

SENSORY ATTRIBUTES AND BIOCHEMICAL CHARACTERISTICS OF UNDERUTILIZED FRUIT, *PRUNUS NAPAULENSIS* (SER.) STEUD

PHAREICHON KASHUNG* and KARUTHAPANDIAN DEVI

Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu- 641043

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ABSTRACT

This study conducted in 2023, provides a comprehensive analysis of *Prunus napaulensis* (Ser.) Steud, focusing on its physical, biochemical, and sensory attributes. It aims to explore the biochemical composition and sensory profile to provide insights to its nutritional and bioactive compounds and its consumer preferences. Phytochemical screening in aqueous, ethanol and methanol extracts revealed the presence of various bioactive compounds such as flavonoids, tannins, phenols, anthocyanin and alkaloids. Antioxidant activity (DPPH assay) indicated varying degrees of radical scavenging activity in aqueous, ethanol and methanol solvents with IC₅₀ values recorded at 46.90 µg/mL, 144.62 µL/mL and 51.68 µL/mL respectively. The fruit exhibited characteristic physical dimensions and biochemical composition with good amounts of iron (3.03 ± 0.15 mg), calcium (80 ± 2 mg), potassium (371.33 ± 2.52 mg), magnesium (29.33 ± 2.52 mg), zinc (2.6 ± 0.45 mg), vitamin C (49.36 ± 3.92 mg) and significant levels of anthocyanin (244 ± 58.59 mg) highlighting its nutritional value. The Descriptive sensory analysis of the fruit provided an insight into the appearance, colour, aroma, flavour, firmness, taste and juiciness of the fruit contributing to a comprehensive understanding of its sensory attributes and consumer preferences. Thus, the study underscores the significance of the fruit and its potential commercial value and further research and exploration in both the food industry and healthcare sectors.

Keywords: Antioxidant activity, Biochemical composition, Descriptive sensory attributes, Phytochemicals, *Prunus napaulensis*.

INTRODUCTION

Prunus napaulensis (Ser.) Steud, also known as Sohiong, is a flavourful and nutritious fruit indigenous to the eastern Himalayas, including regions of Nepal, Myanmar and China. In India, it thrives in areas such as Meghalaya, Manipur, Assam, Nagaland, and Arunachal Pradesh wherein, this cherry-like fruit is consumed in its raw form or as jam and

wine. The fruit boast high levels of vitamins, minerals and antioxidants. Additionally, it possesses medicinal properties with its leaves having diuretic effects and astringent berries. Despite its nutritional richness and culinary potential, it remains underutilized due to poor or limited storage facilities and processing techniques which lead to significant post-harvest losses. However, *Prunus napaulensis*

*Corresponding author email id: devi_fsn@avinuty.ac.in;

(Ser.) Steud holds a potential for broader consumption and application in food industry for value added products as well as extraction of natural edible colorant. Studies show that the extracted colour when incorporated into squash and jam can remain stable for up to one year. Furthermore, the appealing purple colour of the fruit from the pulp and juice is being utilized in the production of Ready to Serve (RTS) products and cherry wine (Aparna *et al.*, 2018; Rymbai *et al.*, 2016).

This drupe matures between the months of August-November depending on the altitude. They are green to pink during the early stage and turn to dark purple upon ripening and categorized based on variations in size of fruit: big fruit size (7.91g) and small fruit size (3.98g) (Rymbai *et al.*, 2016). Bioactive compounds including naringenin, palmitoleic acid, rutin, quinic acid and quercetin have been extracted from various *Prunus* species found in China (Aparna *et al.*, 2018). Bioactive compounds exhibit potential radical scavenging activity, which can prevent the development and advancement of degenerative diseases. *Prunus napaulensis* (Ser.) Steud. is an excellent source of vitamin C, polyphenols and anthocyanin (Vivek *et al.*, 2018).

This underutilized fruit can be extensively utilised based on the available studies on its bioactive components in addition further needed studies on the sensory attribute and nutritional properties in the support of the utilization of the fruit in the product development and healthy consumption among consumers (Silva *et al.*, 2021) Top of Form. Hence the present study has been attempted at the analysis of sensory attributes and biochemical composition of *Prunus napaulensis* (Ser.) Steud.

MATERIAL AND METHODS

Fresh ripe fruits were collected from Ukhrul, Manipur, India. The fruits were washed

and cleaned to remove any dirt and separate the fruit from its stalk and leaves. The fruits were then kept at room temperature to remove the adhering water. The stone was separated from the fruit pulp; the fruit pulp was pulverized then freeze dried for further analysis. Chemicals used in the study were of analytical grade purchased from Beeline Scientific Company Pvt. Ltd.

Phytochemical Screening

Extract Preparation: The dried fruit sample was subjected to extractions with solvents; aqueous, ethanol and methanol; at ratio of 1:10 at 37°C for 24 h to obtain aqueous, ethanol and methanol extracts. The excess solvents were removed by rotary evaporator; the dried extract was stored at 4°C for further analysis.

The dried extracts were screened for the presence of phytochemicals such as Tannins, Flavonoids, Saponin, Anthraquinone, Anthocyanin, Steroids, Protein, Phenols, Polyphenol, Amino acids and Alkaloid using standard protocol (Balamurugan *et al.*, 2019).

Physicochemical and Nutritional Properties of *Prunus Napaulensis*(Ser.) Steud

Physical properties of fruit namely weight (g); length and diameter (mm), Stone weight (g), Stone length and diameter (mm) were recorded using Vernier calliper. Chemical and nutritional properties like moisture, carbohydrate, protein, crude fat, ash, pH, Total soluble solids, titratable acidity, minerals and ascorbic acid were analysed according to the AOAC methods, 2012. Anthocyanin was analysed according to the method proposed by (Li *et al.* 2017). Energy was calculated by factorial method (protein*4 + carbohydrate*4 + fat*9).

Sensory Attributes

Sensory attributes of *Prunus napaulensis* (Ser.) Steud was analysed by a

panel of 15 semi-trained members using a five point hedonic scale adapted from (Silva *et al.*, 2021). The attributes were classified according to the intensity and scored as 1 for the lowest intensity and 5 for the highest intensity. Descriptive attributes such as smoothness of the Epidermis, Colour intensity, Colour uniformity, Odour intensity, Flavour, taste (Sweetness, Acidic, Bitter, Astringency), Firmness (Force needed to crack the fruit) and Juiciness (Juice extracted from the fruit after chewing) of the fruit were analysed.

Colour Analysis

Colour analysis of a fruit is essential for insight and clarity of the visual appearance and potential applications in food industries as well as other industries such as pharmacy and cosmetics. The fruit colour attributes of *Prunus napaulensis*(Ser.) Steud fruit were quantified by Hunter colorimeter on account of CIELAB (1976) color space, which includes lightness (L*), red-green (a*) and yellow-blue (b*). Colorimeter equipped with D65 illuminant and standard observer at 10° was used to measure the colour parameters.

Antioxidant Activity of *Prunus Napaulensis* (Ser.) Steud

DPPH assay was based on (Bhusal *et al.*, 2020) with slight modifications. Extracts of aqueous, ethanol and methanol with varying concentrations of 10µL/mL, 50µL/mL, 150µL/mL, 250µL/mL, 350µL/mL, 500µL/mL and 750µL/mL were prepared. To ensure accurate measurement within linear range of the spectrophotometer, an aliquot of the extract solution was diluted to 1:4. 0.1 mL of the diluted sample was added to 3.9 ml of 0.1 mM DPPH solution and left to stand in dark for 30 mins at 37°C. Ascorbic acid was used as the standard for this assay. The IC₅₀ value of the extract samples was calculated by the log dose inhibition curve. The absorbance was measured at 517 nm and the DPPH radical

scavenging effect (%) was calculated from the following equation:

$$\% \text{ Inhibitory activity} = \frac{(A1-A2)}{A1} \times 100$$

Where,

A1= absorbance of control

A2= absorbance of testing sample solution

Statistical Analysis

Data were reported and expressed as mean±SD of triplicate observation.

RESULTS AND DISCUSSION

Phytochemical Screening

Aqueous, ethanol and methanol extracts of *Prunus napaulensis* (Ser.) Steud were subjected to qualitative screening of phytochemicals; the test reported the presence of secondary metabolites such as tannins, flavonoids, saponin, anthraquinone, anthocyanin, phenols, polyphenol and alkaloids in all three extracts as presented in the Table 1. This finding was in concurrence with the report stated by (Swier *et al.*, 2016).

Physicochemical and Nutritional Properties of *Prunus Napaulensis* (Ser.) Steud

Physical parameters such as weight, size of fruit and seed were measured using Vernier calliper and depicted in Table 2 revealing that the weight of the fruit was 6.30±1.25g; the size of fruit (length: 20.15±1.91mm and diameter: 20.30±1.39 mm); weight of the stone was 1.79±0.54g with the stone size; 13.73±1.82mm in length and 13.89±1.68mm in diameter. The measurements observed were within the range as reported by (Rymbaiet *al.*,2016; Vivek *et al.*, 2018). The physical parameters of *Prunus napaulensis*(Ser.) Steud fall within the range of dimension typical to plum, peach and cherry fruits evidencing *Prunus napaulensis* (Ser.) Steud belongs to the Rosaceae family (Rymbai *et al.*,2016; Vivek *et al.*,2018).

Table1. Phytochemical screening of extracts of *Prunus napaulensis*(Ser.) Steud

Phytochemicals		Solvents		
		Ethanol	Methanol	Aqueous
1.	Tannins	+	+	+
2.	Flavonoids	+	+	+
3.	Saponin	+	+	+
4.	Anthraquinone	+	+	+
5.	Anthocyanin	+	+	+
6.	Steroids	-	-	-
7.	Protein	-	-	-
8.	Phenol	+	+	+
9.	Polyphenol	+	+	+
10.	Amino acid	-	-	-
11.	Alkaloids	+	+	+

+ Present, - Absent

Table 3 presents the biochemical parameters (mean $\pm$ SD) of *Prunus napaulensis* (Ser.) Steud (*Sohiong*). Acidic pH of 3.73 ± 0.21 , titratable acidity of $0.8 \pm 0.04\%$ and total soluble solids (TSS) content measured at 10.66 ± 0.41 °Brix were recorded. The moisture content of the fruit was $81.51\% \pm 3.50$ indicating high moisture content which is a critical factor for determining the stability of the fruit which in turn aids in the selection of appropriate conditions and storage parameters during the development of new products. However, it was observed to be lower than that of plums and peaches (Rymbai *et al.*,

2016; Vivek *et al.*, 2018). Moderate energy content of 70.58 ± 0.71 Kcal was recorded, It also exhibited moderate amount of carbohydrates (13.2 ± 0.43 g), protein (3.06 ± 0.30 g) and low amount of fat (0.61 ± 0.08 g) and a good source of fibre (2.28 ± 0.59 g).

It nutritionally exhibited low amount of fat (0.61 ± 0.08 g), moderate amount of protein (3.06 ± 0.30 g) and carbohydrates (13.2 ± 0.43 g), and a good source of fibre (2.28 ± 0.59 g) and energy of 70.58 ± 0.71 Kcal. The fruit was notably rich in iron (3.03 ± 0.15 mg), calcium (80 ± 2 mg), potassium (371.33 ± 2.52 mg),

Table 2. Physical parameters of *Prunus napaulensis*(Ser.) Steud

Sl. No.	Physical parameters	Mean $\pm$ SD
1.	Weight of fruit (g)	6.30 $\pm$ 1.25
2.	Fruit length (mm)	20.15 $\pm$ 1.91
3.	Fruit diameter (mm)	20.30 $\pm$ 1.39
4.	Stone weight (g)	1.79 $\pm$ 0.54
5.	Stone length (mm)	13.73 $\pm$ 1.82
6.	Stone diameter (mm)	13.89 $\pm$ 1.68

magnesium (29.33 ± 2.52 mg), zinc (2.6 ± 0.45 mg), and vitamin C (49.36 ± 3.92 mg) and significant levels of anthocyanin (244 ± 58.59 mg) indicating potential properties. Vitamin C as well as minerals values mentioned above was observed to be higher compared to varieties of peach and plum (Rymbai *et al.*, 2016; Vivek *et al.*, 2018). The anthocyanin content was found to be lower than that of blackberries but higher when compared to raspberries (Vivek *et al.*, 2018). These biochemical properties highlight the nutritional and potential health benefits of the fruit, *Prunus napaulensis* (Ser.) Steud.

Descriptive Sensory Profile of *Prunus Napaulensis* (Ser.) Steud

The descriptive sensory analysis of *Prunus napaulensis* (Ser.) Steud was analyzed

by 15 semi-trained panel members using by five point hedonic scales. The descriptive sensory as depicted in Fig. 1 and plate 1 reported a favorable evaluation of its external appearance; smoothness (epidermis) with a score of 4.2 ± 0.86 . The intensity of the dark purple color was reported to be 4.86 ± 0.35 indicating a vibrant and visually appealing hue, however, the colour uniformity scored lower (4.06 ± 0.79) due to the variability in coloration. Colours are a primary indicator for the freshness of a fruit while firmness is recognized as a crucial textural attribute for assessing fruit quality. The odour intensity of the fruit and flavoured garnered a score of 3.13 ± 1.24 and 3.73 ± 1.09 indicating a moderate aroma and a moderate to flavourful taste profile. The sweet taste score was recorded to be lower 1.53 ± 0.83 as compared to acidic taste score

Table 3. Physico chemical and nutritional properties of *Prunus napaulensis*(Ser.) Steud

Sl. No.	Biochemical Parameters	Mean $\pm$ SD
1.	pH	3.73 ± 0.21
2.	Titratable Acidity (%)	0.8 ± 0.04
3.	TSS ($^{\circ}$ Brix)	10.66 ± 0.41
4.	Total Sugar (g)	5.55 ± 1.13
5.	Moisture (%)	81.51 ± 3.50
6.	Energy (Kcal)	70.58 ± 0.71
7.	Carbohydrate (g)	13.2 ± 0.43
8.	Protein (g)	3.06 ± 0.30
9.	Fat (g)	0.61 ± 0.08
10.	Ash (%)	1.00 ± 0.17
11.	Vitamin C (mg)	49.36 ± 3.92
12.	Calcium (mg)	80 ± 2
13.	Iron (mg)	3.03 ± 0.15
14.	Potassium (mg)	371.33 ± 2.51
15.	Magnesium (mg)	29.33 ± 2.5
16.	Zinc (mg)	2.6 ± 0.45
17.	Anthocyanin (mg)	244 ± 58.59
18.	Fiber (g)	2.28 ± 0.59



Fig. 1. Images of the fruit *Prunus napaulensis* (Ser.) Steud

of 3.13 ± 1.12 which due to the low pH of the fruit. The bitter taste and Astringency profile were rated to be 1.93 ± 1.09 and 2.64 ± 1.39 respectively indicating a mild astringent quality. Firmness is the force needed to crack the fruit scored 1.8 ± 0.94 suggesting a relatively soft texture. Juiciness is the amount of juice extracted after chewing scored 3.46 ± 0.99 indicating a moderately juicy fruit. Hence, the findings provide valuable insights on the sensory characteristics of *Prunus napaulensis* (Ser.) Steud, aiding in understanding its quality and consumer preferences.

Color Analysis

The color analysis of *Prunus napaulensis* (Ser.) Steud is essential for understanding and

Table 4. Color values of *Prunus napaulensis* (Ser.) Steud

Sl.No.	Color	Values
1.	L*	23.312
2.	a*	4.385
3.	b*	0.686
4.	ΔL^*	-72.708
5.	Δa^*	4.423
6.	Δb^*	-1.690

analyzing the visual appearance and its potential application as dyes and pigments in food processing industries as well as for use in cosmetics. The color values L^* , a^* , b^* , ΔL^* , Δa^* , Δb^* were measured. The L^* value in the CIELAB color space denotes the lightness-darkness of a color ranging from 0 (black) to 100 (white). The higher the value of L^* the brighter or lighter the color while a lower value indicates a darker shade. The a^* value in the CIELAB color space represents the color range between green (-a) to red (+a) on the Chroma axis. Negative a^* value indicates a green tint while a positive value suggest a reddish color. The b^* value represents the blue- yellow color. A negative b^* value indicates a blue color while a positive b^* represents a more yellowish color. The results as shown in table 4 indicates that, the color attribute of *Prunus napaulensis* (Ser.) Steud measured 23.312 for lightness, 4.385 as a^* value and 0.686 as the b^* value. Thus indicating a reddish color due to the positive a^* value however, (Vivek *et al.*, 2018) observed a higher a^* value.

Antioxidant Activity of *Prunus Napaulensis* (Ser.) Steud

DPPH assay was used to evaluate the free radical scavenging capacity. The result

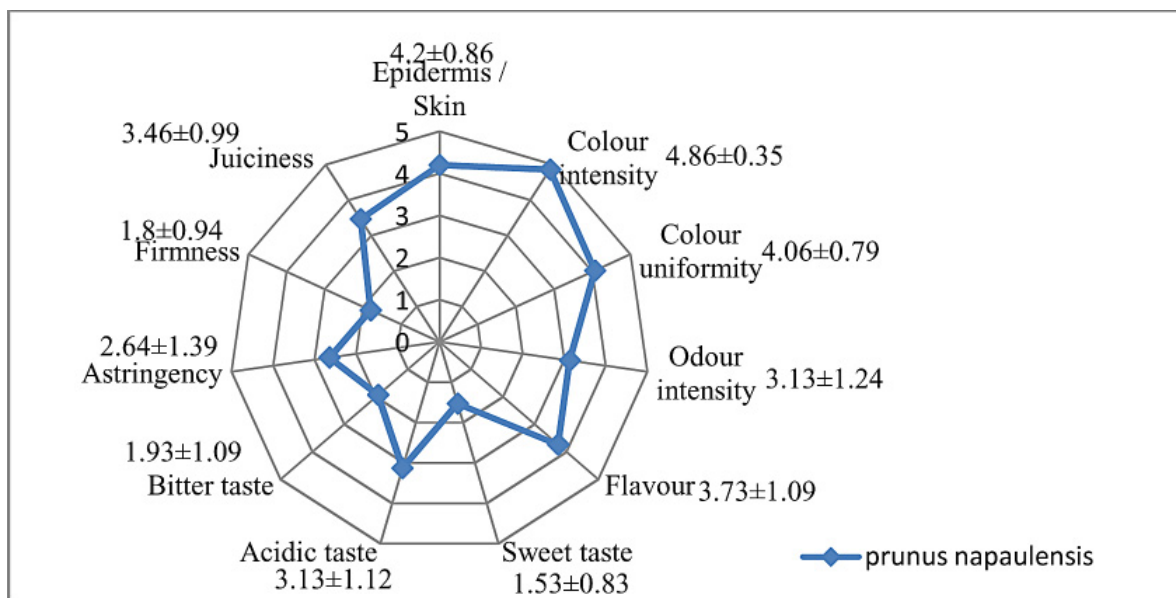


Fig. 2. Radar chart of Descriptive sensory Attributes of *Prunus napaulensis* (Sohiong)

exhibits that various extracts of *Prunus napaulensis* (Ser.) Steud fruit reduced the DPPH concentration indicating that the DPPH activity is also influenced by the type of solvent used. Aqueous extract exhibited the highest antioxidant inhibitory activity (97.44%) at 750 μ L as compared to samples prepared using methanol extract (91.7%) and ethanol extract (86.61%). However, among all extract, methanol extract exhibited the strongest inhibition activity (45.56%) at the lowest concentration (10 μ L). In the present study, samples exhibited concentration dependent DPPH radical scavenging activity (Fig. 3.). With the increase in concentration, the scavenging activity of the sample extracted was increased. The IC₅₀ value of extracts (Table 5): aqueous, methanol and ethanol were 46.90 μ g/mL, 51.68 μ L/mL and 144.62 μ L/mL respectively. Ascorbic acid, demonstrated 95.9% radical scavenging activity at a concentration of 15 μ L/mL with an IC₅₀ value of 1.530 μ L/mL. The high antioxidant potential stems from the presence of anthocyanin, phenolic acids and phenolic compounds like flavonoids present in *Prunus*

napaulensis (Ser.) Steud. Flavonoids are known for their antioxidant activity. Red and black rice exhibited higher antioxidant activity as compared to white rice owing to the higher content of quercetin and catechin (Chen *et al.*, 2022).

Recent studies by Igwe and Charlton (2016) and Smith *et al.*, (2022) reported the health promoting and nutritional benefits of *Prunus* species, particularly, extracts of prunes (*Prunus domestica* and *Prunus salicina*) due to its rich composition of polyphenols, anthocyanins and flavonoids. These bioactive compounds are known to exhibit physiological benefits such as improved bone density, enhanced gastrointestinal function and protection of the cardiovascular health (Ayub *et al.*, 2023). Additionally, dried plums exhibited protective effects against bone loss due its polyphenolic profile (Smith *et al.*, 2022). Furthermore, experimental studies on anthocyanin-rich extracts of *Prunus* fruits demonstrated significant mitigation of oxidative stress and potential amelioration of

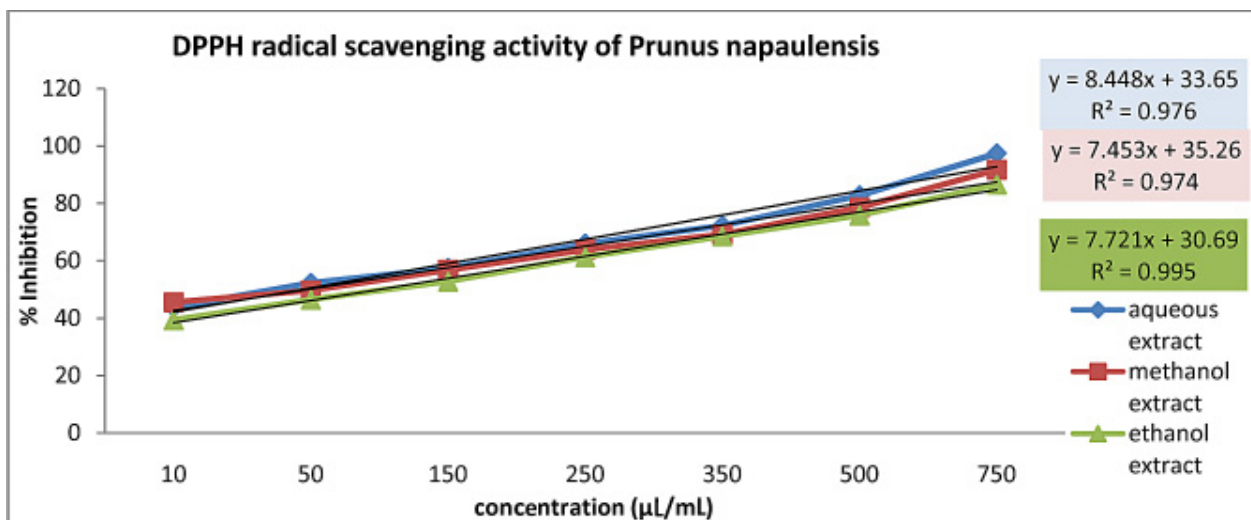


Fig. 3. *In vitro* antioxidant activity (DPPH assay) of aqueous, methanol and ethanol extract of *Prunus napaulensis*(Ser.) Steud.

Table 5. IC₅₀ values of extracts of *Prunus napaulensis*(Ser.) Steud

Fruit extract	IC ₅₀ value (μL/mL)	
1.	Standard ascorbic acid	1.530
2.	Aqueous extract	46.90
3.	Ethanol extract	144.62
4.	Methanol extract	51.68

hyperlipidaemia (Seniuk *et al.*, 2021; Das *et al.*, 2022; Chaudhuri *et al.*, 2015).

CONCLUSION

This study comprehensively evaluated the physical, physicochemical and nutritional characteristics of *Prunus napaulensis*(Ser.) Steud fruit shedding light on its nutritional composition and various bioactive compounds along with the phytochemical screening for secondary metabolites including tannins, flavonoids, saponin, anthocyanin, phenols and polyphenols. The antioxidant activity (DPPH assay) exhibited a radical scavenging activity with IC₅₀ value 46.90 μL/mL in aqueous extract. The physical properties showcased the characteristic dimensions of both fruit and seed aligned with Cherry fruit. The nutritional composition highlighted the significant presence of minerals such as iron (3.03 ± 0.15

mg), calcium (80 ± 2 mg), potassium (371.33 ± 2.52 mg), magnesium (29.33 ± 2.52 mg), and zinc 2.6 ± 0.45 mg), and Vitamin C (49.36 ± 3.92 mg), emphasizing the nutrient density of the fruit. The descriptive sensory analysis of the fruit provided insights into the external appearance, colour, aroma, flavour, taste, firmness, and juiciness, contributing to a comprehensive understanding of sensory attributes of *Prunus napaulensis* (Ser.) Steud towards consumer preferences. The sensory profile indicated a visually appealing dark red to purple hue with moderately juicy texture and lower sweetness score due to the low pH. Overall, this research highlights the nutritional abundance, sensory attributes of *Prunus napaulensis* (Ser.) Steud fruit, suggesting avenues for further exploration for applications in both the food industry and healthcare domains.

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