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Valorization of Jamun waste seeds Powder, Nutritional and Functional Insights

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Abstract

Jamun seeds, when ground into a powder, are recognized for their rich nutritional content. They are valuable sources of plant-based compounds that may support fertility, cardiovascular health, brain function, and digestive well-being. Additionally, Jamun seed powder is a caffeine-free alternative to coffee. This study focused on analyzing the nutritional composition of powdered seeds and confirming their potential as nutrient-dense ingredients. The results revealed that Jamun seed powder contains significant macronutrients: carbohydrates (78.12 ± 2.25 g), protein (8.81 ± 1.5 g), fat (2.19 ± 0.8 g), and crude fat (1.02 ± 0.85 g). It also provides essential micronutrients, including vitamin C (ascorbic acid) at 19.16 ± 1.75 mg, insoluble dietary fiber (1.21 ± 0.3 mg), total sugars (10.14 ± 1.1%), and energy (367.43 ± 1.15 kcal). Additional properties measured were moisture content (8.49 ± 0.6%), ash (2.39 ± 0.5 g), acidity (0.04%), pH (2.6 ± 0.4), and water absorption capacity (101.32%). Mineral analysis indicated the presence of several essential elements: sodium (0.79 ± 0.22 mg), potassium (11.32 ± 1.2 mg), calcium (6.38 ± 1.24 mg), zinc (0.33 ± 0.02 mg), magnesium (111.6 ± 0.04 mg), iron (0.88 ± 0.02 mg), phosphorus (83.6 ± 2.25 mg), copper (2.12 ± 0.02 mg), manganese (0.3 ± 0.03 mg), lead (0.62 ± 0.01 mg), and chromium (1.3 ± 0.03 mg). In summary, jamun seed powder (JSP) has a high nutritional value and can be effectively used in the development of various food products.

Keywords: *Jamun seeds Powder, Food Waste Utilization, Traditional Medicinal Macronutrients and Micronutrients.*

Introduction:

Jamun is a fruit-bearing tree native to India. Is called as by various other names, including Java plum, black plum, jambul and Indian blackberry. (Ali. S. et al. 2013). [6] In Assam, Gujarat, Tamil Nadu, Uttar Pradesh, and Maharashtra were the top producers of jamun in India. In northern India, jamun tree flowers begin in March and last until April. Both tropical and subtropical climates are suitable for tree growth, especially in rich loamy soils with good drainage. Jamun, which originated on the Indian subcontinent, has now expanded to Africa, Latin America, and Southeast Asia. (De. Sousa. Sabino. et al., 2018). [20]

Most jamun trees in India are located in tropical and subtropical areas. At heights of 1,300 meters in the lower Himalayan ranges and 1,600 meters in the Kumaon highlands, they can also be seen growing. Jamun grows extensively over much of India, from Tamil Nadu in the south to the Indo-Gangetic plains in the north. In both tropical and subtropical regions, these trees flourish. When the rain begins to fall in June and July, the fruits begin to develop. After full bloom, they take approximately three to five months to mature. The fruits turn from green to bluish-black or a deep scarlet as they ripen. It is highly prevalent in both urban and rural Markets. The nutritional potential of *jamun* has long been approved for its diverse Food and pharmacological applications. Nearly every part, that is, fruit, leaves, bark, and seeds, has been utilized for centuries for various food and non-food applications., oblong shape, and pinkish Pulp (Jagatai, 2017). [24]

Jamun is above Sholak used in all puja functions and shows that the Indian subcontinent is called Jambu dweep because of presence of huge Jamun tree It is also called Jamun is known as Ram jamun (Hindi), Nerale (Kannada), Neredu pandu (Telugu), Naaval pazham (Tamil) and Jambul (Marathi). It is a native underutilized fruit that is gaining importance, similar to multifarious uses, and holds excellent trade exploitation in wilderness land horticulture. In India, jamun trees are commonly found in warm and humid climate areas. (Mishra *et al*. 2014). [31]

Jamun is seasonal delicacies and are mostly consumed fresh. Various value-added products such as juice, jam, jelly, nectars, squashes, and wine. In India Jamun cultivation is huge and the country 2nd ranks in the producing of jamun with a contribution of nearly 15.4% to the world's total annual output of 13.5 million tons (Hameed *et al*., 2020).

The fast-growing jamun tree can grow up to 30 m (100 feet) in height and survive for more than a century. Its thick foliage, which is primarily cultivated for aesthetic reasons, provides substantial shade.

The tree bark is dark gray and firm at the base, becoming lighter and softer as it rises. Between March and April, Jamun trees produced small, aromatic flowers of approximately 5 mm (0.2 inches) wide. The drupaceous fruits start to form around May or June and resemble large berries. The fruit is oval and oblong in shape, initially green, then turning pink, followed by bright crimson red, and eventually maturing to black. (Tanmay Sanjay Kamble et al., 2023). [28]

Jamun fruits are small, usually oval-shaped with a pink purple to blue-black color when completely ripe, with a subtly sweet, astringent, and sour flavor, and a firm seed inside (Gajera, H.P. *et al.*, 2018 & De. Sousa. Sabino *et al.*, 2018). [23, 20]

Jamun fruit is rich in iron, minerals, sugars, and proteins. In addition to being enjoyed as a dessert fruit, it can be used to create a range of delicious beverages and products including jellies, jams, squash, wine, and vinegar etc. (Devi *et al*., 2016). [21]

Proteins, carbohydrates, minerals, sugars, and iron are abundant in jamun fruit. Fully ripe fruits are consumed fresh, but can also be processed to produce vinegar, wine, squash, jam, and jelly. The fruit is especially delicious when cooked in squash and has a slightly spicy, acidic flavor. Fruit syrup can be used to treat diarrhea at low doses. It is well known that vinegar produced from the juice of somewhat unripe fruit has digestive, cooling, diuretic, carminative, and stomach-soothing properties. It is also possible to produce drinks from smaller, less suitable fruits, which are high in tannins, acids, and anthocyanins. (Singh *et al.*, 2011). [41]

The nutritional properties of jamun help cure stomach infection, dyspnea, and diarrhea. Jamun causes constipation, improves taste sensation, and improves digestion. Indian traditional medicine has given jamun a great deal of respect, and the pharmaceutical industry has taken notice. Its exclusive composition is unique and different from other non-traditional fruits, and it contains tannins, anthocyanins and flavanols. It also has several other medicinal benefits. The three esters are probably responsible for the distinctive flavors of jamun, dihydrocarvylacetate, geranyl butyrate, and terpinylvalerate. The antioxidant activity of the fruit is believed to be associated with the presence of vitamins, tannins, and anthocyanins. (Singh and Singh 2006).

According to reports, jamun fruits provide a number of health benefits, including antifungal, antibacterial, anti-HIV, antileishmanial, neuropsycho-pharmacological, antioxidant, and anti-inflammatory properties. They are also well-known for their ability to scavenge free radicals and nitric oxide, their negative effects on fertility and diarrhea, and their anorexigenic, gastro protective, anti-ulcerogenic, and raedioprotective properties.
(H. Sagrawat *et al*., 2006). [25]

Jamun is rich in anthocyanins and other phenolic compounds, primarily flavanols and ellagitannis, which provide it with potent antioxidant properties and a host of other biological functions. (Kannan and Puraikalan, 2016). [29]
Jamun causes constipation, improves taste sensation, and improves digestion. Jamun has gained recognition in Indian folk medicine. Apart from this, it has also earned respect in pharmaceutical trade. Its exclusive composition is unique and different from other non-traditional fruits, and it contains tannins, anthocyanins and flavanols. It also has several other medicinal benefits. Therapeutic uses of jamun include managing diabetes, enhancing skin health improving hemoglobin levels, and preventing healthy heart infection. The fruits of the jamun plant are produced only once a year and are usually available in June and July. (Shrivastava and Kumar, 2009). [40] A glycoside called jamboline, which is found in jamun seeds, aids in preserving blood glucose levels within acceptable bounds. (Kalse *et al*., 2016). [27]

The kernel, seed coat, and edible portion comprise the jamun fruit. Approximately 75% of the fruits are the edible portion. This edible portion was composed of 14% carbohydrates, 0.4% ash, 0.3% fat, 0.9% crude fiber, 0.7% protein, and 83.7% moisture. (Chaudhary and Mukhopadhyay, 2012). [18]

Jamun seeds contain substantial amounts of dietary fiber and appreciable quantities of anthocyanins, chlorophyll, phytosterols, amino acids, vitamin C, vitamin B complexes (thiamine, riboflavin, and folic acid), essential minerals and trace elements (calcium, iron, sodium, magnesium, zinc, phosphorus, chromium, vanadium, and potassium), essential oil, albumin, and fats (Singh, S. *et al*., 2022 & Venu Gopal, K.S. *et al*., 2017). [42 & 45]

Jamun seeds contain a variety of fatty acids, including oleic, linolenic, malvalic, stearic, palmitic, lauric, myristic, and sterculic acids, as well as β-sitosterol, a phytosterol β-sitosterol.
(Dangour, A.D. *et al*., 2009). [19]

In Ayurvedic medicine, the jamun tree's fruit, leaves, seeds, and bark have been utilized historically. For many years, jamun seed powder has been used as a natural method to maintain normal blood sugar levels. It is an aromatic-cleansing plant that promotes sweating and spontaneous urination. A glycoside called jamboline, which is found in jamun seeds, aids in maintaining the blood sugar levels within acceptable ranges. (Kalse *et al*., 2016). [23]
For type-2 diabetes, jamun seeds are widely used as an adjuvant treatment. In addition to the fruit's dark-purple, anthocyanin-rich pulp, the seedswhose antidiabetic qualities have been thoroughly investigated are also responsible for this. According to findings from Indian medical publications, people with diabetes may benefit from both jamun seeds and bark. (Y. Srivastava *et al.*, 1983). [47]

The jamun seeds contain protein, although rich in dietary fiber content, calcium, vitamin C and vitamins-B1, B2, B3 and B6) or rich in dietary fiber and satisfactory quantities of protein are present. However, it is also rich in elements such as potassium, calcium, sodium, iron, magnesium and phosphorus. (Priyanka. A.A. *et al*, 2015). [34]
The proximate contained jamun seed moisture content: 47.00, carbohydrate: 72.0, protein: 6.8, fibers: 0.35, crude fibers: 2.9 and ash 2.0. Jamun seeds contain fatty acids 30g/kg involve lauric- 2.8, myristic - 31.7%, palmitic- 4.7 %, stearic-6.5%, oleic-32.2%, linolenic- 16.1%, malvalic- 1.2%, sterculic- 1.8% and phytosterol. (Lock. K *et al*., 2009). [30]

The application of jamun seed used in bakery products and supplementation of various nutrients is increasing daily. In Ayurveda medicine, several medicinal benefits of jamun seeds have been documented. The ability of fresh jamun seeds to quickly lower urine sugar levels makes them useful for managing diabetes. (Swami, S.B., *et al.*, 2012). [43]

Materials and Methods:

Materials

All the Raw material Jamun Seeds were purchased from the local Market at Beed, Maharashtra. The study was conducted at the MGM Institute of Biosciences & Technology. N-6, CIDCO, Chhatrapati Sambhajinagar (Aurangabad), Maharashtra, India.

Methods:

Preparation process of Jamun Seeds Powder:

The preparation of jamun seed powder requires mature, disease-free, and healthy jamun fruits. A pulper was used to separate the jamun fruit pulp from the seeds. the seeds were then cleaned with water, dried for 48 h at 50°C in a tray drier, and pulverized to a fine powder with an average particle size of 0.58 mm.

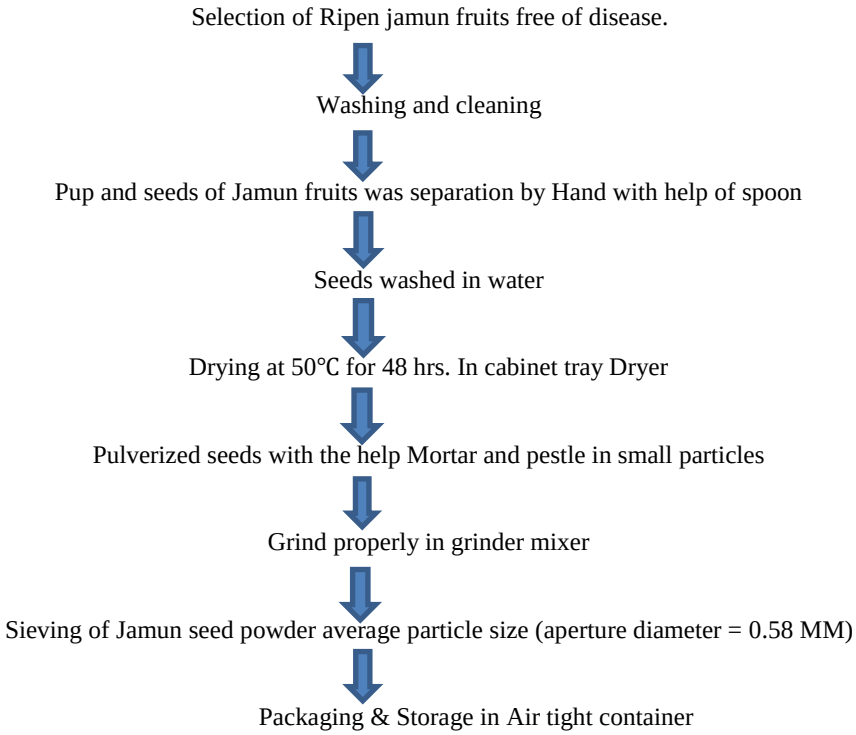


Fig. 2: The process of making jamun seed powder

Proximate analysis:

Estimation of moisture content:

Moisture content was estimated using the methods described by AOAC (2000). [11] Among the oven-drying methods for moisture determination, sterile empty petri dishes and lids were dried in an oven at 105℃ for 3hours and transferred to a desiccator for cooling. Weight of empty Petri dish and lid to be noted. Approximately 5 g of each sample was placed in a dish. The dish was then placed in a hot air oven at 105℃ for 3hours. After drying, the Petri dishes were cooled in a desiccator. The dish containing the dried sample was again weighed until a constant weight was achieved, followed by a 1 h interval. The moisture content was then calculated using the formula for moisture content.

Calculation:

$$(\%)\ \text{Moisture content} = \frac{[\text{wt. of the sample before drying} - \text{Wt. after drying}]}{[\text{Wt. of sample}]} \times 100$$

Determination of ash content:

The amount of ash was determined using gravimetric techniques (AOAC, 2000). [11] The inorganic residue that remains in food after organic matter has been completely oxidized or ignited is referred to as ash. A steady weight was achieved by heating, cooling, and weighing the crucibles. The crucible was filled with 5–10 g of food sample. A modest Bunsen flame is used to heat the crucible. After the vapors were stopped, the crucible was heated to 525ºC for four–six hours in a muffle furnace. After cooling in a desiccator, the crucible was weighed again. The crucible was heated in a muffle furnace for an hour, cooled, and weighed to ensure full ashing.

Calculation:

$$\text{The amount of ash (g/100g sample)} = \frac{Weight\ of\ the\ ash}{Weight\ of\ the\ sample\ taken} \times 100$$

Estimation of Fat content:

The Evaluation of Fat content by solvent extraction techniques uses a Soxhlet Apparatus (AOAS, 2000). [13] Take 10 gm of the food sample was wt. and transferred to a 250ml Erlenmeyer flask filled with hexane until the food sample was completely submerged. The mouth of the Erlenmeyer flask was covered with an aluminum foil. The Erlenmeyer flask was mixed every half min hour. The next day, hexane in the Erlenmeyer flask was slowly decanted in a pre-weighed beaker. The beaker was stored open to evaporate the hexane. Hexane was refilled into the conical flask and the process was repeated for three days. After 3 days, when hexane completely evaporated from the beaker, the wt. of the beaker along with fat was noted.

Calculation:

$$\text{Fat (g/100g of sample)} = \frac{\textit{weight of beaker with fat} - \textit{weight of empty beaker}}{\textit{amount of sample taken}} \times 100$$

Evaluation of protein:

The Micro-Kjeldahl aperture method was used to measure the protein concentration **(Waterborg, J. H., 2009).[46**] The mixture was centrifuged for 15 min at 5000 rpm after 1 g of powdered material was combined with 4 mL of potassium phosphate buffer. One milliliter of supernatant was used for protein estimation. A succession of test tubes were used to pipette out the working standard solution in increments of 0.2, 0.4, 0.6, 0.8, and 1 mL distilled water was added to each test tube until the volume reached one milliliter. The blank was a test tube filled with one milliliter of purified water. A solution of alkaline copper sulFate (5 ml) was added to each test tube, stirred, and allowed to stand for 10 min. Folin-Ciocalteu reagent (0.5 ml) was added to each test tube, mixed well, and allowed to sit at a spectrophotometer to measure the absorbance at 660 nm and calculate the concentration.

Estimation of carbohydrate:

Carbohydrates *were estimated using the Anthrone method* (Sadasivam, S., 1996).[37] For three hours, a test tube containing 100 mg of powdered material was submerged in a boiling water bath with five milliliters of 2.5N HCl for hydrolysis. The tube was then allowed to cool to room temperature. Effervescence was neutralized with solid sodium carbonate until it ceased. A 100 ml volume was added, and the mixture was centrifuged. The supernatant (1 mL) was collected for analysis. Transferring 0.2–1.0 milliliters of the standard solution via pipette into several tubes. Each tube was filled with distilled water on the rim. A test tube containing one milliliter of distilled water served as a blank. There were four milliliters of the Anthrone reagent in each test tube. Eight minutes passed through the test tubes.

Determination of mineral contents:

Mineral content was estimated using standard methods **(AOAC). [23 & 14]** For the macro-elements (potassium and sodium) and micro-elements (lead, cadmium, zinc, copper, and chromium). Five milliliters of 0.1 N nitric acid were added to two grams of seed samples that had been turned to ash. Distilled water was added to the chemicals to obtain the required volumes. The concentrations of pb, Cd, Zn, Cu, and Crwere determined using an atomic absorption spectrophotometer, whereas the concentrations of sodium and potassium were determined using flame atomic emission. The concentrations of the elements were then determined by measuring the emission intensity and constructing a calibration curve.

Estimation of phosphorus:

Estimation of phosphorus using atomic absorption spectroscopy (AAS).Methods. The methods described by (Raghuramulu *et.al.* 2003). [35] Was altered and put to use. The volume was adjusted to 4 ml using double-distilled water after the addition of various aliquots of the standard phosphorus solution (0.5, 1, 2, and 4 ml). One milliliter of the test sample was taken, and double-distilled water was added to bring the volume to four milliliters. 0.4 Ml of the aminonaphtholsulFonic acid reagent and 1 ml of 2.5% ammonium molybdate were applied all test tubes. Four milliliters of double-distilled water, one milliliter of 2.5% ammonium molybdate, and 0.4 milliliters of aminonaphtholsulphonic acid reagent is add to create the blank. After incubation at room temperature for 10 min, the absorbance at 660 nm was measured using a concentration A spectrophotometer.

Determination of sodium & potassium content:

Sodium and potassium contents were determined using Whatman filter paper and a flame photometer (AOAC 2016).[40] Take 1 g of the sample in a tube. Ammonium Oxalate (50 ml) was added. Then the sample solution was filtered using Whatman Filter paper No.1 in a beaker and the sample ton Flame photometers were read.

Estimation of Insoluble Dietary fiber:

Insoluble dietary fiber was estimated using the enzymatic-gravimetric method and liquid chromatography (Raghuramulu *et al*., 2003). [29] Weighing two grams of the substance were weighed in a 500 ml conical flask. A precise halfhour was spent boiling it after 200 mL of 0.255N sulfuric acid was added and cooked gradually on a hot plate. In a separate conical flask, the mixture was filtered through a funnel covered with a muslin cloth. Hot water (200–300 mL) was used to wash the residue from the cloth until no more acid was present. The substance was then moved from the cloth to the beaker. After adding 200 mL 0.313N sodium hydroxide, the mixture was cooked for half an hour. The mixture was filtered through the same fabric using a funnel. Hot water (200–300 mL) was used to wash the residue until all alkali was removed. After being moved to a crucible, the residue was cooked in a hot-air furnace for at least four hours at 150–200 °C. After cooling, the samples were weighed. For half an hour, the crucible was heated to 600ºC in a muffle furnace. After cooling, the samples were weighed.

Calculation*:*

$$\text{Crude fiber (g/100g sample)} = \frac{weight\ of\ the\ crucible\ with\ contents\ before\ ashing - weight\ of\ the\ crucible\ with\ contents\ after\ ashing}{sample\ weight\ (grams)}$$

Estimation of calcium (AOAC 1980):

Estimation of calcium by titration with a standardized solution of ethylenediaminetetraacetic acid (EDTA). In a sanitized Erlenmeyer flask, a 25 ml aliquot of the ash solution was pipetted out. Double-distilled water was used to dilute the chemicals to 150 ml. After adding a few drops of the methyl red indicator, the liquid was neutralized with ammonia until the light pink hue turned yellow. Ten milliliters of ammonium oxalate was added after the solution reached boiling point. The mixture was boiled for a couple of minutes and glacial acetic acid was added until the color of the solution turned pink. The mixture was allowed to stand for four hours, or even better, overnight. The filtrate was filtered through Whatman No. 42 filter paper and washed with warm water until the oxalate was removed. The use of AgNO3 to check for the presence of chloride was simple because the ash solution was made with HCl. Five to ten milliliters of diluted H2SO4 were added to the filter paper, and the point of the paper was broken with a pointed glass rod. The filter paper was then placed in an Erlenmeyer flask. Titrating the solution against 0.01N KMnO4 after it heating to 70 °C produced a permanent pale pink tint.

Determine:

10.04 milligrams of calcium in 1 ml of 0.01N KMnO4

$$\text{Calcium (mg)/ 5g food sample} = \frac{titre\ value \times 0.2004 \times 100}{25}$$

Estimation of total energy content:
It was approximated using the factorial approach to get the overall energy content.

Energy (kcal) = (4 × protein) + (9 × fat) + (4 × carbohydrate)

Determination of pH:

By using (AOAC, 2005) it was directly measured using a digital pH meter (AOAC, 2005). The PH meter was standardized using buffer solutions of pH 7 and 4 at the required temperatures.

Titrable Acidity Test:

Titration techniques are employed in the Titrable Acidity Test (Parmar, 2003). [33] Using a volumetric pipette, 10 ml of the material was extracted and transferred to a beaker. Following the addition of the phenolphthalein indicator, 1N NaOH solution was used to titrate it until a constant pink color was achieved. Titrable with 0.1 N NaOH, note the titrate value and compute the result as a percentage using a few drops of 1% phenolphthalein solution as an indicator.

Result and Discussion:

The nutritional composition of Jamun seed powder was evaluated through proximate analysis, which revealed it to be a rich source of both macronutrients and micronutrients. The macronutrient profile includes carbohydrates (78.12 ± 2.25 g), protein (8.81 ± 1.5 g), fat (2.19 ± 0.8 g), and crude fat (1.02 ± 0.85 g). In addition, the powder contains valuable micronutrients such as vitamin C (ascorbic acid) at 19.16 ± 1.75 mg, insoluble dietary fiber (1.21 ± 0.3 mg), total sugar (10.14 ± 1.1%), total energy (367.43 ± 1.15 kcal), moisture content (8.49 ± 0.6%), ash (2.39 ± 0.5 g), acidity (0.04%), pH level (2.6 ± 0.4), and water absorption capacity (101.32%). Mineral analysis showed the presence of essential elements including sodium (0.79 ± 0.22 mg), potassium (11.32 ± 1.2 mg), calcium (6.38 ± 1.24 mg), zinc (0.33 ± 0.02 mg), magnesium (111.6 ± 0.04 mg), iron (0.88 ± 0.02 mg), phosphorus (83.6 ± 2.25 mg), copper (2.12 ± 0.02 mg), manganese (0.3 ± 0.03 mg), lead (0.62 ± 0.01 mg), and chromium (1.3 ± 0.03 mg). Overall, the jamun seed powder exhibits a highly nutritious profile, supporting its use in various food and health-related applications.

Table: 1. Nutritional Analysis of Jamun Seeds Powder (Macronutrients):

Sr. No.	Test Specification	Unit of Measurements	Test Outcome
1.	Carbohydrate content	gm./100gm	78.12 ± 2.25
2.	Protein content	gm./100gm	8.81 ± 1.5
3.	Fat content	gm./100gm	2.19 ± 0.8
4.	Crude Fat	mg/100gm	1.02 ± 0.85

Chart. 1. Evaluate physicochemical properties of Jamun Seeds Powder (Macronutrients):-

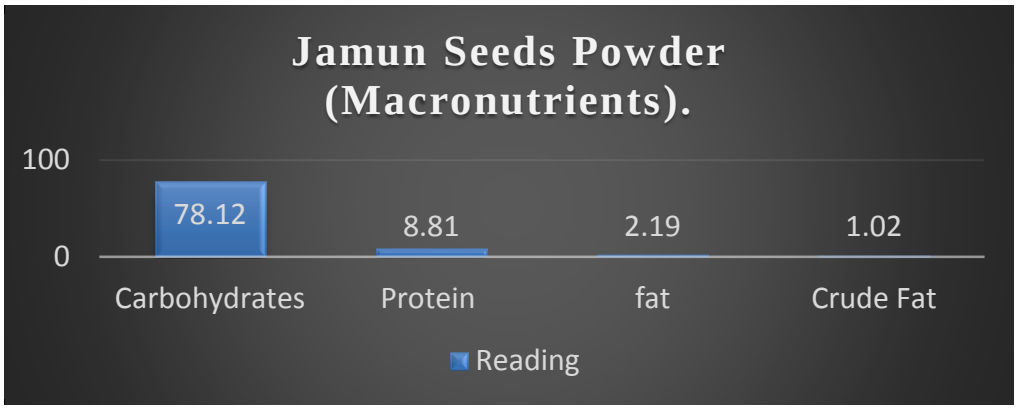


Table: 2. Nutritional Analysis of Jamun Seeds Powder (Micronutrients):

Sr. No.	Test Specification	Unit of Measurements	Test Outcome
1.	Ascorbic Acid [Vit-C]	mg/100g	19.16 ± 1.75
2.	Fibre	%	1.21 ± 0.3
3.	Total Sugar	%	10.14 ± 1.1
4.	Total energy	Kcal	367.43 ± 1.15
5.	Total Moisture	%	8.49 ± 0.6
6.	Ash	gm./100gm	2.39 ± 0.5
7.	Acidity	%	0.04 ± NA
8.	PH		2.6 ± 0.4
9.	Viscosity	%	*N/A*
10.	Water absorption capacity	%	101.32 ± NA

Chart. 2. Evaluate physicochemical properties of Jamun Seeds Powder (Micronutrients):

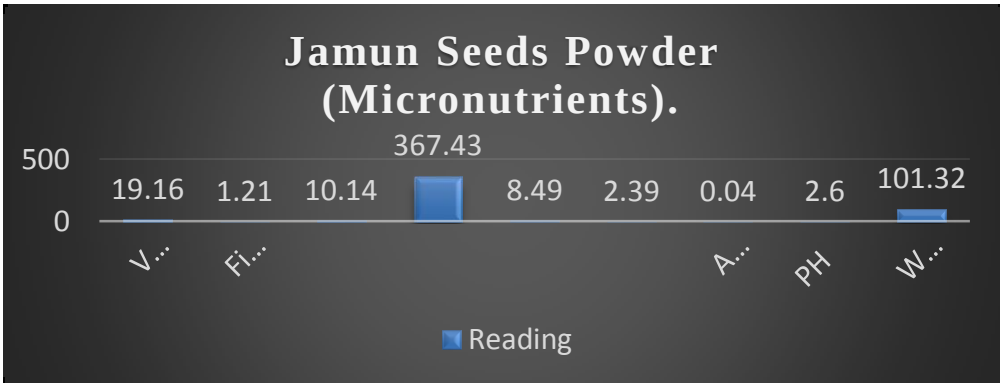
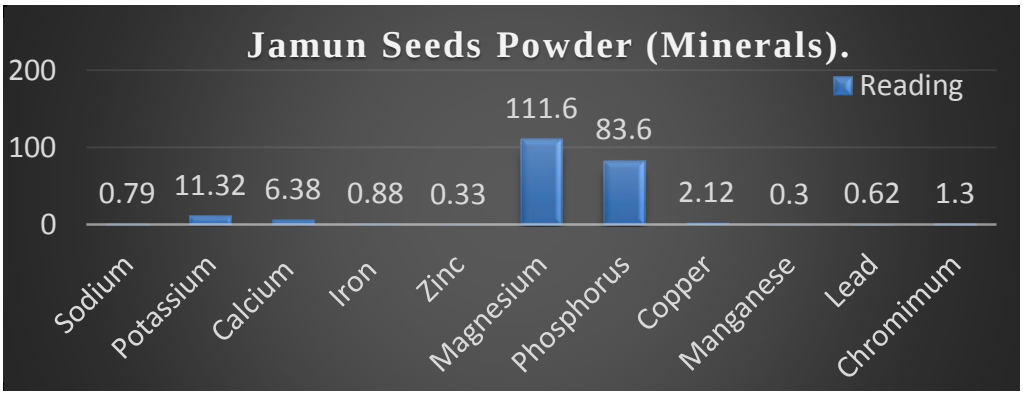


Table: 3. Nutritional Analysis of Jamun Seeds Powder (Minerals):

Sr. No.	Test Specification	Unit of Measurements	Test Outcome
1.	Sodium as Na	mg/100gm	0.79 ± 0.22
2.	Potassium as K	gm./100gm	11.32 ± 1.2
3.	Calcium content (mg/100 g)	mg/100gm	6.38 ± 1.24
4.	Iron as Fe	mg/100gm	0.88 ± 0.02
5.	Zinc as Zn	mg/100gm	0.33 ± 0.02
6.	Magnesium as Mg	mg/100gm	111.6 ± 0.04
7.	Phosphorus	mg/100gm	83.6 ± 2.25
8.	Copper as Cu	mg/100gm	2.12 ± 0.02
9.	Manganese as Mn	mg/100gm	0.3 ± 0.03
10.	Lead as Pb	mg/100gm	0.62 ± 0.01
11.	Chromium as Cr	mg/100gm	1.3 ± 0.03

Chart. 3. Evaluate physicochemical properties of Jamun Seeds Powder (Minerals):



Summary & Conclusion:

It is possible to conclude that waste materials such as jamun seed powder could be a great source of nutritional properties and functional food components, and that they could be used to make inexpensive beverages that replace cocoa. This conclusion was based on an investigation of nutraceuticals. Additionally, jamun seed powder is rich in minerals, proteins, fats, fibers, and antioxidants. It may improve immunity, heart health, and blood sugar levels.

Although other varieties of jamun seed powder are available, we chose Rie jamun seed powder for this investigation. According to recent research, jamun seed powder has high nutritional qualities, including dietary fiber, pectin β-glucan, arabinoxylan, protein and fat. This is because Rie Jamun is easily found in the local Maharashtra market.

In addition to being low in cholesterol, powdered jamun seeds contain phenolics, antioxidants, carotenoids, and oleic acid, which fight cancer and Alzheimer's disease. In addition to being high in iron, B, and A vitamins, jamun seed powder moisturizes and reduces wrinkles. Jamun seeds aid in blood sugar regulation, heart health, immunity, and preservation of DNA integrity during pregnancy. They also include antioxidants, such as phenolics, which help preserve cells that may be hazardous toany form of disease.

Powdered jamun seeds were prepared from jamun fruit pits. It may strengthen the immune system, help with digestion, and regulate blood sugar because it is rich in fiber and antioxidants. Because of its nutraceutical properties, jamun seed powder is highly prized and is widely used in pharmacological and medicinal applications. Assist in the treatment of a number of conditions, including diabetes, heart disease, and gastrointestinal issues. Powdered jamun seeds are an effective way to reduce blood sugar.

Jamun seed powder high in vitamins A, B, and C. Jamun seed powder is also a good source of other nutrients, including calcium, iron, crude fiber, magnesium, potassium, glucose, protein, carbohydrates, and dietary fibers and plays a very significant role in improving digestive function or gut functioning, boosting metabolism and supporting the body's natural fat-burning process. Jamun seed powder is also rich in vitamins A, Band C, which can improve eye and skin health. Jamun seed powder rich in iron content can help purify blood and ensure proper blood supply to the body. Jamun seed powder can assist free radicals which can cause cardiovascular disorders.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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