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Effect of different solvents on color extraction and comparative study of their color profile and antioxidant profile of Palash and Jaba flower petals

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Abstract:
Palash and hibiscus are used in Siddha medicine, a traditional system from India and the Southeast Asian countries of Nepal, Indonesia, Thailand, and Sri Lanka. These plants have natural health benefits that can help to cure diseases naturally. Food color from natural dyes is emerging globally as an eco-friendly colorant. This study is innovative in investigating various Solvents for using color extraction and subsequently conducting a comparative analysis of Different solvents concerning their outcomes. The color, antioxidant activity, and Phytochemicals are also thoroughly examined. There are a total of six samples prepared, and These samples of solutions were respectively 5% Citric Acid 24h (S1), 5% Citric acid 48h (S2), 5% NaOH solution 24h (S3), Glycerin with water (1:3) a time of 24h (S4), Glycerin with Water (1:3) a time of 48h (S5) and pure glycerin solution (S6). Phenolic content was high in The S7 sample in both flowers, and these values were 825.5 mg and 1778.75 mg, respectively, in 100 gm. Free radical scavenging activity (DPPH) was high in the S2 sample in both flowers; these values were 77.41% and 79.16%, respectively. Color parameters, i.e., L*, a*, b*, help to detect the lightness index, redness, and yellowness index. Principle component analysis justifies the correlation of characterization parameters of palash and jaba flower petals. On an overall basis, it was found from the study that 5% citric acid solvent and pure glycerin solvent were considered the most effective and the highest concentration of readily accessible antioxidants and higher antioxidant Activity.

Keywords: Palash, Hibiscus, Antioxidant, color, PCA

1. Introduction

Food coloring, also known as food dye or food colorant, is a substance used to impart color to various food and beverage products. It can be natural or synthetic and is employed to enhance the visual appeal of food, create distinctive appearances, or compensate for color loss during processing. Food colorings come in various forms, including liquids, gels, powders, and pastes. However, concerns about the safety of certain synthetic food dyes have led to increased interest in natural alternatives sourced from fruits, vegetables, and other plant-based ingredients (Lakshmi, 2014).

Natural food coloring refers to colorants derived from naturally occurring sources such as fruits, vegetables, plants, and minerals. These dyes are used to add color to food and beverages while avoiding synthetic or artificial additives. Examples of natural food colors include beet juice for red, turmeric for yellow, spinach for green, and anthocyanin from berries for various shades of purple and blue. Natural food coloring is often preferred by consumers seeking

healthier and more wholesome options, as they generally do not contain synthetic chemicals or additives (Rymbai et al., 2011)**.**

Butea monosperma, commonly known as the "Palash" or "Flame of the Forest" is in reference to the reddish-orange color (Burli & Khade, 2007; Jhade et al., 2009). The tree's timber is valuable, and various parts of the plant have been used in traditional medicine for their potential therapeutic properties (Kasture et al., 2002). *Hibiscus rosa-sinensis*, commonly known as the "Chinese Hibiscus" or "Jaba," is a tropical and subtropical flowering plant admired for its large, showy flowers. These flowers come in a range of colors, including vibrant red, pink, orange, and yellow, and they have a characteristic funnel-shaped appearance. This plant is often cultivated for ornamental purposes, both in gardens and as potted plants (Mejía et al., 2023). Beyond its visual appeal, Hibiscus rosa-sinensis has been used in traditional herbal medicine for its potential health benefits, particularly in teas and extracts derived from its petals. Various chemical constituents like Flavonoid, Alkaloids, Butrin, Palasonic acid, Glycoside, Kino-tannin, Gallic acid, etc., and standard antioxidants such as Ascorbic acid are highly present in Palash petals and Jaba flower petals. The presence of flavonoids and phenolic compounds are dihydrochalcone, dihydromonospermoside, chalcones, butein, monospermoside and isoliquiritigenin, One flavone, 7,3',4'trihydroxyflavone, four flavanones, (-)-butin, (-)-butrin, (+) isomonospermoside and liquiritigenin, and three isoflavones, formononetin, afrormosin and formononetin-7-O-beta D glucopyranoside. It has been chemically reported that both flower petals are given benefits in anticonvulsive, antidiabetic, anti-inflammatory, hepatoprotective, antihelmintic, antioxidant, antistress, antimicrobial activities, etc.

This study evaluated the extraction of one color of dye (yellow) from the Butea Monosperma flower and another dye (red) from the hibiscus flower (Kasture et al., 2002; Mak et al., 2013; Pandit et al., 2016; Rengarajan et al., 2020; Sinha et al., 2012; Yadav et al., 2023). Flower Petals uses the extracted dyes as a source of nontoxic and eco-friendly dye. The activity of flower petals was determined through some in vitro models such as total phenolic content (TPC) and, 2,2-Diphenyl-1-picryl hydroxyl (DPPH) assays Here, I am trying to study in antioxidant activity of both flower petals by different assay and also proven for the presence of total Phenolic content and antioxidant activity in flower petals.

2. Materials and Methods

2.1 Raw materials

Collected the Palash and Jaba flowers in the local area.

2.2 Chemicals

All chemicals were bought from SD Fine Chemicals and Sigma-Aldrich in Mumbai, India.

2.3 Color Extraction from Butea monosperma and Hibiscus Rosa

At first, take palash flowers and hibiscus flowers separately then pick up buds, stigma, and stamen from flower petals. Then only 20 gm of fresh flower petals and immersed in different solutions at different time durations. Here using different solutions and time intervals were respectively distilled water (24 hr.), 5% citric acid (24 hr., 48 hr., and 72 hr.), 5 % Nacl (24 hr.), and the glycerin-water ratio was 1:3 (24 hr., and 48 hr.) and all solution marked as S1, S2, S3, S4, S5, S6, and S7 respectively. After completing time, put off the flower Petals and take the color liquid solution (color shows – yellowish, orange, yellowish-brown for Palash flower) and (color shows – red, brownish red for hibiscus flower). After that preserve all samples in the refrigerator.

2.4 Color measurement

The color measurements were made using a Hunter Lab colorimeter (Hunter Associates Laboratory Inc, 45/0 of color flex, USA) followed by Nahar et al. 2022 (Nahar, Raychaudhuri, et al., 2022).

2.5 Antioxidant properties

In a lab sonicator (Trans-O-Sonic/D150-IM, device located in Mumbai), solutions of 10 ml of solution in 20 mL 80% methanol followed by 1 hr. incubation at 60 °C were subjected to sonication for 30 mins to complete the extraction. The solution was centrifuged in a high-speed centrifuge (Supra 22K, Hanil, Korea) at 8900 rpm for 10 min at 4°C. Then the supernatant will be collected in the Tarson tube for further analysis. The antioxidant content and antioxidant activity were determined from extracts following the procedure described by (Nahar, Hazra, et al., 2022).

2.6 Principal component analysis (PCA)

Principal Component Analysis was used to identify the primary source of variation in the raw FTIR data, texture, and antioxidant which were then used for clustering samples based on the similarity of the characteristics present in different dried samples by Minitab software.

2.7 Statistical analysis

MINITAB 19.0 (Minitab, Inc., Pennsylvania, PA) was used for data analysis.

3. Result and Discussion

3.1 Antioxidant content and antioxidant activity

Together antioxidant content and antioxidant activity, are called phytochemicals, containing a huge number of phenolic and flavonoids, and radical scavenging that have been measured using seven different solutions. The antioxidant content and antioxidant activity of all flower solutions are presented in Table 1. The antioxidant content is highest in 5% citric acid solution for 48 hours in both flower palash and jaba (1018.13 mg / 20 gm and 601.58 mg/gm respectively) and lowest in distilled water solution. Similarly, antioxidant activity (DPPH activity assay) was also high in 5% citric acid solution for 48 hours in both flower palash and jaba (85.75 % and 77.41% respectively) and lowest in distilled water solution (39.03% and 25.05%). Long-time exposure to air generally caused oxidation and as a result, the antioxidant of the product is reduced (Nahar et al., 2023; Saha et al., 2019).

Table 1: Antioxidant content and antioxidant activity of palash and jaba flower petals.

Sl No.	Solution name	Immersing time (hr.)	Palash flower petals		Jaba flower petals	
			TPC (mg/20 gm)	DPPH (%)	TPC (mg/20 gm)	DPPH (%)
1	Distilled water	24	158.1	39.03	0.78	25.05
2	5% citric acid	24	414.8	79.16	271.4	70.83
3	5% citric acid	48	1018.80	85.75	601.58	77.41
4	5% citric acid	72	201.5	72.01	166.34	67.32
5	5 % Nacl	24	302.80	70.17	201.8	63.90
6	Glycerin-water (1:3)	24	427.60	47.56	264.6	38.15
7	Glycerin-water (1:3)	48	900.10	51.53	463.8	49.51

3.2 Color profile analysis

Color changes in flower items are evaluated using the three chromatic coordinates L, a, and b, which stand for brightness/darkness, redness/greenness, and yellowness/blueness respectively. The kinds and amounts of certain elements determine this. Following a heat treatment, color changes are mostly caused by the browning process and pigment oxidation (Nahar, Hazra, et al., 2022; Nahar, Raychaudhuri, et al., 2022; Saha et al., 2019). The color parameters of all flower solution were presented in Table 2. Palash flower petals have high lightness value (L^* = 13.763 of 5% citric acid solution), low redness value (a^* = -6.046 of 5% citric acid solution) and high yellowness value (b^* = 17.087 of 5% citric acid solution) than the jaba flower petals (L^* = 2.81, a^* = 6.20, and b^* = 3.30 of 5% citric acid solution). The color shift was caused by the cellular structure's nonenzymatic browning and superior degree of breakdown at temperatures, time, and nature of solution when the samples were immersing in solution at different time intervals.

Table 2: Color profile of palash and jaba flower petals.

Sl No.	Solution name	Immersing time (hr.)	Palash flower petals			Jaba flower petals		
			L^*	a^*	b^*	L^*	a^*	b^*
1	Distilled water	24	13.103	-1.826	10.323	1.02	1.89	1.9
2	5% citric acid	24	5.153	-0.73	4.913	2.38	3.88	2.57
3	5% citric acid	48	13.763	-6.046	17.087	2.81	6.20	3.32
4	5% citric acid	72	8.135	-6.012	15.092	1.82	4.70	2.36

5	5 % Nacl	24	13.865	-4.482	10.34	0.55	1.21	0.68
6	Glycerin-water (1:3)	24	6.42	-0.42	8.493	3.85	1.27	2.82
7	Glycerin-water (1:3)	48	9.74	-2.63	12.327	2.91	1.93	2.79

3.3 Principal Component Analysis (PCA)

Analysis of the five principal components (PC) produced and percentage of variation explained that the first three PC would be adequate for explaining the variance caused by different ingredients (Figure 1). PC1 was positively correlated with lightness, and yellowness of palash all solution except 5% citric acid solution at 24 and 48 hours, while PC2 is positively correlated with TPC, and DPPH of palash at 48 hours, and negatively correlated with others. From the Bi-plot, it could be seen that palash (S1, S6, S4, S5, S7), samples were similar with high lightness and yellowness. In contrast, palash (S3) had high TPC, DPPH and antioxidant values. Jaba (S1, S2, S3, S4, S5, S6, and S7) sample was characterized by high redness values, and lower lightness, yellowness, TPC and DPPH.

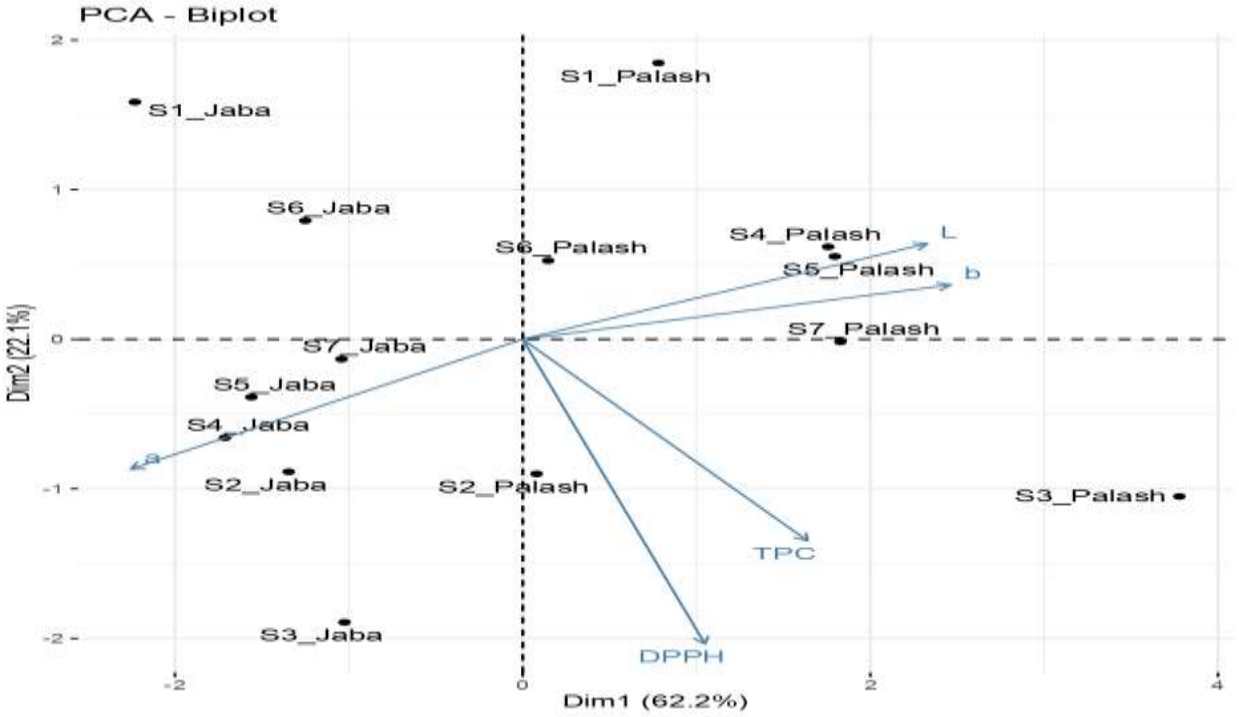

Figure 1: PCA – Biplot of all samples with their parameters.

4. Conclusion

There is a particular need for the development of natural dye worldwide, as its use in favor of human health and environment present work showed that natural dye can be successfully extracted from the petals of Butea monosperms and hibiscus rosa-sinensis flower. Maximum dye extraction was observed using minimum 20 gm of flower petals. With increasing the extraction time, the dye extraction efficiency increased. In Future, this naturally make food color dye from Palash and Jaba flower petals will get tremendous potential as a food coloring material in soft drinks and other food products like ham/sausages, jam, chowmin noodles etc. This dye would has hidden tremendous medicinal properties such as antistrips, Anticonvulsant properties, antibacterial effect and its usefulness in fever & laxative.

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