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MACROSCOPIC,BIOCHEMICALS AND PIGMENTS ANALYSIS OF FRESH FLOWER OF FIVE *SOLANUM SPECIES* (*S. LYCOPERSION* L., *S. MELONGENA* L., *S. NIGRUM* L., *S. TORVUM* SW. AND *S. TRILOBATUM* L.) OF SOLANACEAE

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Abstract

The corollas of ***Solanum*** flowers are blue-purple, yellow or white and they stand out against the anthers' brilliant yellow cones. The present study focuses on the biochemicals and pigments analysis of fresh flower of ***Solanum species*** **(*S. lycopersion* L., S. *melongena* L., *S. nigrum* L., *S. torvum* Sw.** and ***S. trilobatum* L.). *Solanum lycopersicum* L.** (Tomato) flower is small, yellow, star shape, aromatic odour, sweet taste, pubescent odour with smooth texture. ***Solanum melongena* L.** (Brinjal) flower is medium size, violet or pale blue, star shape, pungent, bitter taste with smooth texture. ***Solanum nigrum* L.** (Black nightshades) flower is minute, white, star shape, musk odour, sour tasting with smooth texture**. *Solanum torvum* Sw.** (Turkey berry) flower is medium size, pale white, tubular, star shape, pungent, odour, bitter tasting with smooth texture. ***Solanum trilobatum* L.** (Climbing brinjal) flower is a large, violet, star shape, aromatic odour, sour taste with smooth texture. The macroscopic characters such as description of theplant, colour, odour, taste, nature, texture were studiedfor morphological investigation. Preliminary screening result shows that the present of phenolic compounds, tannin, saponins and terpenoids in all five flowers**.** Flavonoids are absent in ***S. lycopersicum, S. melongena***. Resin is absent in ***S. melongena***. Presence of quinone in all flowers. Cartenoids and anthroquinone are absent in ***S. nigrum*** and ***S. torvum***. Anthocyanin is present in ***S. nigrum*** and ***S. torvum***. According to the results of the quantitative pigments analysis, the greatest absorbance peak was visible in the spectra of white flowers at 620 nm, yellow flowers at 570 nm and purple flowers at 490 nm.

Key words: *Solanum species,* Flowers, Morphology, Biochemicals, Pigments, Colorimeter

INTRODUCTION

Solanum is the most economically important largest genus in the Solanaceae family with 1,328 species distributed across the whole world. Flowers from the Solanum genus have corollas that are blue, purple, yellow or white, which contrast with the bright yellow cone of the anthers (Lilian Passarelli and Liliana Bruzzone, 2004). The Solanum genus is distinguished by this morphologic pattern (Cocucci, 1988). ***Solanum lycopersicum* L.** Thakkali in Tamil, Tomato in English, is a pubescent herb with star shaped yellow flowers. ***Solanum melongena* L.** "Kathiri" in Tamil, "Brinjal" in English, is armed annual subshrub having pendent star shaped violet or pale blue flowers. Flower of this plant is edible. ***Solanum nigrum* L.** Manthakallli in Tamil, "Black night shades" in English, is unarmed shrub with star shaped white flowers. ***Solanum torvum* Sw.** "Chundakkai" in Tamil, "Turkey berry" in English is a bushy, broad leaved, evergreen spiny shrub with tubular pale white flowers. Flowers used for cough. Whole plant is used as sedative, diuretic and stomachic (Fig.2.). The juice of the flowers, with salt added, is used as eye drops. Syrup is prepared from flowers used to treat colds. ***Solanum trilobatum* L.** "Thuthuvalai" in Tamil, "Climbing Brinjal" in English, is a thorny creeper with large, star shaped violet flowers. Flowers are used for cough (Gamble, 1935; Matthew, 1983; Mayuranathan, 1929).

Phenolic compounds are responsible for colour and flavouring properties. Flavonoids are secondary metabolites that are very abundant in plants. They comprise the most numerous and varied group of pigments found in angiosperms (Iwashina, 2015). Flavins are one of the flavonoid compounds omnipresent in angiosperms. Terpenoids are the largest group of plant specialized (secondary) metabolites. They are the major components of resin. They are the primary constituents of the essential oils imparting characteristic fragrance. Resin is the primary constituents imparting characteristic fragrance.

The presence and type of pigments play a major role in flower colour. The pigment in the cell sap responsible for petal colour. Some plant species' petals advertise with plain, homogeneous colours, while other plant species' petals display incredibly complex colour patterns. One or more major pigment classes may be collected to produce a distinct colour even in petals or petal portions with uniform colour (Kay *et al.*, 1981; Grotewold, 2006; Davies, 2009). There are certain pigments in flower petals that absorb UV light and create pattern visible to bees. Some flowers even have chlorophyll that gives them green coloring. The color measurement can be used as an indirect way of analyzing the colored components.

MATERIALS AND METHODS

COLLECTION OF PLANT MATERIALS: Fresh flowers of *Solanum lycopersicum* L., *Solanum melongena* L., *Solanum nigrum* L., *Solanum torvum* Sw. and *Solanum trilobatum* **L.** were collected from Chromepet, Chennai, Tamil Nadu, India.

MORPHOLOGICAL STUDY (Bumrela and Naik, 2011**):** Fresh flowers were collected, thoroughly washed to remove impurities present on the surface. The morphological characteristics of flower such as colour, odour, tastes, size, shape and texture analyzed and photographed.

PREPARATION OF EXTRACT: Fresh flowers were collected, thoroughly washed with running tap water to remove soil particles and other impurities present on the surface. Around 10 g of fresh flowers were ground with 100 g of distilled water (1:5 ratio) crushed in Mortar and Pestle. Ground it and filter the extract to remove all non-soluble material. The fresh filtrate used for further research analysis.

PRELIMINARY BIOCHEMICALS SCREENING (Akindahunsi and Salawa, 2005; Khandelwal, 2008; Kokate *et al.*, 2007; Trease and Evans, 1985)

Test for Phenolic compounds ($FeCl_3$ Test): Flower extracts (2 ml) taken and 0.5 ml of 5% ferric chloride added. An intense color ranging from dark green is observed. Indicates the presence of phenolic compound

Test for Flavanoids (NaOH Test): Flower extracts (1 ml) was taken in a test tube and added few drop of dilute NaOH solution. An intense yellow colour appeared in the test tube. It became colourless when on addition of a few drop of dilute acid that indicated the presence of flavonoids.

Test for Tannin (Lead acetate Test): Flower extracts (2 ml) was taken and 0.5 ml of 10% lead acetate solution added and the formation of white precipitate indicates the presence of tannins

Test for Resin - Turbidity test (Pooja and Vidyasagar, 2016): Flower extracts (2 ml) was taken and few ml of acetone added. Gum like appearance indicates the presence of resin.

Test for Saponins (Foam Test): Flower extracts (1 ml) diluted with distilled water to 20 ml and shaken in a graduated cylinder for 15 minutes. Development of stable foam suggests the presence of saponins.

Test for Terpenoids (Salkowski Test) Flower extracts (2 ml) mixed with chloroform (2 ml) and Conc. H_2SO_4 (3 ml) carefully added to form a layer. A reddish brown coloration of the inter face formed to show positive results for the presence of terpenoids.

QUALITATIVE PIGMENTS ANALYSIS

Test for Anthocyanin -HCl Test (Savithramma *et al.*, 2011; Obouayeba *et al.*, 2015): Two ml of extract and add 2ml of 2N HCl. Pink red colour indicate the presence of anthocyanins.

Test for Anthraquinone -Borntrager's Test (Njoku and Obi, 2009; Uma *et al.*, 2017; Gul *et al.*, 2017): Flower extracts (2 ml) was taken into a dry test tube and 5 ml of Chloroform added and shaken for 5 min. The extract filtered and the filtrate shaken with an equal volume of 10% ammonia solution. A pink violet or red colour in the lower layer indicates the presence of anthraquinone.

Test for Carotenoids-H_2SO_4 Test (Tyagi, 2017): Flower extracts (2 ml) and 10ml Chloroform added. Shaken vigorously and filtered. Filtrate and Conc. H_2SO_4 added. Blue colour at the interface indicates the presence of carotenoids.

Test for Quinones - Alcoholic KOH Test (Singh and Kumar, 2017; Kumar *et al.*, 2013): Flower extracts (1ml) and few ml of alcoholic KOH added. Red or blue colour appeared indicate the presence of quinones.

QUANTITATIVE PIGMENTS ANALYSIS (Heredia *et al.*, 1998; Kasajima 2016, 2018a)

The flower and leaf pigments were measured in different regions using a digital colorimeter. The distilled water is used as reference blank and aqueous extracts of flower to study the absorption spectra at different wavelengths ranging from 400-680nm.

RESULTS AND DISCUSSION

Solanum melongena **L.** flower is medium size (1.5 cm), violet or pale blue, star shape, pungent odour, bitter taste with smooth texture. ***Solanum trilobatum*** **L**. flower is a large (2 cm), violet, star shaped, aromatic odour, sour taste with smooth texture. ***Solanum lycoperscum*** **L.** flower is small (1 cm), yellow, star shaped, aromatic odour, sweet taste, pubescent odour with smooth texture. ***Solanum nigrum*** **L.** flower is minute (0.4 cm), white, star shaped, musk odour, sour taste with smooth texture. ***Solanum torvum*** **Sw.** flower is medium size (1.4 cm), pale white, tubular, star shaped, pungent odour, bitter taste, smooth (Fig.1.1-1.5; Table 1).

. Flavonoids are responsible for the color, fragrance and flavor characteristics. Phenolic compounds are responsible for colour and flavouring properties. Polyphenols are secondary metabolites, which then serve as flower pigments, protection from UV light and defence. Tannins are naturally occurring plant polyphenols widely distributed in plants. They are responsible for the astringency, colour and flavor. Saponins are bitter tasting organic chemicals. Terpenes and terpenoids are the major components of resin and primary constituents of the essential oils imparting characteristic fragrance. The result shows that the present of phenolic compounds, tannins saponins and terpenoids in all the five flowers**.** Flavonoids were absent in ***S. lycopersicum*** and ***S. melongena.*** Resin was absent in ***S. melongena*** (Table 2).

Fig.1. FLOWER MORPHOLOGY

1. ***S. melongena*** **2.** ***S. trilobatum*** **3.** ***S. lycopersicum*** **4.** ***S. nigrum*** **5.** ***S. torvum***

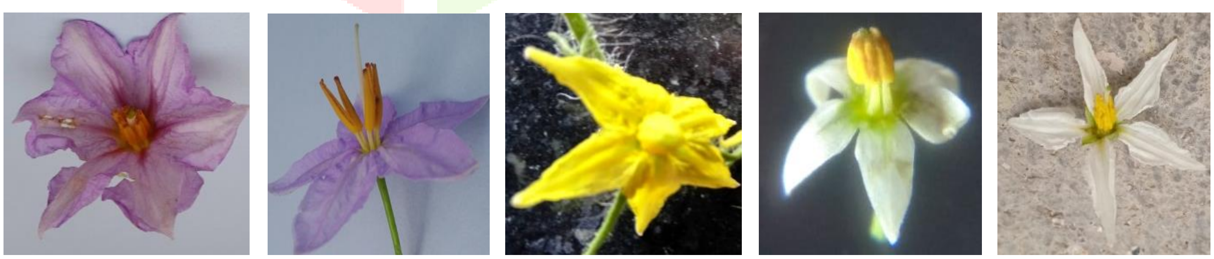


TABLE 1. MORPHOLOGICAL CHARACTERISTICS OF FLOWERS

S. No.	Flower	Organoleptic characteristics					
		Size (cm)	Colour	Shape	Odour	Taste	Texture
1.	*S. melongena*	1.5	Purple	Star	Pungent	Bitter	Smooth
2.	*S. trilobatum*	2.0	Purple	Star	Aromatic	Sour	Smooth
3.	*S. lycopersicum*	1.0	Yellow	Star	Aromatic	Sweet	Smooth, Pubescent
4.	*S. nigrum*	0.4	White	Star	Musk	Sour	Smooth
5.	*S. torvum*	1.4	White	Tubular	Pungent	Bitter	Smooth

TABLE 2. PHYTOCHEMICAL ANALYSIS OF FRESH FLOWER EXTRACTS

S. No.	Phytochemical	*S. lycopersicum*	*S. melongena*	*S. nigrum*	*S. torvum*	*S. trilobatum*
1.	Phenolic compounds	+	+	+	+	+
2.	Tannins	+	+	+	+	+
3.	Flavonoids	-	-	+	+	+
4.	Resin	+	-	+	+	+
5.	Saponins	+	+	+	+	+
6.	Terpenoids	+	+	+	+	+

PIGMENTS ANALYSIS

Chlorophylls, carotenoids, flavonoids and betalains are the four main pigment classes that contribute to the wide variety of floral colours (Lee, 2007; Narbona *et al.*, 2021). Each pigment class has a unique chemical structure, which determines the colour of the flowers and plants it produces (Grotewold, 2006; Glover, 2007; Tanaka and Ohmiya, 2008). According to the EFSA Panel on Dietetic Products, Nutrition and Allergies, they are particularly noticeable in the petals of many types of flowers (2010). In order to reflect the remaining light and the colour it produces, pigments can selectively absorb certain wavelengths of light. Polyphenols include quercetin and catechins serve as flower pigments. Carotenoids are yellow, orange and red pigments to flowers (Grotewold, 2006). They act as a type of antioxidant for humans. The qualitative pigments analysis of aqueous flower extracts shows that the presence of quinone in all flowers. Quinones are ubiquitous biological pigments bright yellow solid with a sharp odour found in a range of living organisms. They are a potent oxidizing agent with a variety of medical applications including as anti-cancer, anti-aging and arteriosclerosis agents. ***S. nigrum*** and ***S. torvum*** lacked cartenoids and anthraquinone (Table 3)**.**

TABLE 3. QUALITATIVE PIGMENTS ANALYSIS OF *SOLANUM* FLOWERS

S.No.	Pigments	*S. lycopersicum*	*S. melongena*	*S. nigrum*	*S. torvum*	*S. trilobatum*
1.	Anthocyanins	-	-	+	+	-
2.	Anthraquinone	-	+	-	-	+
3.	Carotenoids	+	+	-	-	+
4.	Quinone	+	+	+	+	+

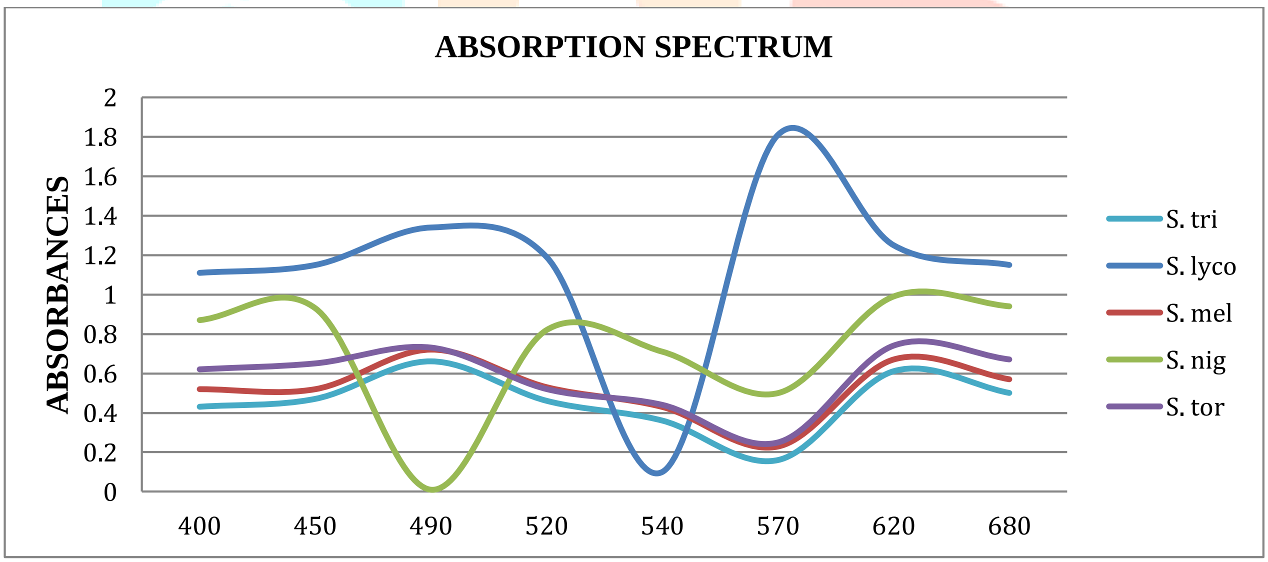
Rutin, quercetin and kaempferol are substances that are white or pale yellow. A pigment is a chemical substance that absorbs visible light between roughly 380 nm (violet) to 760 nm (ruby red). Different wave lengths have different colors: Extremely short waves (<420 nm) light colors; 420-500 nm blue; all short waves (<440 nm) blue; 500-580 nm green; 580-660 nm red; all long waves (>640 nm) red; extremely long waves (>660 nm) light colors. Color of each wave length is strictly defined by the mixture of standard red, green and blue (RGB) lights. In order to reflect the remaining light and the colour it produces, pigments can selectively absorb certain wavelengths of light. Pigments are helpful to plants because they interact with light to absorb just specific wavelengths. There are numerous established connections between chemical elements and reflectance in the visible spectrum (Curran, 1989; Baccia *et. al.*, 1998). The absence or decrease in anthocyanidin content is associated with the colour of white flowers. Flavones (Luteolin) and/or flavonols (Quercetin) pigment is present in white flowers. The spectrum of the white flowers showed a maximum absorbance peak at 620 nm in ***S. nigrum*** and ***S. torvum***. Flavonoids and flavonols are typically yellow or ivory-coloured pigments. Yellow-orange colouring results from carotenoids' predominant absorption in the blue zone. Xanthophylls are yellow pigments. They are a class of oxygen-containing carotenoid pigments absorbs well at 400–530nm. They has functional ingredient has role in preventing chronic and degenerative diseases due to their, anti-oxidant, anti-inflammatory, anti-cancer, hypoglycemic activities (Hamid, 2010; Yao and Jiang, 1997). In ***S. lycopersion***, the yellow flower's spectrum displayed a highest absorbance peak at 570 nm. Important classes of flavonoids include aurones and chalcones, which absorb in the blue region, as well as flavonols, flavones and flavanones, which absorb in the UV spectrum (Harborne, 1984). The red and blue colours primarily come from them. The red, blue, pink and purple pigments that give flowers their most variegated coloration are caused by flavins. Flavonoid pigments called anthocyanins are water-soluble. According to Castaeda-Ovando *et al*. (2009), there are six of them that are more prevalent in angiosperms: cyanidin (pink colorations), delphinidin (blue), pelargonidin (orange-red), peonidin (red), petunidin (purple) and malvidin (blue). Both ***S. nigrum*** and ***S. torvum*** included them. They take up energy from various wavelengths in the green section of the spectrum and generate. Both ***S. nigrum*** and ***S. torvum*** included them. They absorb in various green wavelengths, creating various floral colour tones in blue, pink, orange and red

(Grotewold, 2006). In S. melongena and S. trilobatum, the purple flowers' spectra displayed a highest absorbance peak at 490 nm (Table 4; Fig. 2).

TABLE 4. COLORIMETRIC PIGMENT ANALYSIS OF *SOLANUM* FLOWER

S. No.	Wave lengths	ABSORBANCES				
		S. lycopersion	*S. melongena*	*S. nigrum*	*S. torvum*	*S. trilobatum*
1.	400nm	1.11	0.52	0.87	0.62	0.43
2.	450nm	1.15	0.52	0.93	0.65	0.47
3.	490nm	1.34	0.72	0.01	0.73	0.66
4.	520 nm	1.19	0.53	0.82	0.52	0.46
5.	540 nm	0.10	0.43	0.71	0.44	0.36
6.	570nm	1.81	0.23	0.50	0.25	0.16
7.	620 nm	1.25	0.67	0.99	0.74	0.61
8.	680nm	1.15	0.57	0.94	0.67	0.50

Fig.2. ABSORPTION SPECTRUM OF PIGMENTS OF *SOLANUM* FLOWERS



WAVE LENGTH (nm)

REFERENCES

Akindahunsi, A. A. and Salawa, 2005. Phytochemical Screening and nutrient composition of selected tropical green leafy vegetables. Afr. J. Biotech 4:497-501.

Baccia L., M. De Vincenzic, B. Rapib, B. Arcac and F. Benincasac, 1998. Two methods for the analysis of colorimetric components applied to plant stress monitoring. Computers and Electronics in Agriculture; vol. 19 (2), P.167-186.

Bumrela, S. B. and S. R. Naik, 2011. Phytochemical and Morphological studies for establishing quality standard. Int. J. Pharm. Biomed. Res., 21:98-103.

Castaneda-Ovando, A., M. de Lourdes Pacheco-Hernandez, M.E. Paez-Hernandez, J.A. Rodriguez and C. A. Galan-Vidal, 2009. Chemical studies of anthocyanins: A review. Food Chem., 113: 859-871.

Cocucci, A. A., 1988. Polinización en Solanáceas Neotropicales. - Doct. Thesis, Córdoba: Universidad Nacional de Córdoba, Argentina.Grotewold E. 2006. The genetics and biochemistry of floral pigments. Annual Review of Plant Biology 57: 761–780.

Curran P.J., 1989. Remote sensing of foliar chemistry. Remote Sensing of Environment 30: 271–278.

Davies, K. M., 2009. "Modifying anthocyanin production in flowers," in *Anthocyanins*, ed. K. S. Gould, K. M. Davies and C. Winefield (New York, NY: Springer), 49–83.

EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2010. Scientific Opinion on Dietary Reference Values for carbohydrates and dietary fibre. *EFSA Journal* 2010; 8(3):1462, 77 pp. 10.2903/j.efsa.2010.1462.

Gamble J. S., 1935. The Flora of Presidency of Madras. Adlard and son, Ltd. London.

Gul R., Jan S. U., Syed F., Sherani F. and Nusrat Jahan, 2017. Preliminary Phytochemical Screening, Quantitative Analysis of Alkaloids and Antioxidant Activity of Crude Plant Extracts from *Ephedra intermedia* Indigenous to Balochistan. The Scientific World Journal, 1-7.

Harborne J. B., 1984. Phytochemical Methods. A guide to modern techniques of plant *analysis.* London, UK: Chapman & Hall.

Heredia, F. J., Francia-Aricha, E. M., Rivas-Gonzalo, J. C., Vicario, I. M. and C. Santos-Buelga, 1998. Chromatic characterization of anthocyanins from red grap- I. PH effect. Food Chemistry 63: 491-498

Iwashina T., 2015. Contribution to flower colors of flavonoids including anthocyanins: A review. Nat. Prod. Commun. 10, 529–544.

Kasajima I., 2016. Alexandrite-like effect in purple flowers analyzed with newly devised round RGB diagram. Sci. Rep. 6, 29630.

Kasajima I., 2018a. Plant colorimetry. Plant Technol Rep (Shokubutsu Gijutsu Kenkyu Ho) 1: 5–18 (in Japanese)

Kay Q. O. N., Daoud, H. S. and C. H. Stirton, 1981. Pigment distribution, light reflection and cell structure in petals. *Bot. J. Linn. Soc.* 83, 57–83.

Khandelwal K. R., 2008. Practical Pharmacognocy. NiraliPrakashan, Pune, edition.

Kokate C. K, Purohit A. P. and S. B. Gokhale, 2001. Carbohydrate and derived Products, drugs containing glycosides, drugs containing tannins, lipids and protein alkaloids. *Text book of Pharmacognosy*, 7, Ed: 133 -166, 167- 254, 255-2 69, 272-310, 428-52 3.

Kumar R. S., Venkateshwar C, Samuel G. and S. G. Rao, 2013. Phytochemical Screening of some compounds from plant leaf extracts of *Holoptelea integrifolia* (Planch.) and *Celestrus emarginata* (Grah.) used by Gondu tribes at Adilabad District, Andhrapradesh, India. International Journal of Engineering Science Invention. 2(8):65-70.

Lee, D., 2007. Nature's palette: the science of plant color. University of Chicago Press, Chicago, USA.

Lilian Passarelli and Liliana Bruzzone, 2004. Significance of floral colour and scent in three Solanum sect. Cyphomandropsis species (Solanaceae) with different floral rewards. Australian Journal of Botany; 52(5) 659-667.

Matthew K. M., 1983. The Flora of the Tamil Nadu Carnatic, Vol. I-III. The Rapinat Herbarium, St Joseph's College, Tiruchirapalli, India.

Mayuranathan P. V., 1929. The flowering plants of Madras City and Immediate Neighbourhood. Bull; Madras Govt. Mus. N. S. 2:1-345, tt. 1-38. Glover, B., 2007. Understanding flowers and flowering: an integrated approach. New York, NY: Oxford University Press.

Narbona E., Del Valle, J. C. and J. B. Whittall, 2021. Painting the green canvas: how pigments produce flower colours. *Biochemistry* 43, 6–12.
Njoku O.V. and C. Obi, 2009. Phytochemical constituents of some selected medicinal plants. African Journal of Pure and Applied Chemistry; 3(11):228-233.

Obouayeba A. P., Diarrassouba M., Soumahin E.F. and T. H. Kouakou, 2015. Phytochemical Analysis, Purification and Identification of Hibiscus Anthocyanins. Journal of Pharmaceutical, Chemical and Biological Sciences; 3(2):156-168.

Singh V. and R. Kumar, 2017. Study of Phytochemical Analysis and Antioxidant Activity of *Allium sativum* of Bundelkhand Region. International Journal of Life Sciences Scientific Research; 3(6):1451-1458.

Tanaka Y. and A. Ohmiya, 2008. Seeing is believing: Engineering anrhocyanin and carotenoid biosynthetic pathways. Curr. Opin. Biotechnol., in press.

Tanaka Y., Sasaki, N. and A. Ohmiya, 2008. Biosynthesis of plant pigments: anthocyanins, betalains and carotenoids. *Plant J.* 54, 733–749.

Treare G. E. and W. C., Evans, 1985. Pharmacognosy, Ed.17, Bahiv Tinal, London. P.149.

Tyagi T., 2017. Phytochemical Screening of Active Metabolites Present in *Eichhornia Crassipes* (Mart.) Solms and *Pistia stratiotes* (L.): Role in Ethanomedicine. Asian Journal of Pharmaceutical Education and Research; 6(4):40-56.

Pooja S and G. M. Vidyasagar, 2016. Phytochemical screening for secondary metabolites of *Opuntia dillenii* Haw. Journal of Medicinal Plants Studies; 4(5):39-43.

Savithramma N. Rao M. L. and D. Suhrulatha, 2011. Screening of Medicinal Plants for Secondary Metabolites. Middle-East Journal of Scientific Research; 8(3):579-584.

Uma K. S., Parthiban P and S. Kalpana, 2017. Pharmacognostical and Preliminary Phytochemical Screening of Aavaarai Vidhai Chooranam. Asian Journal of Pharmaceutical and Clinical Research; 10(10):111-116.

https://www.frontiersin.org.

www.slideshare.net.

http://www.edwardmaxwell.com.

https://en.wikipedia.org/wiki?curid=57374888