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Quantitative Estimation and Comparative Analysis of Mineral Content of *Syzygium jambos* Fruit and Its Seed

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ABSTRACT: In recent times, medicinal plants are gaining popularity in human life as an alternative to drugs. The use of genus *Syzygium*, as a traditional medicine are practiced since ancient times. *Syzygium jambos* is one of them. It is generally found in South-East Asian countries. The fruit of this plant is commonly known as 'Malabar plum' / 'Rose apple' / 'Plum rose'. In West Bengal (India) it is familiar as 'Golapjam'. Purpose: The main objective of this study to the estimate mineral content like, Calcium, Phosphorus, Iron, Sodium, Potassium, Zinc, Selenium, Iodine, Copper, Manganese, Lead and Sulphur of *Syzygium jambos* fruit and its seed that has not been revealed yet. Method: Standard methods of AOAC have been used to quantify different mineral contents of samples. Result: The finding shows that *Syzygium jambos* fruit and its seed contain an adequate amount of essential macro and micro minerals. These are mostly abundant in Calcium, Phosphorus, Potassium and Copper content. Conclusion: So, it may be concluded that *Syzygium jambos* fruit and seed could be one of the good sources to meet the daily dietary requirements for an adult as well as it could keep diseases away. Finally, a comparative study has been done among the mineral content of *Syzygium jambos* fruit, seed with Jackfruit, Black plum, Watermelon and their respective edible seeds.

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INTRODUCTION

Globally, different parts of the plant have been used for a long time as traditional medicines to treat different ailments. WHO has found that almost 80% of the population of developing countries depends on traditional medicines as their primary health-care needs [1]. The genus *Syzygium* (**Figure 1**) has made its place in traditional medicine for a decade. Among this genus, *Syzygium jambos* is comparatively less utilized as a medicinal plant. It is native to South-East Asia like Indonesia, the Philippines, Malaysia and few different parts of Southern India. *Syzygium jambos* is a medium-sized tropical tree, growing up to 20 feet tall. The evergreen leaves are leathery, glossy, dark green with10-22 cm long and smells rosy when young. The flowers are creamy-white or greenish-white in colour. The fruit is nearly round, oval, or slightly pear-shaped, 4-5 cm long, with smooth, thin, pale-yellow or whitish skin (**Figure 2**). It is sweet in flavor with a crispy and crunchy texture and has a delicate rose-water fragrance. In the hollow center of the fruit, there are 1-2 brown, rough-coated, medium-hard seeds, which are loosely bound with the inner wall and rattle when the fruit is shaken (**Figure 3**). The fruit is commonly known as Malabar plum /Plum rose /Rose apple [3]. In West Bengal (India), it is known as '**Golapjam'.**

In Indian traditional medicinal system, leaves of *Syzygium jambos* were used as a diuretic, as an expectorant in the treatment of rheumatism, to treat sore eyes and as a febrifuge [6]. Extract of the leaves of *Syzygium jambos* has a higher analgesic effect on inflammatory cutaneous pain than the diclofenac, a well-known anti-inflammatory drug [7]. Methanolic extract of the leaves of *Syzygium jambos* also has the ability to fight against *Staphylococcus aureus*, as well as Gram-negative bacteria [8].

The bark of the *Syzygium jambos* tree is used to treat asthma, bronchitis and hoarseness [6]. It has high tannin, alkaloids,

saponins, terpenoids and flavonoids content [9]. It has been detected that the methanolic extract of stem bark has significant free radical scavenging activity, antibacterial and antifungal activity [10].

kingdom	Plantae
Sub kingdom	Viridiplantae
Super division	Embryophyta
Division	Tracheophyta
Sub division	Spermatophytina
Class	Magnoliopsida
Order	Myrtales
Family	Myrtaceae
Genus	Syzygium
Species	Syzygium jambos (L.) Alston

Figure 1: Taxonomical classification [2]

Figure 2: Syzygium jambos fruit [4]

Figure 3: Syzygium jambos seed inside a fruit [5]

As a herbal medicine, the fruit has been used as a tonic for the brain and liver and as a diuretic. The flowers are believed to reduce fever. The seeds are used to treat diarrhea, dysentery and catarrh [6]. Aqueous extract of seed has greater activity against *V. cholerae* when compared with standard antibiotics such as streptomycin and tetracycline. In Nicaraguarura, people use an infusion of roasted and powdered seed as an anti-diabetic [11].

Syzygium jambos fruit is not much cultivated and explored rather consumed by local people of India, especially in West Bengal. Though, the full range of goodness of the fruit and its seed is still unfamiliar to the common people. Therefore, the main objectives of this study are-

- To estimate the mineral content of the fruit and its seed.
- To make a comparative study of minerals and trace elements content between *Syzygium jambos* fruit and its seed.
- These minerals and trace elements content is further compared with other common fruits and their respective edible seeds.

MATERIALS AND METHODS

1. Sample collection and identification

Syzygium jambos fruits were collected from the market of Baruipur, situated near Kolkata (West Bengal), India. The sample was identified by the Botanical Survey of India, Shibpur, Howrah. The Specimen No. is UC/SD-01, dated on 30.12.2019

2. Preparation of working solution [12]

The ripe fruit and matured seed were selected for the quantitative estimation of the minerals. Firstly, the samples were washed thoroughly. Then 5g of each sample was crushed and digested with 10 ml of 5 N concentrated hydrochloric acid. The mixtures were kept on a water bath and evaporated almost to dryness. The solution was cooled and filtered into a 100ml standard flask and diluted to volume with distilled water.

3. Mineral Analysis

The mineral content of both samples were determined by the methods of Association of Official Analytical Chemists (AOAC) with the help of Atomic absorption spectrophotometer (ICP-OES ; Model No. ICAP6800, Serial No. ICP 20073108) calibrated with NIST certified multi-standards.

3.1 Determination of Calcium (Ca) content [13]

About 1ml of the sample was pipetted into a test tube in duplicate. Then 3ml of calcium working reagent was added and absorbance at 512nm was read against the blank.

3.2 Determination of Sulphur (S) content [12]

1 ml of the sample solution containing 5% of H_2O_2 was mixed with 6 ml of the colouring reagent (5 ml of 0.01 mol/l dimethyl sulphoneazo- III of 0.01 mol/l, 5ml of 1 mol /1 KNO_3, 1.25 ml of 0.01 mol K_2SO_4 and 10ml of conc. acetic acid were mixed in 200ml double-distilled water and then topped up with ethanol to make up 11 of fluid). Then, the mixture was allowed to stand for 30 minutes. Then the sample was measured photometrically at 655nm against a blank sample.

3.3 Determination of Phosphorus (P) content [12]

An aliquot of 5ml of the sample solution was pipetted in a 10 ml volumetric flask and 1ml of Ammonium molybdate solution was added to it, then mixed well and allowed to stand for a few seconds. 1ml of hydroquinone solution was added to it, mixed well and Na_2SO_3 solution is added to it. The solution was diluted to make up the volume with water and shaken thoroughly. The time allowed for a reaction was about 30 minutes and absorbance was taken at 650nm.

3.4 Determination of Manganese (Mn) content [13]

5ml of the sample was taken into a test tube in duplicate and 0.25ml of concentrated sulphuric acid was added and boiled for 1 hour in a boiling water bath. A spatula tip full sodium periodate was added and heated for another 10 minutes, cooled and the absorbance was taken at 520nm against the blanks.

3.5 Determination of Selenium (Se) content [13]

About 1ml of the sample was taken into a test tube in duplicate. Then 1ml of concentrated HCl and 0.4ml of 2,4-dinitrophenyl hydrazine/N-1, Napthylethlenediamine hydrochloride (2,4-DrPH-NEDA) were added to it. Then 2.6ml of distilled water was added and mixed. The absorbance was measured at 520nm against the blank.

3.6 Determination of Iron (Fe) content [13]

About 2.5ml of the sample was pipetted into a test tube in duplicate and 0.4ml of 5N sodium hydroxide was added to bring the pH between 4.0-4.5. Soon 0.75ml of acetate buffer of pH 4.5 was added and 0.5ml of 25% hydroquinone was added and 0.5ml of 0.1% dipyridyl was also added and 0.35ml of distilled water added to make it up to 5ml. The absorbance was taken at 520nm against the blank.

3.7 Determination of Sodium (Na) content [12]

The fruit and seed samples for Na estimation was digested by diacid (a mixture of 100 ml conc.HNO_3 and 40 ml of 60% $HCLO_4$) through wet ashing. The digest is diluted to the suitable concentration range so that the final concentration lies between 0 to 5 ppm. The samples are then read in a flame photometer at 598 nm wavelength.

3.8 Determination of Potassium (K) content [13]

5ml of the sample was taken into a test tube in duplicate. Then 2ml of cobalt nitrite was added, shaken vigorously and allowed to stand for 45 minutes and centrifuged for 15 minutes. The supernatant was drained-off and 2ml of ethanol was added to the residue. The solution was shaken vigorously and centrifuged for another 15 minutes. The supernatant was drained off and 2ml of distilled water was added to the residue. The solution was boiled for 10 minutes with frequent shaking to dissolve the precipitate. About 1ml of 1% choline hydrochloride and 1ml of 2% sodium ferric cyanide was added. Then 2ml of distilled water was also added and the solution was shaken to mix well. The absorbance was taken at 620nm against the blank.

3.9 Determination of Lead (Pb) content [13]

A volume of 5ml of the sample was taken into a test tube in duplicate and 5ml of 10% sodium citrate and 1ml of 25% ammonia were also added. From this mixture, metals were extracted by adding consecutively 5ml portions of the dithizone extraction solution until dithizone became green after extraction. After the extraction, the supernatant was separated from the residue, 12.5ml of 1% nitric acid was added, shaken and allowed to settle. The supernatant was transferred again to a dry test tube, 2.5ml of hydroxylamine hydrochloride, 2ml of ammonia and 2.5ml of dithizone were added to the supernatant. The mixture was shaken for 1minute and the residue was separated from the supernatant. The supernatant was discarded while the residue was allowed to settle and centrifuged for 15minutes. The absorbance was taken at 520nm against the blank.

3.10Determination of Zinc (Zn) content [12]

50ml of both the sample solution and 10ml dithizone solution are taken into 50ml 0.02 N HCl solution containing the Zinc. Shaken it for 1 minute and the phases were separated. The lower portion was collected in a test tube. Then, 5ml of the extract was taken in a 25ml volumetric flask, diluted to volume with CCl_4 and measured at 525nm.

3.11Determination of Iodine (I) content [12]

1ml of the sample solution is pipetted in a 10ml test tube with a stopper. To it, 1ml of distilled water and 1ml of As(III) solution were added. The test tubes were closed and warmed at 40 degrees for 40 minutes. In intervals of 1 minute, 1ml of the Ce(IV) solution, which was even warmed at 40 degrees, was added. After a reaction time of 15minutes at 40 degrees, the solution was treated with 0.5ml Brucine solution under shaking and heated to 100 degrees for 15 minutes. The colour turns into a deep orange-red indicating the presence of Iodine. After cooling to room temperature, absorbance was taken at 430nm in the spectrophotometer.

3.12Determination Copper (Cu) content [12]

An aliquot of 5ml of both samples was taken in a 125ml separating funnel. Then, 2ml of ammonium citrartesolution

and ammonium hydroxide (1+1) was added, until the solution turns pink. To it, 10ml of CCl_4 was added and shaken for 5 minutes. Next, CCl_4 is drained, contents were centrifuged for 5 minutes and absorbance was taken at 430nm.

RESULTS & DISCUSSION

Table 1: Mineral content of *Syzygium jambos* fruit and its seed

Mineral	Value (mg/100 g)	
	***Syzygium jambos* fruit**	***Syzygium jambos* seed**
Calcium	12.71	23.72
Sulphur	10.31	12.73
Phosphorus	11.63	14.62
Manganese	0.045	0.093
Selenium	BDL(DL: 0.5)	BDL(DL:0.5)
Iron	0.73	1.15
Sodium	0.71	0.79
Potassium	45.62	329.32
Lead	0.022	0.022
Zinc	0.24	0.39
Iodine	BDL(DL: 0.6)	BDL(DL:0.5)
Copper	0.067	0.186

BDL : Below Detection Limit

DL : Detection Limit

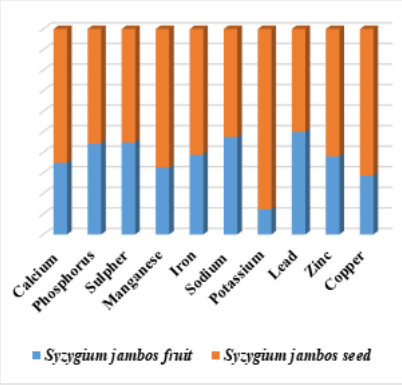

Figure 4: Mineral content of Syzygium jambos fruit and its seed

Micronutrients like minerals, vitamins and antioxidants have medicinal properties. They play a vital role in regenerative processes and help to survive against ongoing oxidative stress in the body tissues. From **Table 1**, it can be seen that both *Syzygium jambos* fruit and its seed has a considerable amount of micronutrients like Calcium, Phosphorus, Potassium and essential trace element Copper (**Figure 4**).

According to ICMR, the Recommended Dietary Allowance for Indians – 2010, the daily dietary requirements of Calcium and Phosphorus are 600 mg for an adult [14]. Calcium and Phosphorus content of *Syzygium jambos* fruit is 12.71mg/100g, 11.63 mg/100g and its seed has 23.72mg/100g, 12.73 mg in 100g (**Table 1**) respectively. **Calcium and Phosphorus** are the most important structural components for both the skeleton and teeth. Calcium is also essential for blood regulation, membrane permeability, neuromuscular excitability, the transmission of nerve impulses. Phosphorus takes part in the production of ATPs that are used for generating energy within cells and it also participates in cell division and reproduction [15].

Another macromineral is **Potassium**, a major cation in the intracellular fluid that plays a crucial role in maintaining electrolyte balance in the body. It is also involved in the excitability of both nerve and muscle cells and regulates acid-base balance [16]. The amount of potassium in *Syzygium jambos* fruit and its seed is 45.62 mg/100g and 329.32 mg/100g, respectively, whereas the ICMR has suggested that daily requirement of Potassium are 3750 mg for men and 3225 mg for women[14].

According to the RDA of Indians, the daily dietary requirement of Copper for an adult is 1.7 mg/day[14]. The *Syzygium jambos* fruit, seed has 0.067mg/100g and 0.186mg/100g of copper respectively. **Copper** is one of the essential components for synthesis and maintenance of the normal hemoglobin status in the body, helps in muscle function and boosts immunity [16].

It has also been noticed that Lead (Pb) content in both fruit and seed is 0.022 mg/100g (i.e. 0.00022 mg/kg), which is less than the Permissible limit (0.1mg/kg) as recommended by WHO [17]. So, from this study it can be seen that *Syzygium jambos* fruit and its seed has the potentiality to become one of the good sources of these minerals which could make its place to meet daily dietary requirements for an adult individual without an adverse health effect.

From **Table 2** and **Figure 5**, it has been found that **Iron** content of *Syzygium jambos* fruit (0.73 mg/100g) is greater than jackfruit, blackplum and a watermelon (0.36mg/100g, 0.33mg/100g, 0.22 mg/100g respectively) and also **Zinc** content of the *S. jambos* fruit (0.24 mg/100g) is higher than jackfruit, black-plum and watermelon (0.17mg/100g, 0.06mg/100g, 0.10mg/100g respectively). It is well-known that Iron and zinc are essential micronutrients for human growth, development and maintenance of the immune system. Along with this, the amount of **Phosphorus** (11.63 mg/100g) and **Copper** (0.067 mg/100g) of the *S. jambos* fruit is greater than black-plum (9.60 mg/100g, 0.02mg/100g respectively) and watermelon (11.33 mg /100g , 0.04 mg/100g respectively).

Table 2: Comparison among the mineral content of jack fruit, black plum and watermelon fruit with *Syzygium jambos* fruit (obtained in this study)

Mineral	Value (mg/100 g)			
	Artocarpus heterophyllus (Jack fruit) [18]	*Syzygium cumini* (Black plum) [18]	*Citrullus lanatus* (Watermelon) [18]	*Syzygium jambos* fruit
Calcium	35.03	25.36	5.29	**12.71**
Sulphur	-	-	-	**10.31**
Phoshorus	23.02	9.60	11.33	**11.63**
Manganese	0.35	0.04	0.04	**0.045**
Zinc	0.17	0.06	0.10	**0.24**
Iron	0.36	0.33	0.22	**0.73**
Sodium	1.62	2.64	1.89	**0.71**
Potassium	279	103	124	**45.62**
Copper	0.19	0.02	0.04	**0.067**

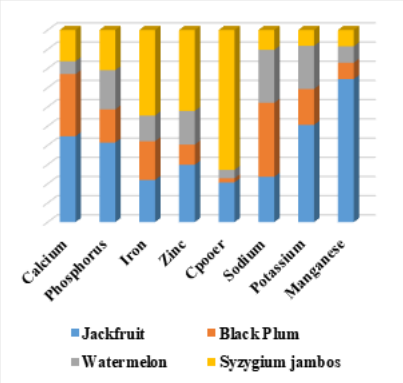

Figure 5: Comparison of different mineral contents among fruits

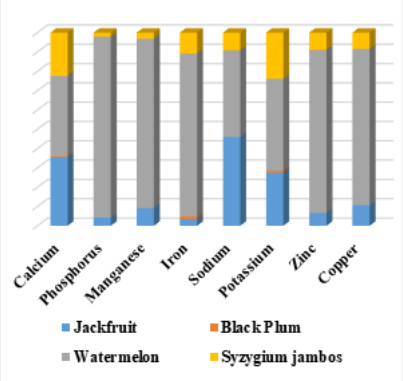

Figure 6: Comparison of different mineral contents among seeds

Table 3:Comparison among the mineral content of jack fruit, black plum and watermelon seed with *Syzygium jambos* seed (obtained in this study)

Mineral	Value (mg/100 g)			
	Artocarpus heterophyllus (Jackfruit) seed [18]	*Syzygium cimuni* (Black plum) seed [19]	*Citrullus lanatus* (Watermelon) seed [20]	*Syzygium jambos* seed
Calcium	37.56	0.65	44 *	**23.72**
Sulphur	-	-	-	**12.73**
Phosphorus	29.33	0.072	663*	**14.32**
Manganese	0.27	-	2.6*	**0.093**
Zinc	0.29	0.009	3.7*	**0.39**
Iron	0.37	0.14	9*	**1.15**
Sodium	4.00	-	3.9*	**0.79**
Potassium	376	16.07	652*	**329.32**
Cooper	0.21	-	1.6*	**0.186**

*In the original paper, the value was given in ppm unit. But for convenience, the value has been converted in mg/100 g.

From **Table 3** and **Figure 6**, it can be seen that **Zinc** and **Iron** content of *Syzygium jambos* seed (0.39 mg/100g, 1.15mg/100g, respectively) is higher than jackfruit and black plum seed. The **Copper** and **Potassium** content of *S. jambos* seed (0.186mg/100g, 329.32mg/100g, respectively) is very similar to jackfruit seed (0.21 mg/100g, 376 mg/100g respectively). As per data, the overall mineral content of *Syzygium jambos* seed is greater than black plum (*Syzygium cumini*) seed. It has been reported that black plum seed has many beneficial health effects like anti-diabetic, anti-cancer, anti-bacterial activity and also effective for Alzheimer's disease [21, 22, 23]. It may be concluded that *Syzygium jambos* seed may also have similar beneficial health effects like a black plum seed that are yet to be revealed.

CONCLUSION

Nowadays, many researchers suggest that daily consumption of an adequate amount of fruit, vegetable and edible seed is one of the best ways to keep away metabolic and neurodegenerative diseases. In spite of being abundant with micronutrients and trace elements, *Syzygium jambos* fruit and seed remain underutilized. This fruit and edible seed can be introduced in the dietary regimen that would be associated with the nutritional requirement for an individual's optimum growth as well as it could be beneficial for combating many

oxidative stress-related diseases. However, further study is necessary to understand the full range of health benefits of *Syzygium jambos* fruit and seed.

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CONFLICT OF INTEREST

There is no conflict of interest regarding the research article.

DATA AVAILABILITY

Available on request

FUNDING SOURCE

The experiment has been financially supported by the University Grant Commission.

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