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Nutrient Content and Antioxidant Profile of Raw And Lyophilized Jamun (*Syzygium Cumini*) Fruit Pulp

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Abstract : A comparative study was made to evaluate the nutritive content, anthocyanin, total phenolic and antioxidant activity of Lyophilised Jamun Pulp (LJP) with Jamun Pulp (JP). The objective of the study focussed towards the analysis of nutrient content (AOAC), phytochemical screening, total anthocyanin (pH differential method), total phenols (Folin – Ciocalteau reagent method) and total antioxidant activity (phosphomolybdic method). The antioxidant potential, anthocyanin and phenolic content detected are known to have several health benefits were preserved well and higher in LJP (287.22mg and 305.8mgGAE) than JP (158.55mg and 267.4mgGAE) respectively. Lyophilization of jamun pulp can be a suitable preservation technology to promote commercial nutraceutical and functional foods, which in turn also makes the availability of jamun product throughout the year rather than during season alone. In addition, this post-harvest processing technique retains the nutritional value of the fruits as well as it reduces the wastage of fruits during seasonal availability and aids in micronutrient security.
Key words : Jamun, S*yzygium cumini*, pulp, lyophilization, antioxidant, anthocyanins, and polyphenols.

Introduction

Jamun, *Syzygium cumini* (L.) Skeels, the Indian blackberry is called the fruit of gods, belonging to family Myrataceae. The other names are Jamun, Jambul, Black plum, Java plum, Indian blackberry and Jamblang[1]. It is fruit from a very large ever green tropical tree[2], with property of astringent, purple-skinned fruit, native to India, Nepal, Pakistan, Sri Lanka, Indonesia, Bangladesh, and Philippines. Jamun holds a firm place in Indian literature and religion. Since, Lord Rama lived by having jamun for 14 years after his exile from Ayodhya. The seasonal availability of jamun fruit is from May to July with a shelf life of 2-3 days at room temperature made them to be high economical value. Plants of this family are known to be rich in volatile oils which are reported for their uses in medicine and many fruits of the family have a rich history of uses both as edible and in traditional medicines as divergent ethno botanical practices throughout the tropical and subtropical world[3].

The fruits are oblong berries, deep purple or bluish in colour with pinkish pulp and are widely consumed as raw and used for the treatment of various diseases as an astringent, antiscorbutic, antidiabetic, antidiuretic, chronic diarrhoea and enlargement of spleen[4]. Fruits of jamun are well known for its nutritional, therapeutic properties and as a rich source of dark coloured anthocyanins. Anthocyanins are naturally occurring poly-phenolics that impart orange, red, purple and/or blue colour to many fruits, vegetables, flowers and plants.

These compounds are known for their strong antioxidant capacity and health-protecting effects such as reduced risk of coronary heart disease, prevention of cancer and neurodegenerative diseases [5].

Antioxidants play an important role in biological system by suppressing the formulation of reactive oxygen species by reducing hydrogen peroxides, and scavenging free radicals. Plants are the potential source of its secondary metabolites such as natural antioxidants or phytochemical antioxidants[6]. Free radicals generated in the redox processes, may cause cancer, cardiovascular diseases and neurodegenerative diseases by inducing oxidative damage to biomolecules[7].

The purple colour of the pulp and peel is attributed to the presence of anthocyanins whereas its astringent taste relates to high tannin content[8]. Almost 75% of the fruit weight is from fresh pulp (including skin) and the rest 25% is contributed by seed, both having good nutritive value and phytochemicals[2]. There are many studies on the antidiabetic, antioxidant and anticancer activity of leaves, bark, leaf and seeds. But there are not many studies on the processed fruit powder as phytomedicines. Considering the growing trend and usage of phytomedicines, this study was taken up to explore the antioxidant activity of lyophilised *Syzygium cumini* (LJP) pulp and raw fruit pulp (JP). The objective of the study was to analyse and compare the nutritive value, screening phytochemicals, estimate total antioxidant activity, anthocyanin and phenolic content of LJP and JP.

Experimental

Processing of sample

The fresh fruits were collected from Chennai, India. The fruits were thoroughly washed and dried in room temperature. The pulp along with the skin is separated from the seed and then the pulp along with skin is pulverised to make the mixture homogeneous. The pulp is taken in a lyophilizer tray and pre-treated by freezing at - 80°C in the deep freezer and lyophilised at -40°C for 48 hours (Penguin, 2014). Later the powder is stored for further analysis.

Proximate Analysis[9]

The proximate analysis of nutrients like carbohydrate, protein, fat, crude fiber, sodium, potassium, calcium, phosphorus, iron, moisture and ash content of fresh jamun pulp and processed lyophilised jamun pulp powder were analysed by following the standard methods of Association of Official Analytical Chemist and Indian Standards.

Extraction using different solvents

The LJP was extracted using different solvents like petroleum ether, chloroform, ethyl acetate, methanol and water using rotary evaporator.

Phytochemical Screening[10]

For preliminary phytochemical screening of the lyophilised jamun pulp and fresh jamun pulp was dissolved in distilled water. The freshly prepared aqueous extract of the samples LJP and JP were tested for the presence or absence of phytoconstituents such as reducing sugar, tannins, saponins, flavanoids, alkaloids, proteins, steroids, quinines, terpenoids, cardio glycosides and phenols.

Total antioxidant activity (Phosphomolybdic acid method) [11]

The total antioxidant activity of the sample is evaluated by phosphomolybdic acid method by the transformation of Mo(VI) to Mo(V) to form phospho molybdenum complex. To 100µl of sample add 1ml of reagent and then Incubate at 95˚C for 90 mins and the OD is read at 695 nm with ascorbic acid (0.1mg/ml) as the standard.

Determination of total anthocyanins [12]

Anthocyanin content was determined using pH – differential method and expressed as cyanidin -3-glucoside equivalent using molar extinction coefficient. For which 500ul of the extract was diluted with buffers of pH 1.0 and 4.5. The reaction mixtures were allowed to equilibrate at room temperature for 15 mins and their absorbance was measured at 510nm and 700nm. The difference in absorbance is equivalent to anthocyanin content is calculated by using the formula:

Total anthocyanin = (Absorbance x Mol. Mass x dil factor)/ƐL

Where, Absorbance (A) = (Abs510-Abs700) pH1.0-(Abs510-Abs700) pH4.5

Determination of total phenolic content [13]

The total phenolic content was determined by Folin-Ciocalteu spectrophotometric method with some modifications[12]. An aliquot of 100µL of extract was mixed with 0.5mL of Folin-Ciocalteu reagent, 2.9mL of de- ionized water and 2mL of 20% sodium carbonate solution. The mixture was allowed to stand for 60 minutes and the absorbance was read at 760 nm against a reagent blank. Calculations were carried out using the standard calibration curve of gallic acid. Results were expressed as gallic acid equivalent mgGAE/100gdw). All the samples were analysed in triplicates to arrive the mean value.

Results and Discussion

Nutrient content of jamun varies with freshness, type of soil, climate and season. The edible fruit pulp of jamun shows good content of nutrients and can be preserved during lyophilization than raw fruit pulp (Table – 1). The nutrient analysis of LJP shows that the nutrients like energy, protein, fat, carbohydrate and crude fibre is high compared to JP. The macro and micro minerals like calcium, potassium, phosphorus, sodium and iron are also very high in LJP than JP. The JP has 89% of moisture compared to LJP (25%). The ash content of the LJP is high when compared to JP (2.89%). All the analysed nutrients are high in LJP compared to JP except moisture because the nutrient analysis was calculated as wet sample basis for JP sample and LJP is processed by lyophilisation. The proximate composition of jamun pulp values are similar to the results of the studies reported earlier[8,14,15,16] .

Table 1. Nutritive value of JP and LJP

Parameters	Method	Units	JP	LJP
Energy (by Calculation)	FAO method	Kcal/100g	71.93 ± 3.45	299.60 ± 6.77
Carbohydrate (by difference)	CTL/SOP/FOOD/262-2014	g/100g	16.09 ± 0.52	65.51 ± 2.34
Total Fat	AOAC 19th Edn. 2012, 954.02	g/100g	0.45 ± 0.20	2.44 ± 0.64
Protein (N X 6.25)	AOAC 19th Edn. 2012, 986.25	g/100g	0.88 ± 0.26	3.90 ± 0.43
Crude fibre	AOAC 19th Edn. 2012, 962.09	g/100g	0.43 ± 0.09	3.24 ± 0.82
Sodium	AOAC 19th Edn. 2012, 969.23	mg/100g	10.05 ± 1.11	26 ± 1.40
Calcium	IS 5949: 1990 (RA.2003)	mg/100g	18.34±4.56	63 ± 2.70
Potassium	AOAC 19th Edn. 2012, 969.23	mg/100g	98.78 ± 6.55	1328 ± 34.50
Iron	AOAC 19th Edn. 2012, 999.11	mg/100g	0.12 ± 0.06	3.86 ± 0.66
Phosphorus	AOAC 19th Edn. 2012, 995.11	mg/100g	44.76 ± 3.89	195 ± 18.99

Moisture	AOAC 19th Edn. 2012, 984.25	g/100g	89.26 ± 5.67	25.26 ± 2.38
Ash	AOAC 19th Edn. 2012, 925.51	g/100g	0.18 ± 0.19	2.89 ± 0.22

Selection of suitable solvents for phytochemical extraction will be most important step as extraction of secondary metabolites will be extracted by the type of solvent used for extraction. Since polyphenols, flavonoids, proteins and polysaccharides are highly soluble in polar solvents. The extractability with various solvents used for the sample is tabulated in Table 2

Table 2. Extractability of *S.cumini* (LJP) in different solvents

Solvents	**% of w/w**
Petroleum ether	0.72
Chloroform	1.0
Ethyl acetate	1.24
Methanol	0.09
Water	**1.31**

From the Table 2 it was clear that the percentage extractability with various solvents used for the LJP shows that the maximum yield was obtained in aqueous solvent. So therefore, further analysis was carried out using the aqueous extract.

Table 3. Screening of Phytochemicals in JP and LJP

Phytochemical constituents	**Name of the test**	**JP**	**LJP**
Tannins	Lead acetate	++	+
Saponins	Foaming	++	++
Flavonoids	Ammonia	+++	++
Alkaloids	Dragondraff test	++	++
Proteins	Barford's test	+	+
Steroid	Sulphuric acid	+	+
Quinones	Ammonia	+	+
Terpenoid	Glac. Aceticacid	-	-
Cardio glycosides	Salkowaski	++	++
Phenols	Ferric chloride	+++	++

+++High ++Moderate +Present -Absent

The phytochemical screening shows the presence of various phytochemical compounds like saponins, flavanoids, alkaloids, quinones, cardio glycosides, phenols, proteins, amino acids and steroids .Similar results were also reported for presence of phytochemicals in S. cumini[17,18,19]. Either the phytochemical constituents or the secondary metabolites of these compounds could be responsible for the antioxidant activity. These phytochemical compounds detected are known to have beneficial importance in medicinal sciences.

Antioxidants are the widely used as potent oxidative stress scavenger to combat chronic lifestyle diseases such as diabetes, cancer and neurodegenerative diseases, which leads to utilization of antioxidants in nutrition and health[19].

Table 3 – Total Antioxidant activity of JP and LJP

Assay	**% Inhibition (per mg of sample) Mean ± SD (n=3)**	
	JP	**LJP**
Total antioxidant activity	18.5±0.2	22.54±2.36

From the above table 3, it was clear that the total antioxidant activity of LJP was better than JP. Sehwag and Das (2016) also studied the phytochemicals and reported the presence of flavonoids, flavanols, carotenoids and phenolic acids in different solvents and aqueous solvents[20]. It was also observed that the total phenolic content increased with increase in aqueosity of absolute alcoholic solvents. The aqueous extract also reported good antioxidant activity in this study on dry weight basis for lyophilised sample. Our results agree with the earlier reports on antioxidant activity of jamun [5, 19,21].

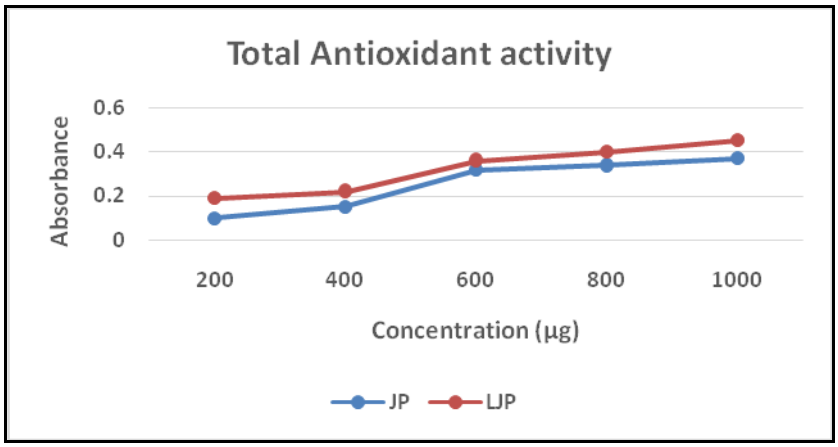

Fig 1: Absorbance of JP and LJP at different concentration

From the fig 1, the absorbance of JP and LJP increases with concentration. The absorbance of LJP is higher than JP at different concentration, therefore the antioxidant activity of LJP is better than JP.

Table 4. Mean Anthocyanin and total phenolic content of JP & LJP

Mean ± SD	**JP**	**LJP**
Anthocyanin mg/100g	158.55±0.80	287.22±1.16
Total phenols mgGAE/100g	267.4±0.59	305.8±0.64

The above table clearly shows that there is a significant difference in the mean anthocyanin content and total phenolic content of LJP than JP. Similar antioxidant activity of *Syzygium cumini* and anthocyanins was also reported[22, 23]. This shows that the potent compounds like anthocyanin and phenols are high in LJP which in turn provides potential antioxidant activity. These anthocyanins and phenols provide wide range of health and therapeutic benefits. Phenols, flavonoids are known to provide wide range of health benefits, as well as decrease the risk of diseases such as cancer, ageing, cardiovascular diseases etc. Phenolic compounds are most significant common group of phytochemicals studied as they have diversified health benefits and they are required in considerable amount in our diet for physiological function. Jamun appears to be the only berry that contains five anthocyanidins present in blueberry. Different agro climatic conditions could potentially explain these differences although we cannot rule out, varied content was due to the presence of extraction procedure or processing technique.

Conclusion

The Indian blackberry jamun is known for its therapeutic properties from the ancient era. Jamun has attractive colour, astringent taste, nutritious, but are seasonal, perishable and underutilised fruit. So, this study

attempts to compare the nutritive value, phytochemicals and antioxidant activity of lyophilised jamun pulp with jamun pulp. The results obtained shows that the nutritive value, phytochemicals, total antioxidant activity, anthocyanins and total phenolic content are better in LJP than JP, so LJP can be considered as a good source of natural antioxidants. The lyophilised jamun pulp powder may be utilised as a source of bioactive compounds and can be explored as functional food in the market to provide therapeutic benefits and can also be used as a major cure for diseases resulting from free radicals.

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