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# Evaluation of the buri palm (*Corypha elata Roxb*.) sugar properties

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## ABSTRACT

Most people want to live a long and healthy life, so they focus more on health and wellness thus, producing a low glycemic index (GI) foods are now in demand. The work presented here is concerned with the evaluation of sugar from Palm tree such as Buri Palm (*Corypha elata Roxb.)* which has a big potential to be used as healthy alternative sugar. Based on the findings of Food and Nutrition Research Institute (FNRI 2007), Buri palm sugar from Verde Island, Batangas has a medium GI but still its other properties are not yet explored. Evaluation of sugar profile was done thru High Performance Liquid Chromatogra(HPLC) and Gas Chromatography Mass Spectrophotometry (GCMS). The sugar properties of Buri Palm sugar were also compared with brown sugar and coco sugar. The results showed that Buri palm sugar had neutral to basic pH and showed variances in color properties. It can be noted that brown sugar has the highest sucrose content of 92.35 ug/100mg followed by coco sugar with 84.94 ug/100mg, while Buri palm sugar had the lowest sucrose content of 82.50 ug/100mg. For glucose content, brown sugar has the lowest content of 1.32 ug/100mg, while the coconut sap sugar has the highest with 2.61 ug/100mg , almost doubled that of brown sugar. Buri palm sugar has 2.01 ug/100mg glucose content which is in between that of brown and coconut sap sugar. It can be inferred that Buri palm sugar contains mostly of sucrose with a minimal content of glucose and fructose and is comparable to that of the coconut sap sugar. Buri palm sugar contains minerals which are essential to health and is comparable to that of the mineral contents of coconut sap sugar (PCA 2015) with emphasis to sodium, iron and zinc. Furthermore, no heavy metals are present on Buri palm sugar. This research can be used as baseline for further processing and value adding of the Buri palm sugar.

***Keywords*** : buri palm sugar, food processing, sucrose, glycemic index

## 1. Introduction

At present, most people want to live a long and healthy life, thus more and more people focuses on health and wellness. From the existence of refined or processed or the so called extracellular sugars which have been long associated with human diseases, there is the intracellular sugar that can be found in fruits and vegetables and provides our body the nutrition we need.Producing a low glycemic index (GI) foods such as fibre-rich foods are now in demand. Low GI foods are more slowly absorbed and therefore produce a less pronounced rise in blood sugar levels and Coconut is one of the palm trees in the country which has low glycemic index. However, due to demand for heatlthy alternatives researches on other low GI foods must be given priority. Sap from Palm trees such as buri palm (*Corypha elata Roxb.)* are not given much emphasis but it has a big potential to be used as sugar, however in the Philippines not much had been made regarding the characteristics and properties of this palm sugar. Philippines is endowed with abundant tropical fruits and other agricultural produce which are still spoiled and wasted due to mishandling and lack of good preservation and processing methods.

Buri palm trees are naturally growing in Batangas Province. Many handicrafts are produced using buri palm from Batangas, especially in Lobo like bags, baskets, hats, among others and even in Ilocos Sur the use of buri palm parts have been considered[1]. In addition, Pakaskas or buri palm sugar is also one of the products made from buri sap but is produced in small quantity only, since no added value has been realized for this palm sugar aside for snacks and sweetening. According to Office of the City Veterinarian and Agricultural Service (OCVAS 2010) there are almost 5700 buri trees in Batangas Province, mostly found in the communities located at Verde Island and Lobo. Thus, the researchers chose buri palm since its sap is very promising in producing a medium to low glycemic sugar according to the intial analysis of some unpublished research conducted by Batangas State Univerity and of Food and Nutrition Research Institute [2],[3]. However, at present no other researches on the properties of the said buri palm sugar had been made.

The main aim of the study is to evaluate the characteristic properties of the buri palm sugar in terms of pH and color ,sugar profile and mineral content. Furthermore the buri palm sugar was also evaluated and compared with brown sugar and coconut sugar acquired from the supermarket of the State of Louisiana.

## 2. Materials and methods

2.1. Sample collection and preparation of extract

The buri palm sap was collected in Verde Island, Batangas City, Philippines. The liquid sap is derived from the nutritious toddy / sweet sap (tuba) oozing out from the unopened inflorescence. The color is beige to light brown with pH (≥6) and heat evaporation of boiling the toddy/sap at 115 $^{0}$C, forming a granulated sugar [4]. It is a simple farm-level technology involving a natural process of heat evaporation to convert liquid sap to solid form of sugar granules [5]. Brown sugar and coconut sugar were purchased from the supermarket in Baton Rouge, Louisiana USA for mineral and sugar profiling.

2.2. Characteristic profile measurement of sugar

*2.2.1. pH measurement*

The pH of buri palm sap (10% w/v) was measured using a Seven Compact pH Benchtop Meter (Mettler Toledo, USA). Calibration was standardized using pH 7.0 and 4.0 buffers [6]. Each sample was measured in three replications.

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*2.2.2. Determination of color using LabScan XE spectrophotometer*

Color of the sugar was determined using LabScan XE spectrophotometer (Hunter lab, USA). In which L is the lightness or darkness, while "a" is redness or greenness where a positive number indicates red and a negative number indicates green and the b value yellowness or blueness. Chroma is the intensity of the color while Hue is the predominant wavelength reflected, which determines what the perceive color is (red , green, yellow, blue. etc) [7].

2.3. Evaluation of sugar content thru mass spectrometry

The sugar properties were further determined thru Mass Spectrometry and was identified thru efficient separation systems. High Performance Liquid Chromatography and Gas Chromatography Mass Spectrophotometry (GCMS) were used. Sample preparations were done based on the modified procedures of [8].

*2.3.1. Sugar profile*

Sugar profiling was performed using High Performance Liquid Chromatography from Waters USA which has Refractive index detector (Waters 2414), and Binary HPLC pump (Waters 1525) with MilliQ water as the solvent was used. The samples were diluted 10 times with deionised water and then filtered using a 0.45 µm nylon filter (Labserve). Twenty µL of sample were injected into a LiChroCART® Single bond $NH_2$column (Merck) with dimensions of 250 mm × 4.6 mm, particle size of 5 µm. The temperature of the column was set at 40°C. The mobile phase consisted of HPLC-grade acetonitrile and double-distilled water (80:20, v/v ratio. The sugars were separated isocratically at a flow rate of 1.5 ml/min. Standard curves were constructed based on sugar reference standards (arabinose, fructose, fucose, galactose, glucose, rhamnose, mannose and sucrose) by plotting peak area against various concentrations of each sugar [9],[10].

*2.3.2. Mineral analysis using inductively coupled plasma mass spectrometry.*

Different mineral content of buri palm sugar was determined following the method in Plant Analysis handbook [11].

The mineral contents were analyzed by inductively coupled plasma mass spectrometry (ICP-MS). 1.0 g of each sample was digested with 4.0 mL of 65% (v/v) $HNO_3$ and 0.5 mL of 35% (v/v) $H_2O_2$ in *polytetrafluoroethylene* (PTFE) vessels. The sample were digested using the microwave system applied were as follows: up to 120°C for 15 min and then constant for 10 min; up to 160°C in 20 min and constant for 15 min; finally, a cooling stage (30 min) was carried out to 22°C and diluted to 50 mL with deionized ultrapure water. This solution was finally used for elemental analysis, performed with an ICP-MS equipped with a concentric Nebulizer, a quartz torch with quartz injector tube, and cyclonic spray chamber. All samples were analyzed in duplicate and each sample was measured in triplicate by ICP-MS detection.

## 3. Results and discussion

Table 1 show the pH and the color properties of buri palm sugar . The sample has a pH from neutral to almost basic. The results also clearly demonstrate that there are variances in color properties of buri palm sugar . The sugar has light brown color , however the chroma or the intensity of the color is almost the same for both samples. Furthermore, the value for Hue (H) or the of hue angle (H*) 75.71±0.13 and chroma (C*) 36.91±2.66 is significantly ($p \leq .05$) lower than buri palm sugar. This indicates that brown sugar and coco sugar exhibited a lower color saturation as higher values of H* and C* indicate higher saturation of color.

**Table 1.** The pH and color properties of Buri palm sugar.

| Parameter | | Value ± S.D. |
|---|---|---|
| pH (sol.10% p/p) | | 7.36 ± 0.01 |
| Tristimulus colour (Hunter scale) | L | 51.94±1.89 |
| | a | 12.12±0.71 |
| | b | 34.76±2.59 |
| Chroma (C) | | 36.91±2.66 |
| Hue (H) | | 75.71±0.13 |

Different concentrations of sugar samples and different standards were run using the HPLC to determine the best condition for the separation of the sugar content. Sensitivity and temperature were adjusted to ensure the best separation can be acquired. As can be observed from the different chromatogram from the HPLC (Waters,USA) it was determined that most of the sugar content of the buri palm sugar is sucrose. In addition the brown sugar and coconut sugar also showed sucrose as its main sugar content different sugar standards.

Table 2 represent the peak identification based on retention time ($t_R$). The identification of the three sugars were confirmed with different known sugar standard injected separately through the HPLC and the retention time for buri , brown and coconut The calibration curve was determined for the calculation of the sugar content of the samples. Three concentrations for each of the standards were prepared and placed in HPLC for reading. The different peak areas were plotted to have a calibration curve which will be used for the determination of the sugar content of the samples.

**Table 2**. Retention time of different sugar standards.

| Standards | Retention time (tR, min) |
|---|---|
| Arabinose | 11.30 |
| Fructose | 12.40 |
| Fucose | 11.25 |
| Galactose | 10.40 |
| Glucose | 9.00 |
| Mannose | 11.98 |
| Rhamnose | 10.60 |
| Sucrose | 7.70 |

Figures 3 show the different peak area of the different standards grouped together. This was done to determine if the

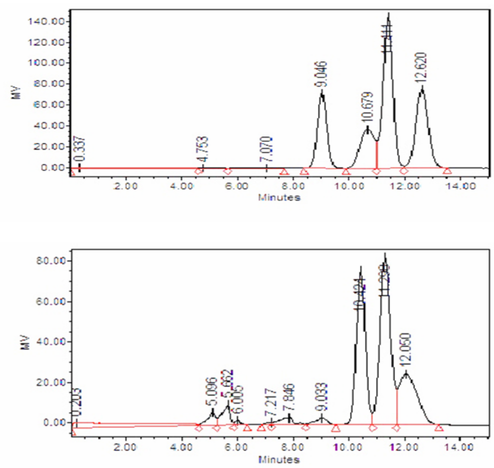


**Figure 3**. Chromatogram of sugar standard.

separation of the sugars in the samples will be efficient and peak areas can easily be determined and measured.

As shown in Figure 4 the chromatograms of each of the sample sugars with retention time and area. It can be observed that the highest peak area is the same as with the sucrose standard. Thus it can be noted that most of the sugar content of each of the samples is sucrose, although there are other small peak areas but the peak areas are too small and are in different retention time as compared to the determined standards. However ,peak areas for glucose and fructose can also be observed retention times for the sugar.

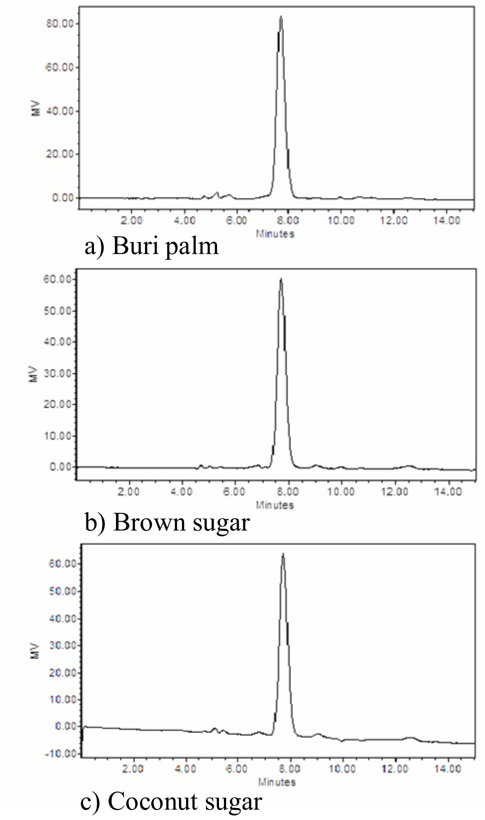


**Figure 4**. Chromatograms of a) buri palm sugar, b) brown sugar, and c) coconut sugar.

Figure 5 shows that sucrose content of the sugar samples is the highest as compared to glucose and fructose content which shows a very minimal amount. This results are in line with the range from Philippines National Standards for coconut sap sugar [12]. It can be noted that brown sugar has the highest sucrose content of 92.35 ug/100mg followed by coco sugar with 84.94 ug/100mg, while buri palm sugar had the lowest sucrose content of 82.50 ug/100mg.

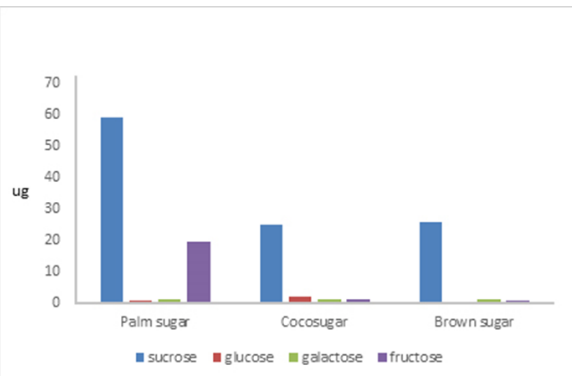


**Figure 5**. Sucrose, glucose and fructose content of sugar samples as determined using HPLC.

Furthermore, brown sugar has the lowest glucose content of 1.32 ug/100mg while the glucose content of coconut sap sugar is the highest with 2.61 ug/100mg and is almost doubled that of brown sugar. Buri palm sugar had the highest fructose content of 6.658 ug/100mg, while coconut sap sugar had the lowest fructose content of 1.86 ug/100mg. It can be noted that the sugar content results for both buri palm sugar and buri palm syrup is comparable to that of the coconut sap sugar which is coconut sap sugar has been reported to be in low category GI of 35± 4 to 42±4 [13-14].

In addition, GI is the blood glucose response of from a food relative to starchy food, e.g., white bread or a standard glucose solution. Also, low GI food has been shown to reduce postprandial glucose and insulin responses and improve the overall blood glucose and lipid concentration in normal subjects and patients with diabetes mellitus [15]. However further studies must be done to determine the GI of the buri palm sugar.

After several trials of sugar separation using different concentrations and conditions, it can be observed that the properties of buri palm sugar after hydrolysis, reduction of monosaccharides to corresponding alditols and acetylation of alditols are similar to that of the sucrose standards, thus the results of GCMS supports the results from HPLC that buri palm sugar contain mostly of sucrose followed by glucose and fructose.

It can be observed from Table 3 that buri palm sugar contains minerals which are essential to health and is comparable to that of the mineral contents of coconut sap sugar with emphasis to sodium, iron and zinc [16]. It can also be noted that the buri palm sugar contains below the standard levels of heavy metals such as arsenic and lead.

**Table 3.** Mineral composition of the different sugar samples (mg/L, average±SD).

| Mineral (ppm) | Buri palm sugar | Brown sugar | Coconut sugar |
|---|---|---|---|
| Aluminum | * | 1.36±0.56 | 71.67±1.51 |
| Arsenic | * | * | * |
| Boron | 13.75±0.01 | 1.95±0.00 | 7.35±0.92 |
| Cadmium | * | * | 3.78±0.76 |
| Calcium % | 0.003±0.01 | 20.01±0.02 | 29.13±0.23 |
| Cobalt | * | * | 0.41±0.02 |
| Chromium | * | * | 1.50±0.04 |
| Copper | 8.42±0.09 | * | * |
| Iron | 15.69±0.08 | 1.14±0.04 | 34.50±9.77 |
| Lead | * | * | * |
| Magnesium % | 0.10± | 0.003±0.00 | 0.045±0.04 |
| Manganese | * | * | 5.29±0.14 |
| Molybdenum | * | * | * |
| Nickel | * | * | * |
| Phosphorus % | 0.20±0.03 | 0.01±0.00 | 1.19±0.13 |
| Potassium % | 3.72±0.04 | 0.051±0.00 | 1.23±0.69 |
| Selenium | * | * | * |
| Silicon | * | * | * |
| Sodium | 313.10±0.22 | 15.93±0.06 | 3065.10±0.60 |
| Sulfur % | 0.17±0.22 | 21.08±0.24 | 0.07±0.01 |
| Zinc | 3.54±0.24 | * | 3.22±0.13 |

## 4. Conclusion

The results showed that buri palm sugar has almost neutral to basic pH and showed different color properties. It can also be inferred that buri palm sugar contains mostly of sucrose with a minimal content of glucose and fructose. In addition, the buri palm sugar contains minerals necessary to have a healthy body and no heavy metals are present. The sugar characteristics and mineral content of buri palm sugar is comparable to that of coconut sugar. However, it is recommended that further analyses specially on GI and inulin content of the buri palm sugar must be done to have an in depth study on how this can be of great significance in lowering the blood sugar levels of people . In vivo and in vitro study may also be done. The sugar can also be used in product development and further analyses of the developed product can be done to know the viability of the said sugar in terms of GI.

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