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Extraction and characterization of *Butea monosperma* (Lam.) Kuntze flower petals dye for its uses in the colouration of food, pharmaceutical and textile industries

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Abstract
Natural dyes are emerging globally as eco-friendly synthetic colourant. In present study has been made to extract the natural dye from the fresh, shade dried field dropped and sunlight dried flowers petals of *Butea monosperma* (Lam) Kuntze *(Palash)*. Good quantity of crude dye was extracted from dried flower petals of *Palash*. The flowers compounds were analysed and identified as chalcone, butein, orange yellow needles and flavanone, butein and its glycoside butrin. The crude flower petals dye after further purification and refining has tremendous scope as a medicine and can also serve as colouring material in soft drinks and other food products like jam, chow mein, noodles, sausage, etc. Natural dye from the flower petals of *Palash* and its probable application in the field of textile, food items and pharmaceutical industry. Flowers petal dye has got tremendous potential as a colouring material in soft drinks and other food products.

Keywords: *butea monosperma*, flower petals dye food, pharmaceutical, textile industry

1. Introduction
Butea monosperma (Lam.) Kuntze plants [1, 2] belongs to the family- Papilonaceae and Fabaceae, is commonly called as *Palash, Dhak, Tesu* or *Flame of The Forest.* It is a native of India and South Asia and spread other countries like Indonesia, Nepal, Thailand, Cambodia, Japan, Laos, Myanmar, Sri Lanka, Vietnam and China. The natural dyes are known for their uses in the colouring of food substrate, leather, wood, natural fibres like wool, silk, cotton and flax since ancient times [3, 4]. Natural dyes may have a wide range of shades and can be obtained from various plant parts like root, bark, leaves, fruit and flowers [5]. Since the advent of the widely available and cheaper synthetic dyes in 1856 having moderate to excellent colour fastness properties. The uses of natural dyes having poor to moderate wash and light fastness has declined to a great extent. However, recently there has been revival of the growing interest on the application of natural dyes on natural fibres due to worldwide environmental problems [6]. Plant is used for timber, resin, fodder, medicine and dye, it is also a host to the lac insect which produces resin and natural lacquer.

Plant is commonly found in all over India. It is a small to medium sized deciduous tree upto 5-15m tall upto 43cm diameter. Flower is bright reddish yellow in colour, blooms in huge quantity in summer season. Flowers on necked branches appear like Flame of Fire from a distance. Each flower is 2-4cm in diameter and petals of these flowers are great source of natural dye, which can be used as medicine and food constituent. Medicinal uses of the flowers are well documented in Indian medicinal plants [7]. Thus dye obtained from *Palash* flower is used as medicine or ingredient for other medicine. It is usually edible and may found its usage in soft drinks, beverages and other food products. India export of natural colour and dyes in 1995 at value Rs. 21.8 million and imported worth Rs. 23.7 millions [8]. Thus a very big foreign market exists for natural colour and dyes. The present investigation mainly deals with the extraction and characterization of natural dye from the flowers petals of *Butea monosperma* (Lam.) Kuntze *(Palash)* and its probable applications in the field of textile, food and pharmaceuticals industry.

2. Materials and Methods
Butea monosperma (Lam.) Kuntze *(Palash)* flowers were collected from Shahjahan Garden, Agra and Goverdhan, Mathura (U.P.). Flowers were identified at Department of Botany, S.L.S., Khandari Campus, Dr. B. R. Ambedkar University, Agra and Department of Botany, B.S.A. College, Mathura. Flowers petals were taken for the extraction and characterization of natural dye. The flowers petals were collected for the experiment in the following ways:

1. **Flowers on fresh weight basis:** The flowers petals were weighed after green portion of the fresh flowers was removed. For experiment the weighed petals were used for the extraction of *Palash* dye.
2. **Flowers on shade dried basis:** Fresh flowers were collected from trees and green portion of the flowers removed. Flowers petals were dried under shade conditions. Weight of dried flower petals was recorded after keeping the same in shaded place for a week. The dried flower petals were used for the extraction of dye.
3. **Flowers on field dried basis:** Flowers which were naturally dropped from the tree and dried in the sunlight. The dried flower petals were collected and used for the extraction of dyes.

Removal of Impurities

The impurities from the flower petals were removed before extraction of dye. A non-polar solvent Hexane was used for the removal of large amount of unwanted fat and chlorophyll from the flowers by keeping the flower petals completely dipped overnight in Hexane.

Extraction Techniques

Butea monosperma (Lam.) Kuntze *(Palash)* dye was extracted from the flowers petals which was performed by using two extraction methods as described follows:

i) Cold Solvent Percolation Method

Flower petals were weighed and taken in a beaker then continuously shaken with colds ethanol at room temperature by Cold Percolation Method after allowing these petals to be soaked in ethanol solvent for 2 hrs. The extracted material was removed and again added fresh solvent. This process of extraction remains continued till all the colour was extracted from the flower petals. All the extracted material was collected and subjected to concentration by distilling off the extra solvent from the material under vacuum at ambient temperature (27^0C).

ii) Soxhlet Method

The flower petals were taken in a semi permeable thimble and are flushed with a suitable warm ethanol solvent. The ethanol was used as a solvent medium for the extraction of *Palash* dye. Every percolation of the solvent was takes colouring material down in the round bottom flask. Soxhlet technique is very useful for thermally stable compound of flower petal dye. The colour extracts were collected and concentrated at under ambient temperature (27^0C) and under vacuum.

3. Results and Discussion

Yield of *Butea monosperma* (Lam.) Kuntze *(Palash)* dye obtained in all three different ways varied greatly under both Soxhlet and Cold Percolation Methods. The difference in colour shade of dye yield was also observed while followed two methods of the extraction. The percent yield of *Palash* dye (w/w) and percentage of dye count was obtained through two extraction techniques which were applied on three different ways of the collecting flowers petals.

Dye from fresh flowers

Cold Percolation and Soxhlet Method was used for the extraction techniques of dyes. Yield of dye was 4% and 2% respectively whereas dye content recorded was 85% and 75% respectively. The yield and dye content was obtained through extraction using Cold Percolation Method was higher than Soxhlet Method. Yield and dye content were recorded in flowers on fresh weight basis was comparatively lower which might be due to the reason that more than 75% moisture was present in the fresh flowers.

Dye from shade dried flowers

Shade dried flower petals were subjected in Cold Percolation Method and Soxhlet Method of extraction techniques. Yields of crude orange colour dye obtained through above method was recorded 18% and 12% respectively, whereas the dye content recorded was 80% and 65% respectively. The yield percent quality of colour shade and dye content of *Palash* dye was better in Cold Percolation Method than one which was obtained through Soxhlet Method. Final percent yields for both the extraction techniques were good in flowers dried under shade basis. The reason for higher yield and dye content of dye obtained in flowers on shade dried basis was probably due to the moisture present in the flowers petals was optimally reduced during drying and also the drying took place in the absence of direct sunlight which ultimately help to retain natural colour pigment of flowers and thus better yield of dye is obtained from *Butea monosperma* (Lam.) Kuntze *(Palash)* flower petals.

Dye from field dried flowers

Field dried flower petals were separated, weighed and subjected to Cold Percolation and Soxhlet Method for extraction techniques. Field recorded in above methods were 9% and 4% respectively, whereas dye content recorded was 40% and 30% respectively. Present yield quality of colour shade and dye content obtained by Cold Percolation Method was better than obtained through Soxhlet Method. Total yield comparing was found low in both the methods of extraction for flowers collected from field dried basis. The most obvious reason for decrease in the yield and dye content was exposure of the flowers to the direct sunlight and heat which might have caused the degradation of colour compounds in the flower petals.

It was observed that the Cold Percolation Method of extraction gave higher yield and dye content for the flowers collected in the three different methods. Shade of natural dye obtained through above method was orange in colour. Yield and dye content both were reduced considerably when Soxhlet Method of extraction was applied to extract *Palash* dye from flowers collected in all the three methods. There was also a marked difference in colour shade and dye content of *Palash* dye when Soxhlet Method was used as extraction technique. It could be concluded that the extraction of *Palash* dye obtained through the combination of flowers petals dried shade and use of Cold Percolation Method not only gave higher yield but also produced natural colour.

Characterization and Identification of Natural Dye

Palash flower petals extract was obtained after concentration, it is necessary to obtain the desired compounds or material in the pure form. In solvent partition step the flowers extract was acquified and subjected to Liquid-Liquid extraction in a separating funnel starting from low polar solvents as: hexane, chloroform, ethyl acetate and *n*-butyl alcohol. Thin layer chromatography (TLC) of each separated fraction gave the number of compounds present in the flowers extract.

Separated flower compounds were studied for their physical constants like melting points. UV and IR Spectra provided information regarding the colour intensity and functional groups of the compounds. Finally GC-MS provided the molecular mass of each separated compounds. The compounds present in the flowers were identified through above spectral means as: chalcone, butein ($C_{15}H_{12}O_5$) an orange yellow needles having m.p. 213-215^{0}C. It was obtained as yellow amorphous powder, yield 210mg, *R*f 0.63 in

chloroform-benzene-methanol (15:2:3), red colour with aqueous sodium hydroxide indicated the presence of chalcone aglycone.

The UV (MeOH), 235, 274 and 372 nm; IR (KBr/cm^{-1}) 3389 (Chelated –OH group) 2372, 1596, 768 (phenolic –OH group) 1642cm^{-1}. The C>C=0 of chalcones; ^{1}H NMR at 6.28 to 7.65 (aromatic protons), 4.904 to 5.312. The molecular ion peak appeared at m/z 274. It also showed the mass peaks at 254 (M -OH), 227 (256, >C=0), 213 (227 –CH_2) for the confirmation of structure. The small quantities of colourless isomeric flavanone like butin ($C_{15}H_{12}O_5$), m.p. 223-225^{0}C and its glycoside, butrin were also obtained. Results obtained are in full conformily with literature reported earlier on characterization of dye [9, 10]. For identification of some new compounds were reported few novel compounds from *Butea monosperma* (Lam.) Kuntze plant [11]. Similar findings were reported by some other scientist with their medicinal properties [12, 13].

4. Conclusion

Many countries have restricted the uses of synthetic dye or colour in their food products because it is unsafe for human health and environment. India has a great opportunity for the export of natural dye to its plant wealth and rich traditional knowledge of using the colour as dyes. The development of an economically viable and suitable work to promote the uses of natural dyes will be accompanied by this effort. There is a particular need for the development of natural dye world wide as its uses in favour of human health and environment. *Butea monosperma* (Lam.) Kuntze *(Palash)* flower petals dye has got tremendous potential as a colouring material on soft drinks and other food products like sausage, jam, chow mein, noodles, etc. This dye has got hidden tremendous medicinal properties as antistress, antibacterial effect and in fever. Isolation an characterization of novel bioactive compounds may lead into the development of new drug or for the preparation of new drug with better efficacy and low side effects in the pharmaceuticals areas. *Palash* dye was also uses in textile industry for colouring of cotton thread, silk and rayon.

5. References

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