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Antioxidant capacity and phenolics of spray dried *Arrenga pinnata* juice powder

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Abstract

The ferric reducing antioxidant power, total phenolic content, radical scavenging activity, amino acid content and sugar content of spray dried arrenga pinnata juice powder was evaluated to determine the quality of spray dried powder obtained by spray drying of fresh arrenga pinnata juice at inlet temperature of 130oC, feed flow rate of 350ml/h, outlet temperature of 70oC and maltodextrin 10DE addition at 20%. Powder obtained has a total phenolic compounds content of 5.82 mg/100g of GAE and antioxidant potential identified by free radical scavenging activity (IC50) of 0.6mg/ml. The total sugar content of arrenga pinnata powder resulted in 30.14%. The analysis of free amino acids depicted the presence of lysine, glutamic acid, aspartic acid and alanine in higher levels. The homogenous and spherical nutritious particles can easily be reconstituted into juice.

Keywords: *Arrenga pinnata*, antioxidant activity, phenolic compounds

Introduction

Arrenga Pinnata was selected to be investigated in the present study. It is the most versatile palm specie because almost all parts of the tree can be used with the sap being the most important product (Siregar, 2005). Palm sap is consumed fresh as juice in local communities in South East Asia because it is believed to be highly nutritious and a good antioxidant. An antioxidant is a molecule that inhibits the oxidation of other molecules that can produce free radicals, leading to chain reactions that may damage cells. Generally fresh sap juice is sweet, oyster white colour and translucent with nearly neutral pH. The quality of sap juice is affected during storage by the pH of sap and reducing sugar content. Microrganisms use sugars in the sap as an energy source to produce organic acids. Spray drying is a method of producing a dry powder from a liquid or slurry by rapidly drying with a hot gas in a single processing step which can be advantageous for profit maximization and process simplification. It is useful as a method to transfer those molecules responsible for sensory and or biofunctional properties to a solid phase, which will be able to enhance their stability and control their release in food matrices (Verma et al., 2015). The advantages of a dried powder over conventional liquid forms of juice are lower storage costs, a higher concentration, and the stability of active substances. Spray dried Juice powder offers several advantages to protect sensitive food components against unfavourable ambient condition, to mask or preserve flavours and aromas, to reduce volatility and reactivity and also to provide additional attractiveness for the merchandising of food products. Spray drying has been widely utilised for the commercial production of fruit juice powders. Thus the present study was carried out to assess the antioxidant capacity of spray dried arrenga pinnata powder with particular emphasis on ferric reducing antioxidant power, total phenolic content, radical scavenging activity, amino acid content and sugar content of spray dried *arrenga pinnata* juice powder

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MATERIALS AND METHODS

Juice preparation

Samples were prepared with concentrated sugar palm (*arrenga pinnata*) juice. Fresh sugar palm juice tapped from sugar palm tree (*arrenga pinnata*) was collected locally at serdang, Malaysia. Food grade maltodextrin DE 10 was sourced locally and added as drying aids.

Obtaining powders by spray drying

Spray drying was carried out with a spray dryer lab plant SD-05 (West Yorkshire, UK) comprising of spray chamber of 1050mm x 620mm x 500 mm and 0.5mm standard diameter nozzle with co-current flow. The spray drying was conducted at inlet air temperature 130°C, pump speed 350 Ml/h, outlet air temperature 70° C and maltodextrin addition at 20%. Ambient temperature was maintained at 27 ° C and relative humidity of 56±1%. The dryer was washed with water at the desired parameter setting for 10 minutes before and after the spray drying process. Spray dried powders were collected in clean container with known weight and kept inside the desiccators until it cooled down. Powders were then weighed sealed in bottle and stored at 4°C for analysis.

Ferric reducing antioxidant power (FRAP) assay.

Ferric reducing antioxidant power assay was performed according to method of (Buasod, 2006). 500 µl of the samples were added to 1.25 mL of phosphate buffer and 1.25 mL of potassium ferricyanide (1%). The mixtures were incubated at 50°C for 20 min and then 1.25 mL of trichloroacetic acid solution (10 %) was added. Then, the mixture was combined with 1.25 mL of deionized water and 0.25 mL of $FeCl_3$ (1%). The ferric-tripyridyltriazine (Fe3+-TPTZ) complex having an intense blue colour was measured by reading the absorbance at 595 nm. Results were reported as µmol of Gallic acid per g of sample

DPPH radical scavenging activity.

DPPH radical scavenging activities were determined based on a method developed by Mansouri et al. (2005). A sample (1.5 ml) was added to 1.5ml of 0.15 mM 2, 2-diphenyl-1-picrylhydrazyl (DPPH) in methanol. The mixture was vortexed and allowed to stand at room temperature at 25 ± 2°C in dark light for 60 min. The absorbance of the resulting solution was measured at 517 nM using a UV-Visible spectrophotometer (Ultrospec 3100 Amershan Biosciences). The blank was prepared in the same manner, except that distilled water was used instead of sample. Percentage of DPPH radical inhibition was calculated according to equation below.

$$\% \text{ DPPH inhibition} = \left[\frac{(A_c - A_s)}{A_c}\right] X \ 100 \quad (1)$$

Where A_s is the absorbance of sample solution, A_c is the absorbance of the DPPH solution

Determination of total phenolics content

Total phenolics content (TPC) of the extracts was determined according to the method developed by Singleton and Rossi [15]. In brief, 100 μL-aliquot of the extract was added to 2mL of 20 g/L Na2CO3 solution. After 2min, 100 μL of 50% Folin-Ciocalteu reagent was added and the mixture was allowed to stand for 2 h at 25°C. The absorbance was measured at 750nm using a spectrophotometer (UV 1601, Shimadzu Co., Ltd., Kyoto, Japan). The total phenolics content was determined using the standard gallic acid calibration curve and the results were expressed as milligram gallic acid equivalents per gram sample dry weight (mg GAE/g DW).

Determination of type and concentration of sugar

The type and concentration of sugar was determined using HPLC (Shimadzu, CR6A Chromatopac) with a NH_2 HPLC column (4.6mm ID X 250mm, 5m particle size, Lichrosorb NH_2 Merck, Germany thermostated at 30°C and A refractive index (RI) detector was used for detection of sugar peaks. The mobile phase used was the solution of acetonitrile and water

(85:15), pumped at a flow rate of 1.5 ml/min and injection volume 20 µl. The samples were prepared by making appropriate dilutions with distilled water. All sample solutions were passed through a 0.45 µm syringe filter (Nylon) to remove particulates prior to HPLC analysis. D-glucose, D-fructose and sucrose were used as external standards

Amino acid determination

The Amino Acids were separated by reverse-phase HPLC column (waters Milford, MA) controlled by a breeze system (waters). The hydrolysates were injected in a pre –column derivatised with 6-Aminoquinolyl-N-Hydroxysuccinimidyl carbamate (ACCQ) to determine primary amino acids. The separation of amino acids was performed on a waters AccQ.Tag (3.9 x 150 mm). The mobile phases used were solvent A was 1: 10 ratio (AccQ. Tag Eluent A Concentrate Commercial to deionized water) and solvent B was 60% (v/v) acetonitrile solutions. The injection volume was 100 µL and a flow rate of 1 mL min^{-1} was used. For the determination of tryptophan, the hydrolysates were separated on a waters C_{18} column (3.9 x 300mm) using the same mobile phase. The fluorescent detector was adjusted at excitation wavelength of 250 nm and emission wavelength of 395nm. All reagents used were HPLC grade. Amino acids were quantified by comparing peak area of the samples with those of the internal standard, AABA.

RESULTS AND DISCUSSION

In general, Antioxidant activity is derived from phenolic compounds and/or vitamins (Kim et al., 2003). *Arrenga pinnata* sap juice is believed to have phenolic content which can act as antioxidant. The potency of the antioxidant property could be affected by the spray drying process. In this study, the widely used DPPH inhibition and FRAP assays have been applied and data obtained are as reported in table 1.

Table 1. Antioxidant capacity of spray dried *arrenga pinnata* powder.

Total Phenolic Content GAE (mg/100g)	DPPH (% inhibition)	FRAP Value in 1ml
5.82 - 5.83	26.81 - 28.74	0.539 - 0.550

The phenolic content of *arrenga pinnata* juice powder was found to contain 5.82 mg of gallic acid equivalents per 100g of total phenolics. The DPPH radical scavenging of *arrenga pinnata* powder was found to range from 26.81 - 28.74 % inhibition while the Ferric reducing antioxidant power varied between 0.539 - 0.550 in 1ml of powder. The sugar profile of *arrenga pinnata* powder was ascertained. Quantities of glucose, fructose, maltose and sucrose were determined and data are compiled in table 2. The major saccharide was sucrose ranging from 29.16 to 31.11 g/100 g of sample. Exceptionally high amounts of sucrose were found but glucose, fructose and maltose levels were extremely low and not detected.

Table 2. Sugar profile of *arrenga pinnata* powder.

Fructose g/100g	Glucose g/100g	Sucrose g/100g	Maltose g/100g
N.D (<0.001)	N.D (<0.001)	29.16 - 31.11	N.D (<0.001)

Relative quantities of free amino acids in *arrenga pinnata* powder determined by Accq Tags waters method are as compiled in Table 3. Varying kind and quantities of free amino acid was detected in the *arrenga pinnata* powder. Exceptionally high amounts of lysine, glutamic acid, aspartic acid, alanine was found in the arrenga pinnata powder. Others found in reasonable amounts are methionine, threonine, arginine, serine and glycine. Others found in negligible amounts are leusine, Isoleusine, valine, proline, thyrosine and hydroxyproline.

Table 3. Amino acid profile of *arrenga pinnata* powder.

	Amino Acid	g/100g	
		Replicate 1	Replicate 2
1	Hydroxyproline	0.004	0.010
2	Aspartic acid	0.102	0.096
3	Serine	0.071	0.068
4	Glutamic Acid	0.245	0.242
5	Glycine	0.051	0.050
6	Histidine	0.000	0.000
7	Arginine	0.055	0.048
8	Threonine	0.032	0.031
9	Alanine	0.095	0.093
10	Proline	0.025	0.029
11	Thyrosine	0.005	0.028
12	Valine	0.029	0.022
13	Methionine	0.041	0.014
14	Lysine	0.224	0.218
15	Isoleusine	0.021	0.018
16	Leusine	0.015	0.012
17	Phenylalanine	0.008	0.008

CONCLUSIONS AND RECOMMENDATION

The following conclusions can be drawn from the study:

- *Arrenga pinnata* juice powder exhibits high nutritional characteristics. It has homogenous and spherical nutritious particle, which can easily be reconstituted into juice.
- It is free flowing and has excellent keeping quality due to its low moisture content. Data has shown its high levels of polyphenols and presence of antioxidant capabilities from the phenolic contents, antioxidant capacity and free radical scavenging activity measured, Sugar content and amino acid.
- Hence *Arrenga pinnata* juice powder can be reconstituted into a nutritious juice with good antioxidant capacity.

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