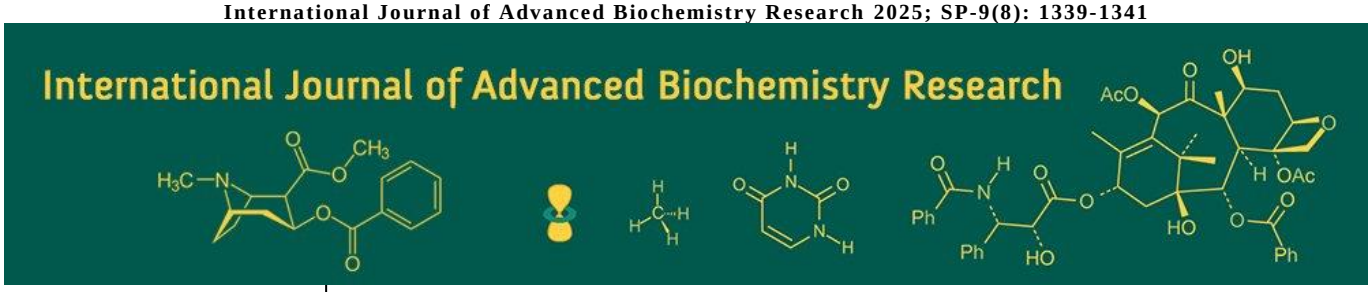

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Assessment of physico-chemical characteristics of fresh roselle (*Hibiscus sabdariffa* L.)

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Abstract
An experiment was conducted at the Laboratory of Post-Harvest Management, K.D. College of Horticulture and Research Station, Jagdalpur, Bastar (C.G.) during 2024-25. The physical parameters observed in fresh roselle included capsule diameter, capsule length, capsule color, pulp color, capsule weight, calyces weight, seed weight, waste portion, edible index and waste index. The corresponding values were 2.3 cm, 4.2 cm, wine red, pinkish red, 4.18 g, 2.27 g, 0.6 g, 1.91 g, 54.30% and 45.69%, respectively. The chemical characteristics evaluated were total soluble solids, pH, titratable acidity, ascorbic acid, total sugar, reducing sugar and non-reducing sugar, with their respective values being 4.5 °Brix, 2.4, 3.3%, 18.2 mg/100 g, 3.38%, 1.65%, and 1.73%. Roselle is commonly used in beverages and is highly valued for its nutritional and medicinal attributes, particularly its antioxidant, anti-inflammatory and therapeutic properties, indicating its significance as a health-promoting food ingredient.

Keywords: Roselle, physico-chemical characteristics, pH, total soluble solids, titrable acidity, ascorbic acid, total sugar, reducing sugar and non-reducing sugar

1. Introduction
Roselle, scientifically known as (*Hibiscus sabdariff*a L.) with a chromosome number of 2n = 4x = 72, is a shrub from the malvaceae family. Originally native to India and Malaysia, this versatile hibiscus plant has spread to many other regions around the world, including Central America, the West Indies and parts of Africa (Bruke, 1975) [1]. It is widely cultivated across states like Karnataka, Tripura, Maharashtra, Andhra Pradesh, West Bengal, Bihar, Odisha and Meghalaya. However, as a minor crop, it is not grown commercially in Chhattisgarh. Around the world, roselle is known by various names, including rozelle, sorrel, red sorrel, indian sorrel, guinea sorrel, sour-sour and queensland jelly plant. It is a highly versatile plant with a long history of use in traditional medicine. It has been used as a natural remedy for various health conditions, including cancer, cough, indigestion, fever, heart disease, high blood pressure, and urinary issues (Duke, 1984) [3]. The plant's calyces are rich in organic acids such as citric acid, malic acid, tartaric acid, and hibiscus protocatechuic acid (Kerharo, 1971; Khafaga and Koch, 1980) [4, 5]. It is rich composition of vitamins C and E, polyphenol acids, and flavonoids, particularly anthocyanins, has been found to possess functional properties that can benefit human health. Additionally, these compounds may help mitigate chronic diseases, such as diabetes, high blood pressure and cardiovascular disease. Notably, the flavonoids and anthocyanins present in roselle are natural and non-toxic, making them a promising area of research for developing new treatments. Roselle has also been traditionally used for its various medicinal properties, including antihypertensive, antiseptic and digestive effects (Cid and Guerrero, 2014; Odigie *et al.*, 2003) [2, 6]. The physico-chemical analysis of roselle is carried out to evaluate its nutritional composition, quality attributes, and processing potential. It helps in determining the levels of vitamin C, sugars, acidity, and other bioactive compounds that contribute to its health-promoting properties. Such analysis not only provides a scientific basis for its medicinal and therapeutic value but also supports its utilization in the development of functional foods and beverages.

2. Materials and Methods

The present work was carried out in the Laboratory of Post Harvest Management, K.D. College of Horticulture and Research Station, Jagdalpur, Bastar (C.G.) during the year 2024-25.

2.1 Physical characteristics of roselle

2.1.1 Colour of capsule and pulp

Colour is a visual characteristic that provides insight into the chemical components needed for processing. The pulp, calyces and capsule colour were identified visually.

2.1.2 Weight of capsule

Ten capsules were randomly chosen from a sample batch and weighed separately on an electric balance. The average weight of the capsules was then determined and reported in gram.

2.1.3 Weight of calyces

Ten randomly selected capsules were weighted separately on an electric weighing balance. The average weight was computed and represented in gram.

2.1.4 Weight of waste

The weight of ten randomly chosen capsules, including seed coat, seed and corolla, is stated in gram.

2.1.5 Weight of seed

Ten capsules were chosen from a sample batch and the seed was taken out and weighed. The average weight of the seed was then determined and given in gram.

2.1.6 Edible index

It is the ratio of the edible portion of the capsule multiplied by 100 to the overall weight. Separate 10 capsules and weigh them individually (W_1). The edible calyces are separated from the capsule and weighed (W_2). It was computed using the provided formula and expressed as a percentage.

$$\text{Edible index} = \frac{W2}{W1} \times 100$$

2.1.7 Waste index

It is the ratio of the capsule waste portion to its entire weight, multiplied by 100. Separate 10 capsules and weigh them individually (W_1). Waste capsules are collected separately and weighed (W_2). It was computed using the provided formula and is shown as a percentage.

$$\text{Waste Index} = \frac{W2}{W1} \times 100$$

2.2 Chemical characteristics of roselle

2.2.1 pH

The pH of roselle was measured using a digital pH meter.

2.2.3 Total soluble solids (^{0}Brix)

The total soluble solids (TSS) of roselle were measured using a hand refractometer.

2.2.4 Titrable acidity (%)

The method given by Ranganna (1997) [7] was used. For this, 10 ml of sample was taken in a beaker, a small amount of distilled water was added and mixed properly. The solution was then titrated with 0.1 N sodium hydroxide using phenolphthalein as an indicator. The end point was noted when a light pink color appeared.

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{Normality} \times \text{Eq. Wt. of Acid} \times \text{Volume made up} \times 100}{\text{Weight of sample taken} \times \text{Sample taken for estimation} \times 1000}$$

2.2.5 Ascorbic acid (mg/100 g)

The ascorbic acid content of roselle was estimated following the method of Ranganna (1997) [7]. A 3% metaphosphoric solution and standard dye were prepared, stored at 3 °C, and standardized daily. For analysis, 10 ml of the sample was diluted with 3% metaphosphoric acid, filtered and 10 ml of the filtrate was titrated with the dye until a pinkish-red endpoint appeared.

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Volume of filterate taken} \times \text{Volume of sample taken}}$$

2.2.6 Sugar% (Reducing, Total and Non-reducing sugar)

The estimation of sugars was carried out using the Lane and Eynon method, as outlined by Ranganna (1997) [7].

2.2.6.1 Reducing sugar (%)

Reducing sugar was estimated following the standard titration method. The clarified sample was prepared using phenolphthalein, lead acetate, and potassium oxalate, then titrated against Fehling's solutions A and B using methylene blue as an indicator. The appearance of a brick-red color marked the endpoint and reducing sugar was expressed in per cent and calculated by the following formula:

$$\text{Reducing sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Weight or volume of sample taken} \times 1000}$$

2.2.6.2 Total sugar (%)

Total sugar was determined by taking a 50 ml portion of the clarified and deleaded solution. To this, 5 ml of HCl was added and allowed to stand at room temperature for 24 hours. The solution was then neutralized using concentrated NaOH and the volume was adjusted to 250 ml. An aliquot was taken, and total sugar was measured as invert sugar.

$$\text{Total as invert sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Weight or volume of sample taken} \times 1000}$$

2.2.6.3 Non-reducing sugar (%)
Non-reducing sugar is determined by subtracting the value of reducing sugar from the total sugar.

Non-reducing sugar (%) = Total sugar (%)-Reducing sugar (%)

3. Results and Discussion
3.1 Physico-chemical characteristics of fresh roselle
3.1.1 Physical parameters of roselle
The data related to the characteristics of roselle are shown in (Table 1). The roselle calyces were observed to be thick and fleshy, with an average diameter of 2.3 cm and a length of 4.2 cm. The outer colour of the roselle was noted as red wine, while the pulp appeared pinkish red. The average weight of the capsule was found to be 4.18 g, of which the calyces weighed 2.27 g. The remaining waste from the capsule weighed 1.91 g and the seeds weighed 0.6 g. The calculated edible index and waste index were 54.30% and 45.69%, respectively.

3.1.2 Chemical composition of roselle
The data collected on parameters of roselle such as total soluble solids, ascorbic acid, acidity, pH and sugars are presented in (Table 2). The total soluble solids and pH of roselle calyces were recorded as 4.5 (°Brix) and 2.4, respectively. Meanwhile, acidity and ascorbic acid were noted as 3.3 percent and 18.2 mg/100 g, respectively. The total sugar content observed was 3.38 percent, with reducing and non-reducing sugars at 1.65 percent and 1.73 percent, respectively.

Table 1: Physical parameters of roselle

S. No.	Parameters	Observations
1	Diameter of roselle capsule (cm)	2.3
2	Length of roselle capsule (cm)	4.2
3	Colour of capsule (Visually)	Wine red
4	Colour of pulp (Visually)	Pinkish red
5	Weight of capsule (g)	4.18
6	Weight of calyces (g)	2.27
7	Weight of waste from capsule (g) (Seed coat + Seed + Corolla)	1.91
8	Weight of seed (g)	0.6
9	Edible index (%)	54.30
10.	Waste index (%)	45.69

Table 2: Chemical composition of roselle

S. No	Parameters	Composition
1.	Total soluble solids (^{0}Brix)	4.5
2.	pH	2.4
3.	Acidity	3.3
4.	Ascorbic acid (mg/100 g)	18.2
5.	Total sugar (%)	3.38
6.	Reducing sugar (%)	1.65
7.	Non-reducing sugar (%)	1.73

4. Conclusion
The analysis revealed that fresh roselle contains 4.5(°Brix) total soluble solids, pH 2.4, acidity 3.3%, ascorbic acid 18.2 mg/100 g, total sugar 3.38%, reducing sugar 1.65% and non-reducing sugar 1.73%. In terms of physical traits, it showed an average capsule diameter of 2.3 cm, capsule length of 4.2 cm, wine-red capsule color and pinkish-red pulp. The mean weights recorded for the capsule, calyces, seed and waste fraction (seed coat, seed, and corolla) were 4.18 g, 2.27 g, 0.6 g and 1.91 g, respectively, resulting in an edible index of 54.30% and a waste index of 45.69%. Overall, these results suggest that fresh roselle is a nutritionally rich crop, particularly abundant in vitamin C, natural sugars and organic acids, making it suitable for developing health-oriented foods and beverages.

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