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Quantification of Chlorophyll and Carotenoid Concentrations in Young and Adult Leaves of Selected Medicinal Plants in Yogi Vemana University

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Abstract

The chlorophyll a (Chl. a) and b (Chl. b) and carotenoid contents of 10 distinct medicinal plants have been determined in the current investigation. Young and mature leaves were found to have different chlorophyll a (Chl.a) and b (Chl.b) and carotenoid contents in terms of quality. For the purpose of evaluating the chlorophyll and carotenoid concentration, 10 different medicinal plant species were chosen, including *Pterocarpus santalinus, Azadirachta indica, Phyllanthus emblica, Tridox procumbens, Swietenia mahagoni, Hardwickia binata, Pithecetobium dulce, Cassia fistula, Dalbergia latifolia* and *Syzygium cumini*. In all cases, adult leaves had more chlorophyll and carotenoid content than young ones. It has been demonstrated that the age of the leaves has a significant impact on the amount of chlorophyll and carotenoids.

Keywords: Medicinal Plants, Young and Adult leaves, Plant material, Chlorophyll a and b, Carotenoids.

INTRODUCTION

An essential characteristic that is frequently evaluated to provide information on the content of chloroplasts, the photosynthetic process, and plant metabolism is the concentration of chlorophyll in leaves. Mostly found in the green sections of leaves, stems, flowers, and roots, chlorophyll is an antioxidant chemical that is present and stored in the chloroplast of green leafy plants (Mirza *et al.,* 2013; Srichaikul *et al.,* 2011). But since sunlight is a plant's primary energy source, the creation of chlorophyll is mostly dependent on its penetration (Srichaikul *et al.,* 2011). In a laboratory, the pigments are typically extracted using a pestle and mortar and an organic solvent like acetone or dimethyl formamide (Porra *et al.,* 1989). Plant photo systems require the pigments chlorophyll a and chlorophyll b (Richardson *et al.,* 2002). Furthermore, the main photosynthetic pigment in plants that aids in energy production is called chlorophyll A. Nonetheless, plants have two to three times more chlorophyll A than secondary chlorophyll B (Srichaikul *et al.,* 2011).

The presence of diverse pigments such as chlorophyll, carotenoid, and other pigments, together with water content, gives green plants their distinct characteristics. These pigments collectively make up the spectral characteristics of a plant body (John Chang Chen *et al.,* 2007). However, the chlorophyll content has therapeutic properties. In addition to its significant function in plant physiology, chlorophyll may be used as nourishment to lower blood sugar levels and aid in detoxification, digestion, excretion, and the reduction of allergens (Srichaikul *et al.,* 2011; Singh *et al.,* 2011).

Table 1: Medicinal properties of selected plants for experiment

Sl. No.	Medicinal plant	Medicinal properties
1.	*Pterocarpus santalinus*	Anti-inflammatory properties, Antioxidant activity and used in traditional medicine for skin disorders, fever, and digestive issues (Bulle *et al.,* 2016)
2.	*Azadirachta indica*	Antimicrobial properties, Anti-inflammatory effects, used for treating various skin conditions, dental issues, and as an insect repellent (Devi *et al.,* 2023)
3.	*Phyllanthus emblica*	Rich source of vitamin C, Antioxidant properties, Used in traditional medicine for its immunomodulatory and rejuvenating effects (Prananda *et al.,* 2023)

4.	*Tridox procumbens*	Immunomodulatory effects, Antioxidant properties, Used in Ayurvedic medicine for boosting immunity and treating various ailments including fever, diabetes, and arthritis (Jogdande *et al.,* 2024)
5.	*Swietenia mahagoni*	Anti-inflammatory properties, Antioxidant activity, used traditionally for treating digestive disorders and as a tonic (Khamis *et al.,* 2023)
6.	*Hardwickia binata*	Anti-inflammatory effects, used in traditional medicine for treating rheumatism, fever, and skin disorders (Manimegalai *et al.,* 2023)
7.	*Pithecellobium dulce*	Antidiabetic properties, Antioxidant activity, Used traditionally for wound healing and as an anti-inflammatory agent (Aldarhami *et al.,* 2023)
8.	*Cassia fistula*	Laxative properties, Antioxidant effects, Used in Ayurvedic medicine for its purgative and hepatoprotective properties (Singh *et al.,* 2023)
9.	*Dalbergia latifolia*	Antimicrobial properties, Anti-inflammatory effects, used traditionally for its astringent and wound-healing properties (Nayak *et al.,* 2023)
10.	*Syzygium cumini*	Antidiabetic effects, Antioxidant properties, used in traditional medicine for managing diabetes and as an astringent (Choudary *et al.,* 2023)

However, leaf chlorophyll content may also be detected using contemporary methods such as satellite remote sensing technologies. Variations in the amount of chlorophyll in leaves can provide details about a plant's or leaves physiological state. Destructive techniques for quantifying the amount of chlorophyll in leaves include the conventional extraction procedure and spectrophotometric or HPLC analysis; however, these techniques are seen to be costly and time-consuming. Green pigment and nutrients, which are biochemical components of forest canopies, are among the crucial elements that regulate physiological processes (John Chang Chen *et al.,* 2007).

The chlorophyll content of several medicinal plant leaves is recorded in the current study. The amount of chlorophyll in young and adult leaves of the same plant species was compared. To understand the photosynthetic activity of physiological changes in young and adult plant leaves, this type of research is crucial. This study was experimental in nature, with the goal of determining the levels of chlorophyll a and b in the young and adult leaves of particular plants. However, chlorophyll is a crucial macromolecule that shows the efficiency of photosynthesis and the pace at which energy is used. Additionally, it provides humans with energy in the form of plant matter or food. The antioxidant qualities of chlorophyll may be used in the search for new medical treatments (Kamble *et al.,* 2015).

Several bacteria, fungi, algae, and plants all generate pigments known as carotenoids. Plants, algae, numerous bacteria, fungi, and other organic metabolic building blocks can be converted into these crucial colours by means of oils, fats, and other building blocks. Carotenoids from diets typically build up in the fatty tissues of animals. More than 600 different types of carotenoids may be found in nature, and they fall into two main groups: xanthophylls, which have oxygen, and carotenes, which are just hydrocarbons and have no oxygen (Butnariu *et al.,* 2016; Biehler *et al.,* 2010; Giri *et al.,* 2013; Sahabi *et al.,* 2012).

In higher plants carotenoids, primarily have two significant functions. They serve two purposes: first, they absorb light for photosynthesis, and second, they shield chlorophyll from photo damage. These bioactive compounds have the ability to display vitamin A activity. Since lutein and xanthophylls are the most readily accessible carotenoids in the case of higher plants, or angiosperms, and because of their important role in avoiding eye issues, they are now the subject of several scientific studies (Choudary *et al.,* 2023; Doka *et al.,* 2013)

In this study, for evaluating the chlorophyll and carotenoids concentration here we are taken 10 different medicinal plant species, including *Pterocarpus santalinus, Azadirachta indica, Phyllanthus emblica, Tridox procumbens, Swietenia mahagoni, Hardwickia binata, Pithecetobium dulce, Cassia fistula, Dalbergia latifolia* and *Syzygium cumini*. Medicinal properties of the above listed plants are described in table.1.

MATERIALS AND METHODS

Study Area:

Present study was conducted at Yogi Vemana University in Kadapa, Andhra Pradesh, in March 2024. Ten different medicinal plant species were chosen at random from Yogi Vemana university Botanical Garden. Sampling was done once only. To determine the chlorophyll and carotenoids concentration, leaves from the same sample plant, both young and adult leaves, were taken and put through normal chemical processes.

Chlorophyll Analysis:

A clean pestle and mortar were used to carefully homogenate one gram of finely chopped leaf material. 0.5 grams of $MgCO_3$ powder and 20 ml of 80% acetone were added to this homogenized leaf material. The materials were further ground softly. After that, the sample was refrigerated for four hours at 40^0C. The material was then centrifuged for 5 minutes at 1500 rpm. The supernatant was poured into a 100 ml volumetric flask. With the addition of 80% acetone, the final amount was increased to 100 ml. The solution's colour absorbance was measured using a spectrophotometer at 645 and 663nm wavelengths against the solvent. Acetone (80%) was utilized as a blank (Kambli *et al.,* 2015; Ali *et al.,* 2021).

Formula:

Chlorophyll a = $11.75 \times A_{663} - 2.35 \times A_{645}$

Chlorophyll b = $18.61 \times A_{645} - 3.96 \times A_{663}$

Carotenoids Analysis:

The well-known Lichtenthaler and Well burn technique was utilised to determine the concentration of carotenoids. To calculate the total carotenoid contents (xanthophylls + carotene), the 80% acetone extract was measured at 470 nm in a spectrophotometer (Banik *et al.,* 2018).

Formula:

$C_{x+c} = (1000A_{470} - 1.82\ \text{Ch. a} - 85.02\ \text{Ch. b}) / 198$

Where, A = Absorbance at respective wave length,
Ch. a = Chlorophyll-a, Ch. b=Chlorophyll-b

RESULT AND DISCUSSION

Results of the present study have been presented in Table.2. The total chlorophyll content in both young and adult leaves of *Pterocarpus santalinus* is relatively high compared to other species in this study. The adult leaves exhibit slightly higher total chlorophyll and carotenoid content (31.72 and 16.12 mg pigment/m^3) compared to young leaves (29.17 and 17.53 mg pigment/m^3), indicating the maturation process positively influences chlorophyll synthesis. *Azadirachta indica* demonstrates moderate levels of total chlorophyll and carotenoid content in both young (27.74 and 14.59 mg pigment/m^3) and adult leaves (32.53 and 17.11 mg pigment/m^3). Similar to Pterocarpus santalinus, adult leaves of *Azadirachta indica* also show slightly higher chlorophyll and carotenoid content compared to young leaves. Although not as high as some other species, the chlorophyll and carotenoid contents are still substantial, indicating healthy photosynthetic processes. *Phyllanthus emblica* exhibits one of the highest total chlorophyll contents among the studied species, particularly in adult leaves. The significant disparity in chlorophyll and carotenoid content between young (29.78 and 15.74mg pigment/m^3) and adult leaves (39.85 and 19.73 mg pigment/m^3) suggests a substantial increase during maturation, indicating the plant's reliance on photosynthesis for growth and development. *Tridox procumbens* displays a relatively lower total chlorophyll and carotenoid content compared to some other species in this study. Both young (26.57 and 14.90 mg pigment/m^3) and adult leaves (31.18 and 17.48 mg pigment/m^3) show comparable chlorophyll levels, indicating minimal variation with leaf maturity. *Swietenia mahagoni* exhibits moderate to high total chlorophyll and carotenoid content in both young and adult leaves. The disparity between young (26.87 and 13.44 mg pigment/m^3) and adult leaves (35.78 and 17.90 mg pigment/m^3) is not as significant as observed in some other species, suggesting relatively consistent chlorophyll and carotenoid synthesis throughout leaf development. *Hardwickia binata* demonstrates the highest total chlorophyll contents, particularly in adult leaves. The substantial increase in chlorophyll content from young (39.17 and 18.70 mg pigment/m^3) to adult leaves (44.65 and 24.32 mg pigment/m^3) highlights the importance of photosynthesis in the plant's growth and metabolic processes. *Pithecellobium dulce* exhibits a considerable difference in chlorophyll and carotenoid content between young (45.01 and 34.17 mg pigment/m^3) and adult leaves (14.37 and 10.91 mg pigment/m^3), with adult leaves showing significantly higher levels. Despite the high chlorophyll and carotenoid content in adult leaves, the overall values are lower compared to some other species, indicating potential variations in photosynthetic efficiency among different developmental stages. *Cassia fistula* demonstrates moderate levels of total chlorophyll and carotenoid content in both young (27.6 and 21.16 mg pigment/m^3) and adult leaves (28.74 and 22.03 mg pigment/m^3), with slightly higher values in adult leaves. The differences in chlorophyll and carotenoid content between young and adult leaves are relatively minimal, suggesting consistent photosynthetic activity throughout leaf development.

Table 2: Total Chlorophyll and Carotenoids content of different medicinal plant species (mg/l)

Sl. No	Medicinal plant name	Young leaves		Total chlorophyll content	Total carotenoids	Adult leaves		Total chlorophyll content	Total carotenoids
		Chl.a	Chl.b			Chl.a	Chl.b		
1.	*Pterocarpus santalinus*	15.81	13.36	29.17	16.12	18.63	13.09	31.72	17.53
2.	*Azadirachta indica*	16.95	10.79	27.74	14.59	20.36	12.17	32.53	17.11
3.	*Phyllanthus emblica*	17.36	12.42	29.78	15.74	20.54	19.31	39.85	19.73
4.	*Tridox procumbens*	18.83	7.74	26.57	14.90	20.41	10.77	31.18	17.48
5.	*Swietenia mahagoni*	18.56	8.31	26.87	13.44	24.94	10.84	35.78	17.90

6.	*Hardwickia binata*	21.89	17.28	39.17	18.70	24.32	20.33	44.65	24.32
7.	*Pithecellobium dulce*	29.21	15.80	45.01	34.17	8.87	5.50	14.37	10.91
8.	*Cassia fistula*	14.66	12.94	27.6	21.16	15.76	12.98	28.74	22.03
9.	*Dalbergia latifolia*	25.76	19.72	45.48	27.31	11.88	9.72	21.6	12.97
10.	*Syzygium cumini*	21.88	13.09	34.97	17.56	25.81	18.45	44.26	22.2

Dalbergia latifolia exhibits high total chlorophyll and carotenoid content, particularly in adult leaves, which surpasses that of most other species in this study. The substantial increase in chlorophyll and carotenoid content from young (45.48 and 27.31 mg pigment/m^3) to adult leaves (21.6 and 12.97 mg pigment/m^3) underscores the importance of photosynthesis in supporting the plant's growth and physiological processes. *Syzygium cumini* demonstrates moderate to high total chlorophyll and carotenoid content in both young (34.97 and 17.56 mg pigment/m^3) and adult leaves (44.26 and 22.2 mg pigment/m^3). The disparity between young and adult leaves is noticeable, with adult leaves showing significantly higher chlorophyll and carotenoid levels, indicating enhanced photosynthetic activity in mature leaves.

CONCLUSION

in this study, our results provide useful details on the metabolism and photosynthetic efficiency of these plants, which are critical elements in assessing their general health and therapeutic potential. Overall, the findings show that there are notable differences in the total chlorophyll and carotenoid concentration amongst the species under study. Some species showed high chlorophyll and carotenoid content, especially in adult leaves: Hardwickia binata, Phyllanthus emblica, and Dalbergia latifolia. On the other hand, species such as Pithecellobium dulce and Tridox procumbens showed comparatively lower levels of chlorophyll, indicating possible variations in metabolic processes and photosynthetic efficiency. Furthermore, as demonstrated by the observable rise in chlorophyll concentration from young to adult leaves in some species, our findings emphasise the significance of leaf maturity in chlorophyll and carotenoid production.

REFERENCES

- Aldarhami, A., Bazaid, A. S., Alhamed, A. S., Alghaith, A. F., Ahamad, S. R., Alassmrry, Y. A., ... & Alreshidi, M. (2023). Antimicrobial Potential of Pithecellobium dulce Seed Extract against Pathogenic Bacteria: In Silico and In Vitro Evaluation. *BioMed Research International*, *2023*.
- Ali, K. A., Noraldeen, S. S., & Yaseen, A. A. (2021). An evaluation study for chlorophyll estimation techniques.
- Banik, S., Mukherjee, R., Ghosh, P., Karmakar, S., & Chatterjee, S. (2018). Estimation of plant pigments concentration from tulsi (Ocimum sanctum Linn.): a six months study. *Journal of Pharmacognosy and Phytochemistry*, *7*(4), 2681-2684.
- Biehler, E., Mayer, F., Hoffmann, L., Krause, E., & Bohn, T. (2010). Comparison of 3 spectrophotometric methods for carotenoid determination in frequently consumed fruits and vegetables. *Journal of food science*, *75*(1), C55-C61.
- Bulle, S., Reddyvari, H., Nallanchakravarthula, V., & Vaddi, D. R. (2016). Therapeutic potential of Pterocarpus santalinus L.: an update. *Pharmacognosy reviews*, *10*(19), 43.
- Butnariu, M. (2016). Methods of analysis (extraction, separation, identification and quantification) of carotenoids from natural products. *J. Ecosyst. Ecography*, *6*(2), 1-19.
- Choudhary, A., Noman, M., Bano, U., Yahya, S., Khan, A. A., Akhtar, J., ... & Yar, M. S. (2023). Medicinal and therapeutic properties of Jamun (Syzygium cumini)–A Comprehensive Review. *International Journal of Pharma Professional's Research (IJPPR)*, *14*(2), 15-23.
- Devi, J., & Sharma, R. B. (2023). Medicinal Importance of Azadirachta indica: An Overview. *Journal of Drug Delivery and Therapeutics*, *13*(6), 159-165.
- Dóka, O., Ficzek, G., Luterotti, S., Bicanic, D., Spruijt, R., Buijnsters, J. G., ... & Végvári, G. (2013). Simple and rapid quantification of total carotenoids in lyophilized apricots (Prunus armeniaca L.) by means of reflectance colorimetry and photoacoustic spectroscopy. *Food Technology and Biotechnology*, *51*(4), 453-459.
- Giri, S., Shrivastava, D., Deshmukh, K., & Dubey, P. (2013). Effect of air pollution on chlorophyll content of leaves. *Current Agriculture Research Journal*, *1*(2), 93-98.
- Jan-Chang Chen, Chi Ming Yang shou Tsung Wu, Yuh- Lurng Chung, Albert Linton Charles and Chaur-Tzuhn Chen (2007): Leaf chlorophyll content and surface spectral reflectance of tree species along a terrain gradient in Taiwan's Kenting National Park. Botanical studies,. 48,71-77.
- Jogdande, R. G., Kamble, P. R., Chougule, A., Kamble, J., & Chougule, N. (2024). Pharmacological Activity Of Tridax

Procumbens. *International Journal of Pharmaceutical Sciences*, *2*(01), 1-1.

- Kamble, P. N., Giri, S. P., Mane, R. S., & Tiwana, A. (2015). Estimation of chlorophyll content in young and adult leaves of some selected plants. *Universal journal of environmental research and technology*, *5*(6), 306-310.
- Khamis, W. M., Heflish, A. A., El-Messeiry, S., Behiry, S. I., Al-Askar, A. A., Su, Y., ... & Gaber, M. K. (2023). Swietenia mahagoni leaves extract: Antifungal, insecticidal, and phytochemical analysis. *Separations*, *10*(5), 301.
- Manimegalai, P., Selvam, K., Prakash, P., Kirubakaran, D., Shivakumar, M. S., & SenthilNathan, S. (2023). In-vitro antibacterial, antioxidant and anti-inflammatory and In-silico ADMET, molecular docking study on Hardwickia binata phytocompunds with potential inhibitor of skin cancer protein. *In Silico Pharmacology*, *11*(1), 25.
- Mirza, H., Kamrun N., Md. Mahabub A., 2, Roychowdhury R., Fujita M. (2013): Physiological, Biochemical, and Molecular Mechanisms of Heat Stress Tolerance in Plants. Int. J. Mol. Sci., 14, 9643-9684.
- Nayak, S. K. B. R. K. (2023). Indigenous knowledge and phytochemical analysis of potential medicinal plants of Kuldiha wildlife sanctuary in Odisha, India.
- Porra, R., J., Thompson, W., A., Kriedemann, P., E., (1989): Determination of accurate extinction coefficients and simultaneous equations for assaying chlorophylls a and b extracted with four different solvents: verification of the concentration of chlorophyll standards by atomic absorption spectroscopy. Biochim. Biophys. Acta, , 975, 384-394.
- Prananda, A. T., Dalimunthe, A., Harahap, U., Simanjuntak, Y., Peronika, E., Karosekali, N. E., ... & Nurkolis, F. (2023). Phyllanthus emblica: a comprehensive review of its phytochemical composition and pharmacological properties. *Frontiers in pharmacology*, *14*, 1288618.
- Richardson, A.D., S., P., Duigan, G., P., Berlyn, (2002): An evaluation of noninvasive methods to estimate foliar chlorophyll content. New Phytologist, , 153, 185-194.
- Sahabi, D. M., Shehu, R. A., Saidu, Y., & Abdullahi, A. S. (2012). Screening for total carotenoids and β-carotene in some widely consumed vegetables in Nigeria. *Nigerian Journal of Basic and Applied Sciences*, *20*(3), 225-227.
- Singh, D., Singh B, Goel R. K. (2011): Traditional uses, phytochemistry and pharmacology of Ficus religiosa: a review. J Ethnopharmacol, 134, 3, 565–583.
- Singh, R., Khanam, H., & Pandey, J. (2023). The Biological Properties and Medical Importance of Cassia fistula: A Mini Review. *Chemistry Proceedings*, *14*(1), 95.
- Srichaikul, B., Bunsang, R., Samappito, S., Butkhup S., and Bakker, G., (2011): Comparative study of chlorophyll content in leaves of Thai Morus alba Linn. Species. Plant Science Research, 3, 17-20.