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DETERMINATION OF VITAMIN CONTENT OF *SYZYGIUM JAMBOS* (FRUIT, SEED) AND SENSORY ANALYSIS OF DEVELOPED FOOD PRODUCTS

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ABSTRACT

Syzygium jambos L. Alston belongs to the Myrtaceae family. The fruit of this plant is known as underutilized. This fruit has a unique delicate rose fragrance. It is mostly found in the North-East and Southern parts of India. Several studies have indicated the fruit and its seed are nutritionally enriched and have strong antioxidant activity that can help in the prevention of many oxidative-stress-related diseases. In the present investigation, water-soluble vitamins of *Syzygium jambos* fruit and its seed were determined. Along with that, seven food products were also developed from the *Syzygium jambos* fruit and its seed. Those food products were sensory evaluated with the help of the 9-point Hedonic scale based on taste, smell, texture, colour, and overall acceptability. The vitamin C content of the fruit (21.4 mg/100gm) and its seed (12.4 mg/100gm) was also observed as in good quantity. According to the sensory evaluation of food products, overall acceptability shows that out of all the food products, the sweet pickle scored highest (8.67) followed by jelly (8.03), squash (8), Sandesh (7.96), jam (7.70), cookies (7.70) and laddu scored the lowest (6.63). As *Syzygium jambos* fruit has been found abundance of essential nutrients and is also seasonal, it can be preserved by making

different kinds of food products with easily available household ingredients to gain the popularity of this underutilized fruit among people.

Keywords: *Syzygium jambos,* fruit, seed, vitamin, sensory evaluation, underutilized

1. INTRODUCTION

Fruit crops have a protective effect on human physiology. They are rich sources of micronutrients and phytochemicals and these can be helpful in the prevention of several health-related complications **[1]**. India is blessed with varieties of fruit, some of which are popular, and some are underutilized. *Syzygium jambos* fruit comes under this underutilized category. It belongs to the Myrtaceae family. It is mainly cultivated in South-East Asia like Indonesia, Philippines, Malaysia, and a few parts of North-East and Southern parts of India. This fruit is commonly known as "Rose apple", or "Malabar plum," but in West Bengal (India) it is known as "Golapjam". The speciality of this fruit is that it has a unique delicate rose fragrance. In the centre, 1 or 2 round-shaped seeds are loosely bound with the wall of this fruit (**Figure 1**) **[2]**. According to the Indian traditional medicinal system, the fruit of *Syzygium jambos* has been applied as a tonic for the brain and liver and as a diuretic. The seeds are used to treat various ailments such as diarrhoea, dysentery and catarrh. The flowers are also being used to reduce fever **[3]**.

A recent study has found that both *Syzygium jambos* fruit and its seed have a significant quantity of micronutrients and trace elements such as calcium, sulphur, phosphorus, manganese, potassium, iron, zinc and copper **[4]**. *Syzygium jambos* fruit and its seed also have the permissible amount of anti-nutritional factors such as, oxalate, phytate, alkaloid, tannin and saponin [**5]**. The fruit and its seed also possess a good quantity of phytochemicals such as the total phenolic content and total flavonoid content of the fruit and its seed are (127.61 mg/100g GAE), (217.34 mg/100g GAE) & (8.64 mg/100g QE), (16.97 mg/100g QE) respectively. These show that the *Syzygium jambos* fruit and its seed have potent free radical scavenging capacity **[6]**. Several studies were carried out focusing on the stem, bark and leaves of *Syzygium jambos* only. However, there is no extensive study on the *Syzygium jambos* fruit and its seed has not been done yet. So, the aim and objectives of this investigation were to discover the physicochemical properties and vitamin content of *Syzygium jambos* fruit and its seed. Along with the formulation of new food products and sensory analysis of them by 9 point-hedonic scale.

Figure 1*: Syzygium jambos Fruit and Its Seed*

2. MATERIAL AND METHODS

2.1 Sample Collection: *Syzygium jambos* fruit was collected from Baruipur market near Kolkata, West Bengal, India. This fruit is usually found in January-May in West Bengal, India. The sample was identified by the Botanical Survey of India, Shibpur, Howrah. Specimen No. is UC/SD-01, dated on 30.12.2019.

The experimental procedure was approved by the Institutional Ethical Committee for Bio-Medical and Health Research, University of Calcutta, Kolkata, India. (Approval certificate No. CUIEC/03/03/2022-23), all the participants had given their consent.

2.2 Preparation of Samples: The mature ripe fruit of *Syzygium jambos* and its seed was used for the physicochemical, vitamin and food product development. However, mature oven-dried (roasted) seeds were used for product development from the seeds.

2.2 Determination of Vitamin Content:

2.2.1 Estimation of Ascorbic acid (Vitamin C): Ascorbic acid content was measured by 2,6-Dichlorophenolindophenol (DCIP) dye titration **[7]**. The fruit and seed samples each (100 gm) were blended with 6% metaphosphoric acid (HPO_3) with an equal volume to the homogenous slurry and made up to 500 ml of volume. The mixture was measured around 10 to 30 ml and diluted into a 100 ml volumetric flask with 3% metaphosphoric acid (HPO_3). On the other hand, 5 ml of the ascorbic acid working standard and 10 mL of 4% oxalic acid were pipetted out into a 100 mL conical flask. The ascorbic acid in the flask were titrated against the dye solution 2, 6-dichlorophenolindophenol (DCIP) (V_1) until the appearance of a pale pink colour that persisted for a few min. Similarly, 5 mL of the test sample was titrated against the dye solution (V_2). Triplicate titration was conducted for all samples. The ascorbic acid content present in the

test samples was determined using the formula

$$\text{Amount of ascorbic content (mg/100g)} = \frac{500 \times V_2 \times 25 \times 100}{V_1 \times 5 \times 5}$$

Where, 500 = µg of standard ascorbic acid taken for titration, V_1 = Volume of dye consumed by 500µg of standard ascorbic acid, V_2 = Volume of dye consumed by 5 mL of test sample, 25= Corresponds to the total volume of the extract, 100 = Ascorbic acid content/100g of the sample 5 = Weight of sample taken for extraction, 5 = Volume of the test sample taken for titration

2.2.2 Estimation of β-Carotene - 5 g of each sample was grinded with a few crystals of anhydrous sodium sulphate and mixed with 10-15 ml acetone. The supernatant was decanted in a beaker. The process was repeated twice and the combined supernatant was transferred to a separating funnel. 5-10 ml of petroleum ether was added and mixed thoroughly. Two layers were separated out on standing. The lower layer was discarded and the upper layer was collected in 100 ml volumetric flask, volume was made up to 100 ml with petroleum ether and optical density was recorded at 452 nm. The result was expressed as mg/100gm of samples **[7]**.

2.2.3 Estimation of Thiamine (Vitamin B_1) - Fresh samples (5 g) were homogenized with ethanolic sodium hydroxide (50ml). Ethanolic sodium hydroxide was prepared by dissolving 4.2 gm Sodium Hydroxide in 5 ml distilled water and then 1L Ethanol (aldehyde free) were added to it and allow the solution to stand in a tightly stoppered bottle for 24 hours. Then, the colour was developed by the addition of 10 ml of 0.1N Potassium Dichromate. Absorbance was measured at 360 nm. Vitamin B_1 standard stock solution of 100 ml was prepared by dissolving thiamine hydrochloride. The result was expressed as mg/100gm of the sample **[7]**.

2.2.4 Estimation of Riboflavin (Vitamin B_2) - The fruit and seed samples each (5 g) were treated with 100 ml of 50% ethanol solution. The samples were placed in a shaker for 1 hour. Then those were filtered into the flask. Extracted samples of 10 ml were pipette and placed into the volumetric flask. Then Potassium Permanganate (5%) 10ml was added afterwards 10ml of 30% H_2O_2 was added and allowed to stand over a hot water bath for about 30min. Sodium Sulphate (40%) 2 ml was added. The absorbance was measured at 510 nm in spectrophotometer. The result was

expressed as mg/100gm of the sample **[7]**.

2.2.5 Estimation of Niacin (Vitamin B_3) - 5 g of each sample was extracted with 30 ml of 4 (N) sulphuric acid and steamed for 30 minutes. This suspension was filtered through Whatman No.1 filter paper and to 25 ml of the filtrate; 5 ml of 60% basic Lead acetate was added. 2 ml of Conc. H_2SO_4 was added to the supernatant. 5 ml of 40% ZnSO4 was added. The supernatant was collected by centrifugation. This supernatant was used as the source material. Then, 1 ml of aliquot of the above extract was pipetted into different test tubes and the volume was made up to 6 ml with distilled water. 3 ml of cyanogen bromide was added and the contents of the tubes were shaken. 1 ml of 4% aniline was added to each test tube after 10 minutes. The yellow colour developed after 5 minutes was read at 420 nm against the reagent blank. The result was expressed as mg/100gm of the sample **[7]**.

2.4 Formulation and Sensory Evaluation of Food Products from *Syzygium jambos* fruit and its seed

Table 1: Formulation of Food Products from *Syzygium jambos* fruit

Food Product	Ingredients	Recipe
 **Figure 2: Jam**	**Fruit – 500 gm** **Sugar – 500 gm** **Citric acid - 5 gm** **Pectin – 5 gm**	**Selection of fresh fruit** ↓ **Washed** ↓ **Peeling and cutting into slices** ↓ **Seeds removed and pulp prepared** ↓ **Simmer pulp and soften pieces** ↓ **Sugar was added and dissolved** ↓ **Citric acid added** ↓ **Pectin added** ↓ **Boiled vigorously** ↓ **Cooked until the endpoint ^{0}Brix (67-69%)** ↓ **Filled in a sterilized glass bottle** ↓ **Cooled to room temperature** ↓ **Stored**

 **Figure 3: Jelly**	**Fruit -500 gm** **Fruit juice – 550 ml** **Sugar-500 gm** **Citric acid -5 gm** **Pectin -5 gm**	**Selection of fresh fruit** ↓ **Washed** ↓ **Peeling and cutting into slices** ↓ **Seeds removed and pulp prepared** ↓ **Addition of water (1:1 slice: water)** ↓ **Straining the extract with a muslin cloth** ↓ **Boiling the extract with continuous stirring** ↓ **Addition of sugar** ↓ **Addition of pectin (when TSS becomes 55 ^{0}Brix)** ↓ **Addition of citric acid (when TSS becomes 58 ^{0}Brix)** ↓ **Remove the scum** ↓ **Filled in a sterilized glass bottle** ↓ **Cooled to room temperature** ↓ **Stored**
 **Figure 4: Squash**	**Fruit -400 gm** **Fruit juice -300 ml** **Water -300 ml** **Sugar -400 gm** **Citric acid -5 gm**	**Selection of fresh fruit** ↓ **Washed** ↓ **Peeling and cutting into slices** ↓ **Seeds removed** ↓ **Juice extraction** ↓ **Straining** ↓ **Juice measuring** ↓ **Preparation of syrup (sugar+water+acid, heating just to dissolve)** ↓ **Straining** ↓ **Mixing with juice** ↓ **Filled in a sterilized glass bottle** ↓ **Cooled to room temperature** ↓ **Stored**

 Figure 5: Sandesh (Sweet)	Fruit -200 gm Sugar -100 gm Cottage cheese- 100 gm Khoa kheer- 100 gm	Selection of fresh fruit ↓ Washed ↓ Peeling and cutingt into slices ↓ Seeds removed and pulp prepared ↓ Addition of sugar ↓ Addition of cottage cheese ↓ Addition of khoa kheer ↓ Cooked very well ↓ Keep the mixture cool ↓ Made little balls and shape it ↓ Stord in a box
 Figure 5: Sweet Pickle	Fruit- 400 gm Sugar- 200 gm Citric acid- 5 gm Mixed spices -10 gm	Firstly, fresh fruits were Selected ↓ Washed them thoroughly ↓ Peeling and cutting into slices ↓ Seeds were removed ↓ Mixing fruit slices with salt and oil ↓ Addition of spices and sugar ↓ Cooked them altogether ↓ Filled in a sterilized glass bottle ↓ Cooled to room temperature Stored it ↓

Table 2: Formulation of Food Products from *Syzygium jambos* seed

Food Product	Ingredients	Recipe
 Figure 7: Laddu	Roasted seed -60 gm Bengal gram flour – 140 gm Sugar – 200 gm Vegetable Oil -100 gm Ghee -2 tablespoon	Selection of fresh fruit ↓ Washed ↓ Seed removed and roasted ↓ Made seed roast flour ↓ Dry roasted Bengal gram flour and seed flour separately ↓ Added oil to a pan ↓ Fried both flours in the pan for 5-10 mins ↓ Addition of sugar ↓ Removed from fire and allowed to cool ↓ Made balls (Laddu) of even size ↓ Stored in a glass jar

 **Figure 8: Cookies**	**Roasted seed -60 gm** **Refined flour – 140 gm** **Sugar -200gm** **Butter- 100 gm** **Oil -20 ml** **Baking powder – 5gm** **Baking soda -2 gm**	**Selection of fresh fruit** ↓ **Washed** ↓ **Seed removed and roasted** ↓ **Made seed roast flour** ↓ **Creaming (butter+ sugar+ solid milk powder)** ↓ **Folding (seed powder+ baking powder+ creamy matter)** ↓ **Mixing (with milk)** ↓ **Kneading** ↓ **Rolled and made small round pieces** ↓ **Baked (175^{0}C for 25-30 mins)** ↓ **Cooled at room temperature** ↓ **Stored in a glass jar**

Sensory Evaluation:

All food products were developed in the food preservation laboratory, Department of Home Science, University of Calcutta. Sensory evaluation of the food products developed from *Syzygium jambos* fruit and its seed was conducted by using 9 - point Hedonic scale (**9= Like extremely, 8= Like very much, 7= Like moderately, 6=Like slightly, 5= Neither like nor dislike, 4= Dislike slightly, 3= Dislike moderately, 2= Dislike very much, 1= Dislike extremely**). For this study, 30 panel members were randomly selected from the university campus. The consent paper was signed by all the participants. In the questionnaire presented to the panellists, they were requested to observe and taste each sample provided and grade them based on a 9-point hedonic scale showing least acceptable to most acceptable in all attributes. The sensory quality attributes of the samples were colour, smell, texture taste, and overall acceptability. After evaluating each sample to check taste interference, they were also provided with potable water to rinse their mouth.

2.6 Statistical Analysis:

All the experiments were performed in triplicate and the results are expressed as mean±SEM using SPSS.

3. RESULT AND DISCUSSION:

3.1 Determination of Vitamins Content of *Syzygium jambos* Fruit and its Seed

Table 3: Vitamin Content of *Syzygium jambos* fruit and its seed

Vitamin	Quantity (mg/100gm)	
	Syzygium jambos Fruit	*Syzygium jambos* Seed
Vitamin-C	21.4±1.05	12.6±0.87
Beta-carotene	0.30±0.69	0.66±0.43
Thiamine	0.08±0.78	0.47±0.72
Riboflavin	0.023±0.65	0.034±0.61
Niacin	0.21±0.54	0.43±0.59

Note: All the data are expressed as Mean± SEM, (n=3)

Table 4: A Comparison of Vitamins between Recommended Dietary Allowance (ICMR, 2020) and *Syzygium jambos* fruit and its seed

Vitamin	Recommended Dietary Allowance (ICMR, 2020) [8]						*Syzygium jambos* (Obtained value)	
	Male (mg/day)			Female (mg/day)				
	Sedentary worker	Moderate Worker	Heavy worker	Sedentary worker	Moderate Worker	Heavy worker	Fruit	Seed
Vitamin C	80	-	-	65	-	-	21.4	12.6
Thiamine	1.4	1.8	2.3	1.4	1.7	2.2	0.08	0.47
Riboflavin	2.0	2.5	3.2	1.9	2.4	3.1	0.023	0.034
Niacin	14	18	23	11	14	18	0.21	0.43

Table 5: Scores of sensory attributes of food products formulated from *Syzygium jambos* fruit and Its seed

Food Products	Colour	Smell	Texture	Taste	Overall Acceptability
Jam	7.67±0.92	6.74±1.24	7.38±1.18	7.74±1.01	7.70±0.99
Jelly	8.13±0.71	7±1.29	8.2±0.68	8.4±0.72	8.03±0.70
Sandesh	7.06±1.18	7.1±1.22	7.66±0.82	8.23±0.88	7.96±0.79
Squash	6.74±1.01	7.25±1.04	7.45±1.01	8.1±0.93	8±0.71
Pickle	8.35±0.64	8.67±0.58	8.45±0.75	8.70±0.45	8.67±0.53
Laddu	6.2±1.19	6.2±1.37	6.53±1.28	6.93±1.45	6.63±1.22
Cookies	6.9±1.22	7.36±1.11	7.26±0.93	7.7±1.53	7.63±1.01

Note: All the data are expressed as Mean ± S.E.M., (n=3)

A comparison of vitamins between Recommended Dietary Allowance (RDA) ICMR (Indian Council of Medical Research), 2020 and *Syzygium jambos* fruit and its seed is presented in **Table 4**. Here, the RDA is mentioned as the vitamin requirement as per the occupation for adult males and females on a daily basis and the obtained value of *Syzygiium jambos* fruit and its seed. Thiamine is one of the most important water-soluble vitamins that participate as a coenzyme in carbohydrate metabolism and provide energy to the brain and nervous system **[9]**. Other water-soluble vitamins like riboflavin and niacin also have various health-beneficial properties. Co-enzymes of riboflavin actively take part in the metabolism of carbohydrate, protein and fat, DNA synthesis and acts as an antioxidant **[9]**. Vitamin C is best known for its powerful antioxidant activity that can scavenge free radicals from the body and keep the body healthy. Apart from that, it also helps to provide structure and integrity

to the skin, bone, and connective tissues, it increases the bioavailability of iron and produces protein hormones **[9]**. So, it can be said that the inclusion of *syzygium jambos* fruit and its seed with a daily balanced diet would be a great option. This could be beneficial to meet-up the daily vitamin requirements along with other foods for optimum growth and development of human beings.

Table 5 shows the sensory scores of 9-point Hedonic scale of the food products developed from *Syzygium jambos* fruit and its seed.

Colour: In this attribute sweet pickle received the highest mean score (8.35), followed by jelly (8.13), jam (7.67), sandesh (7.06), cookies (6.9). The lowest scores were received by squash (6.74) and laddu (6.2).

Smell: In terms of smell, sweet pickle received the highest mean score (8.67) indicating that the panel members found sweet pickle most acceptable. The other food products of S.jambos fruit and seed i.e. jam, jelly, Sandesh, squash, laddu and cookies received the mean score 6.74, 7, 7.1, 7.25, 6.2 and 7.36 respectively.

Texture: Panelists liked the texture of sweet pickle most with highest mean score (8.45) followed by jelly (8.2), sandesh (7.66), squash (7.45), jam (7.38), cookies (7.26) and laddu (6.53).

Taste: Sweet pickle again scored highest (8.70) and other food products i.e., jam, jelly, sandesh, squash, laddu and cookies scored 7.74, 8.4, 8.23, 8.1, 6.93 and 7.7 respectively.

Overall Acceptability: Panel members liked sweet pickle (8.67) the most over other food products and did not like that much laddu (6.63). The other food products scored jam (7.70), jelly (8.03), sandesh (7.96), squash (8) and cookies (7.73).

4. CONCLUSION:

Syzygium jambos fruit is underutilized, seasonal and not widely cultivated. This fruit and its seed have been used as folk medicine for a long time. The findings suggest that the *Syzygium jambos* fruit and its seed have an abundance of micronutrients, trace elements and phytochemicals that could to helpful to meet the daily dietary requirements of an individual and might provide protection against different types of oxidative stress-related diseases. As the fruit is seasonal; that's why few foods were formulated. The data of sensory analysis reported that the sweet pickle of the fruit was mostly preferred by panellists followed by jelly, squash, Sandesh, cookies and laddu. So, it may be concluded that being underutilized and seasonal; with the help of household ingredients different kinds of food products can be easily developed from *Syzygium jambos* fruit, seed and preserve them for a long time. This technique also may be helpful in gaining the popularity of this

underutilized fruit and its seed among people.

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