ORIGINAL RESEARCH PAPER

Volume-8 | Issue-8 | August - 2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EVALUATION OF PIGMENTS FROM CYMBOPOGON CITRATUS (LEMON GRASS)

Biological Science

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ABSTRACT

Colour is a visual perception which helps in judging the subjective quality of product. (Thorat PP, Sawate AR, Patil BM and Kshirsagar RB). Chlorophyll is a green photosynthetic pigment which helps plants to get energy from light. (Thorat PP, Sawate AR, Patil BM and Kshirsagar RB). Pigment system in plants maintains the activity of trapping electrons from a ray of light produced by the sun. These electrons of a particular spectrum are trapped and processed through a photosystem in plants. Hence, various metabolism relies on the pigment system which support plant for regulation of atmospheric balance.

The quality of plant leaf and the balance of nutrient contents in plants is majorly due to a pigment system. Various research had proven the importance of the pigments. For example: Xanthophyll cycle−related thermal dissipation in the PSII antennae was enhanced significantly in senescent leaves, which may protect the photosynthetic apparatus from photoinhibitory damage in senescent leaves when exposed to high light.(Congming Lu Qingtao Lu Jianhua Zhang Tingyun Kuang).

The present research attempt is made to visualize amount of plant pigments present in *Cymbopogon citratus* by a spectrophotometer analysis. The research concludes an ample amount of pigments such as Chlorophyll-a, Chlorophyll-b, Xanthophyll and carotene in *Cymbopogon citratus* (Lemon grass). The importance of a pigment system in terms of an application before its use for manufacturing of any commercial products has been concluded by an experimental research methodology.

KEYWORDS

Cymbopogon citratus, pigment system, essential oil.

INTRODUCTION

Cymbopogon genus is a member of the family of Graminae which are herbs known worldwide for their high essential content. (Opeyemi Avoseh, Opeoluwa Oyedeji et.al.). This genus is cultivated for more of its volatile components. Due to its efficiency of wide range of characteristics and feasibility in cultivation, this genus easily captures commercial industry for essential oil production.

Plant photosystem is a regulatory function that allows an execution of rays of sun in the atmosphere. These electrons captured by the photosystem of plant maintains a balance in environment. Plant pigments ideally deals with the active functioning of photosystem regulatory activity. The quality of product of all volatile and bioactive compounds depend on the plant pigment system. The amount of essential nutritional absorption leads a healthy metabolic rate in plants. Some research papers focused on pigment system signifies a condition such as stress, drought and senescence which directly marks the amount of plant pigments present in plant parts. Plant pigments, such as Chlorophyll-a and Chlorophyll-b, carotenoids, anthocyanin, and a range of accessory pigments, play a vital role in the earth's biosphere and in sustaining life on the planet, through the light-harvesting reactions of photosynthesis, stress avoidance, and defence. (H. Croft and J. M. Chen). Chlorophyll molecules are magnesium-tetrapyrrole pigments that give plants, algae, and cyanobacteria their characteristic green colour, and are the primary pigments used in plant photosynthesis (Kiang et. al.). Chlorophyll molecules facilitate the conversion of absorbed solar radiation into stored chemical energy, through harvesting light energy, transferring excitation energy to reaction centres, and driving charge separation in the reaction centres (Chen M.).

Carotenoids are water-repelling pigments that are synthesized in the plastids of plant cells, and have both photosynthetic and photo protective roles in leaves (Demmig-Adams and Adams W.W.). While, the xanthophyll cycle allows the leaf to divert energy away from photosynthesis when light is in excess, but not when it is limiting, thereby optimizing the capture of energy within the biological process. (H. Croft and J.M. Chen.).

The present research attempt is made for successful evaluation of plant pigments such as Chlorophyll-a, Chlorophyll-b, Xanthophyll and Carotene from *Cymbopogon citratus* (Lemon grass) by a Spectrophotometer analysis.

MATERIAL AND METHOD

Fresh *Cymbopogon citratus* (lemon grass) leaves of 1 gram was grinded thoroughly in mortar and pestle with 10 ml of 80% acetone. Extract filtered and 30 ml of petroleum ether mixed thoroughly with further addition of 35 ml of distilled water. The mixture was allowed to separate in a separator. From among the two layers, lower layer of acetone-distilled water was discarded; while an upper layer of petroleum ether was further mixed thoroughly with 25 ml of methanol. The two solutions were allowed to be separated in a separator itself. The solution in a separator with petroleum ether contained Chlorophyll-b and Carotenoids while a methanol solution contained a pigment molecules of Chlorophyll-a and Xanthophyll. These two layers were separated and collected in two separate beakers. To a solution of petroleum ether 30 ml of methanolic KOH and 15 ml of distilled water was mixed properly. The solution allowed to stand still for the separation of individual layer of pigments. A 25 ml of diethyl ether and 25 ml of distilled water was mixed thoroughly to a methanol solution; which kept to stand still for separation of individual layer of the pigments.

All layers were separately collected with further analysis by spectrophotometer. Samples were measured in a triplet.

RESULTS AND DISCUSSION

The readings analysed by a spectrophotometer for pigment system of *Cymbopogon citratus* (Lemon grass) is shown in ***Table 1.1***; while its graphical representation is expressed in ***Figure 1.1***.

Sr.no.	Pigment	Wave length (nm)	Absorbance
1	Chlorophyll- a	663.2	0.38
		646.8	0.29
		470	0.38
2	Chlorophyll –b	663.2	0.08
		646.8	0.10
		470	0.12
3	Xanthophyll	470	0.13
4	Carotene	470	0.35

Table1.1

Since, 80% acetone was used for the separation of pigment system the protocol for calculation with reference to the content from 'Chlorophylls and Carotenoids: Measurement Unit F 4.3 and Characterization by UV-VIS Spectroscopy'- Contributed by "Hartmut K. Lichtenthaler and Claus Buschmann" (2001). is as given below

Acetone with 20% (v/v) water,

- C_a (µg/ml):$12.25*A_{663.2} - 2.79*A_{646.8}$
- C_b (µg/ml):$21.50*A_{646.8} - 5.10*A_{663.2}$
- C_{x+c}(µg/ml) :$(1000*A_{470} - 1.82*C_a - 85.02*C_b) / 198$

C_a is *Chl. -a* C_b *is Chl. - b* and C_{x+c} is the total carotenoid (xanthophyll and carotene) pigment present in plant leaves. However, the total carotenoid content for A_{470} is given by a formula as;

$A_{470}=A_{(x+c)470}+A_{(a)470}+A_{(b)470}$.

Based on above mentioned formula, the amount of Chlorophyll–a found to be 384 mg/m^3 of fresh weight of a leaf, Chlorophyll – b found to be 174 mg/m^3 of fresh weight of a leaf. While total carotenoid pigment C_{x+c} was found to be 416 mg/m^3 of fresh weight of leaf. Hence, a total; chlorophyll a+b = 558 mg/m^3, with a value of Chlorophyll a/b = 2.20 mg/m^3. The statistical presentation of mg/m^3 in terms of percentage is shown in **figure 1.2.**

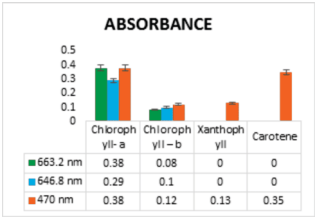

Figure 1.1

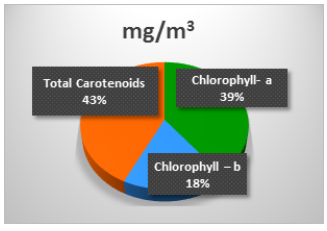

Figure 1.2

The results from **Figure 1.2;** show a greater amount of total carotenoids than Chlorophyll–a and Chlorophyll–b. The statistical record of mg/m^3 is expressed in terms of percentage pigments achieved. The ratio of Chlorophyll–a is higher than Chlorophyll–b for all wavelengths of light as presented graphically in **Figure1.1.**

PHOTOPLATE

CONCLUSION

The present study edifies successful quantification of pigment system. The value of sum of a Chlorophyll content 558 mg/m^3 specifies the type of leaf to be a dark green in colour. The value of Chlorophyll a/b = 2.20mg/m^3 verifies the plant leaf to be in a healthy condition as specified from the reference table for plants disclosed by an author "Hartmut K. Lichtenthaler and Claus Buschmann (2001)".

The present research concludes the quality of a leaf liable for worthy amount of production of Essential oil and also for a study of beneficial characteristics as per the bioactive compounds available in it. *Cymbopogon citratus* (Lemon grass) a successful plant species known for its wide range of capabilities may be effectively brought into practice based on the amount of pigment system before proceeding for manufacturing of any commercial products.

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