash and calcium in Belimbing Dayak (*Baccaurea angulata*) Juice Beverages at different concentrations and conditions

Parameters	LCns	MCns	HCns	LCs	MCs	HCs
pH	3.42± 0.02[a]	3.18± 0.01[b]	3.16± 0.02[b]	3.43±0.01[a]	3.17± 0.01[b]	3.03± 0.01[c]
TSS (°Brix)	0.65[a]	0.65[a]	1.05[b]	7.55± 0.12[c]	7.75[d]	7.95[e]
TA (g/L)	0.06[a]	0.12± 0.09[b]	0.25± 0.01[c]	0.08± 0.01[a]	0.14± 0.01[b]	0.24± 0.01[c]
TSS/TA	10.8:1	5.4:1	5.3:1	94.4:1	55.4:1	33.1:1
Ash (%w/w)	0.02± 0.02[a]	0.02[a]	0.05± 0.01[b]	0.02± 0.01[a]	0.02[a]	0.05[c]
Calcium (mg/L)	9.95	4.89	4.99	10.96	8.43	4.88

Results were expressed as mean±SD, analyzed individually in triplicate ($p < 0.05$). Different superscript letters within row represents significant difference in related parameters.

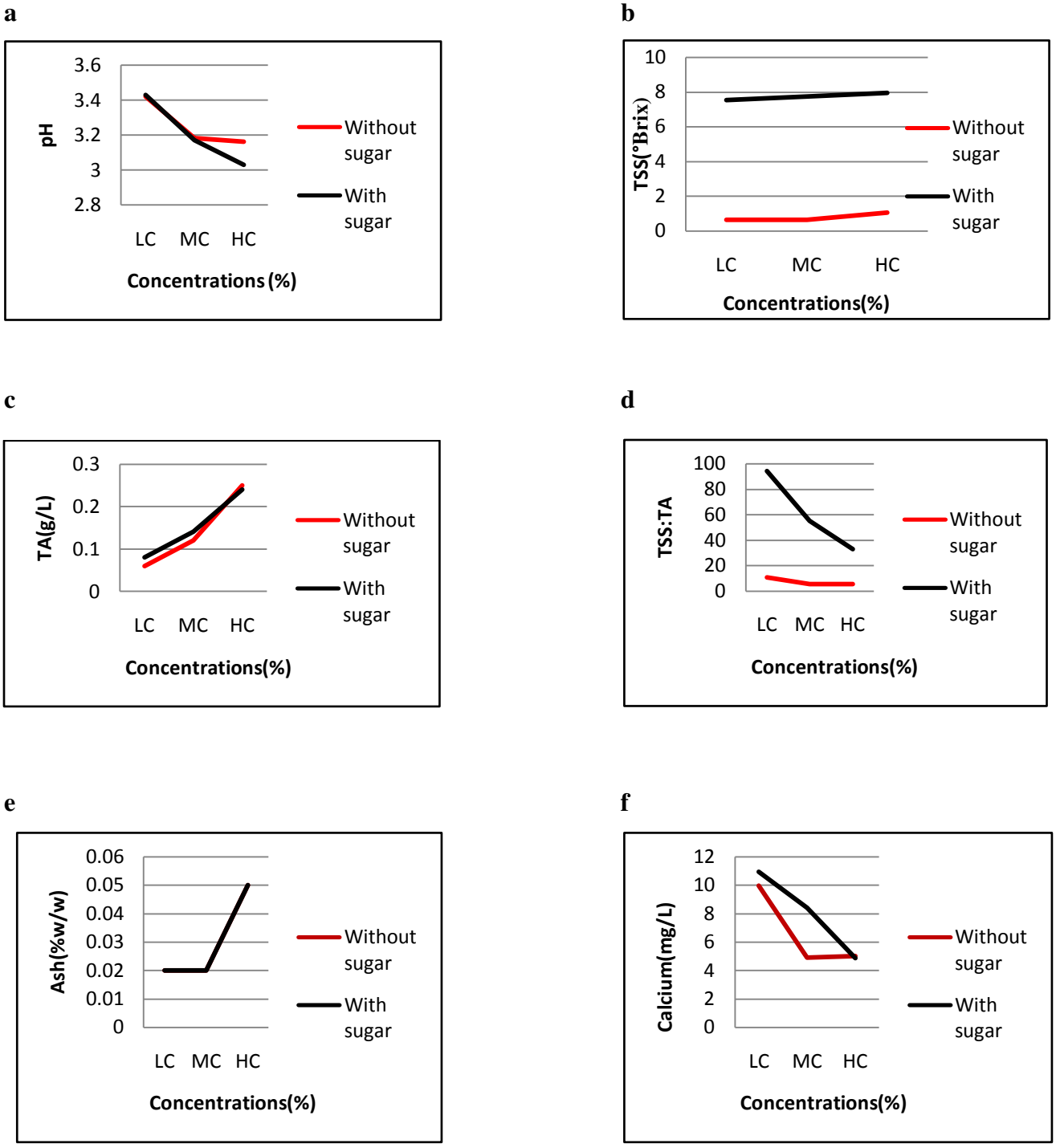

Figure 1 Graph for each parameters which include pH, TSS, TA, TSS/TA, ash and calcium for belimbing dayak (*Baccaurea angulata*) at different concentrations and conditions