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ORIGINAL ARTICLE

Commercial Value of Locally Available Plants with Potential For Use as A Natural Dye

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ABSTRACT

Many locally available plants are reservoirs of compounds that are of commercial and medical importance. Several phytochemicals with possible or well-known biological activity have been recognized from a variety of plants. These compounds can also have potential applications in various industrial fields. The plants around us are also repositories of such industrially and medicinally important compounds. In the present work, efforts were made to extract natural dyes from the plants Clitoria ternetea and Caesalpinia pulcherrima, belonging to the family Fabaceae. Natural dyes are now-a-days gaining importance in the as the raw materials are cheap and readily available unlike their synthetic counterparts. Also, synthetic dyes contain a number of hazardous chemicals which pose serious harm to human health. Exposure to large doses of these substances can be highly toxic and can have severe effects in the human body .The manufacture of synthetic dyes have also reported to cause several kinds of pollution, mainly water pollution as the untreated dye effluents are discharged directly into the nearby water bodies. In the present study, the dye extracted via aqueous extraction method were mixed with three mordants(i.e. Copper Sulphate, Ferrous Sulphate and Potassium Dichromate) and applied onto the scoured cotton cloth. Both the dyes gave varying hues when mixed with different mordants. The analysis of the extracted dyes revealed the presence of anthocyanins and flavonoids in them. The phytochemical analysis of the aqueous extracts of these plants also reveals the presence of many important secondary metabolites such as phenols,tannins, terpenoids.

Keywords: Natural Dyes, Fabaceae, *C.ternetea, C.pucherrima*, phytochemistry

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INTRODUCTION

Many locally available plants are been used since prehistoric times owing to their medicinal and commercial properties. These plants possess various secondary metabolites/phytochemicals that function for defense against insects, fungi, diseases and herbivorous mammals and also are of medicinal importance [1]. In addition to the medicinal properties, several plants have industrial applications also. One such application is the extraction of natural dyes from floral parts.In the modern times, there has been excessive usage of synthetic dyes worldwide in various industries. But, it is known to pose huge threats to human and environmental health [2,3]. Few synthetic dyes contain heavy metals like mercury, lead and chromium. Exposure to large doses of these substances can be highly toxic and can have severe effects in the human body. Also such indiscriminate use of synthetic dyes has a negative impact on the environment. The untreated dye effluents from the textile industries are usually dumped directly on water bodies. Hence it is better to resort to natural compounds for the dyeing of clothes and other materials. Natural dyes are derived from the plants, invertebrates or minerals. Because of their derivation from natural resources dyes are usually received as harmless and safe for the environment.

The present works deals with the extraction of natural dyes from flowers of *Clitoria ternetea and Caesalpenia pulcherrima* and the phytochemical analysis of their leaf extracts. *Caesalpinia pulcherrima*

and Clitoria ternatea of the pea family are grown usually as an ornamental plant. But these plants are also used in food and medicine in other parts of the world.

MATERIALS AND METHODS

Collection of plant material

The plant materialof *Caesalpinia pulcherrima* and *Clitoria ternetea (*Fig.1)were collected from the nearby locality. The fresh flowers were used for dye extraction. The leaves were shade dried for a week and then ground to a fine powder.

Extraction of dye from the flowers of *Clitoria ternetea and Ceasalpinia pulcherrima*

The extraction of colour dye was carried out by aqueous extraction method. 10 g fresh petals of both plants were separately boiled in 100 ml distilled water at 100^0 C for 30 minutes. The decolorized petals were taken out from extraction solvent and stored.

Identification of the chemical constituents

The identification of the chemical constituents in the extracted dye was done using the Shimadzu UV-VIS-NIR Spectrophotometer. The Wavelength of the dyes was measured and the compounds present were interpreted.

Scouring of cotton cloth

Cotton clothes used for dyeing were boiled in 10 % NaOH solution for 10 min to remove starch and other impurities from the cloth. The NaOH treated cotton clothes were then thoroughly washed with cold distilled water.

Dyeing and Mordanting

The clean scoured cotton cloths were subjected to dyeing via Simultaneous mordanting technique. 2% solution of the selected mordants i.e. Copper sulphate, ferrous sulphate and Potassium dichromate were used for this study. In simultaneous mordanting, the fabric was treated with dye-mordant mixtures having equal amounts of dye and mordant. The dyeing process was kept in a water bath for about 3 hours.The dyed fabrics were then washed in cold distilled water and dried at room temperature.

Preparation of leaf extracts &Phytochemical Screening

The leaf extracts were prepared using the simple extraction method.1g each of the powders were dissolved in 10ml of distilled water and was kept for overnight incubation.After 24h the mixtures were centrifuged and the supernatant was collected and stored as plantextracts.The phytochemical screening was performed on the distilled water extracts of both plants according to the standard procedures described by Sofowora [4], Trease & Evans [5] and Harborne [6]. The tests for proteins, carbohydrates, phenols, tannins, saponins, flavonoids, alkaloids, reducing sugar, glycosides and triterpenes were conducted.

RESULTS AND DISCUSSION

Extraction of dye

Natural dye extracted from the flowers of *Caesalpinia pulcherrima and Clitoria ternetea*. A reddish dye was obtained from the flowers of *C.pulcherrima*, while a violet coloured dye was obtained from *C.ternetea* (Fig.2).

Identification of the Chemical Constituents of the Dye

The obtained dye extracts of *C.pulcherrima and C.ternatea* were analysed using UV-VIS-NIR spectrophotometer. The peaks were observed in the range 400-500nm and 600-800nm(Table.1) The peak obtained in the range of 390 -500nm represents the spectral range of flavonoids while, the peak between 600-800nm represents the spectral range of anthocyanins.

Hence it was inferred that *C..pulcherrima and C. ternetea* dyes contained flavonoids as well as anthocyanin content in them.Anthocyanins are generally accepted as the largest and most important group of water soluble pigments in nature [7]. They are responsible for the blue, purple, red and orange hues of many fruits, flowers and vegetables. Anthocyanins also are known to have an antioxidant role in plants against reactive oxygen species produced due to stresses such as overexposure to ultraviolet light [8] and extreme temperatures. Some research articles refer to anthocyanins as a medicinally important component. Articles suggest the role of anthocyanins in cancer prevention.. Flavonoids are the most important plant pigments for flower coloration, producing yellow or red/blue hues n in petals.These compounds are involved in symbiotic nitrogen fixation in higher plants.

Dyeing of Cotton Fabrics

The cotton fabric which was mordanted and dyed with the *C.pulcherrima* dye gave light shades of colours (Fig.3). Since, the colour faded on exposure to sunlight, the colour fastness to light of these dye fabrics can

thus be inferred as less. While the cotton fabric dyed with *C.ternetea* dye gave darker hues (Fig.4) and the colour was retained when exposed to sunlight.

Since both the natural dye and synthetic dye have drawbacks and demand for textile is high, making a choice is challenging. But in the recent times, almost all of the dye manufacturers are minimizing the use of harmful chemicals in their products and are more focused on exploiting dyes with the use of environment- friendly components. Thus natural dyes could find their use in the coloration of textiles, foods, drugs and cosmetics. Small quantities of natural dyes are now-a-days used in coloration of paper, leather, shoe polish, wood, candles etc. But natural dyes suffer from certain intrinsic disadvantages of standardized application. Hence for the natural dyes to be truly commercialized and used as a better dyeing agent than the synthetic dyes, the standardization play a very significant and vital role.

Phytochemical Analysis

The qualitative tests for phytochemical compounds were performed on the leaf extracts of both plants. The secondary metabolites such as phenols, tannins, flavonoids and terpernoids were present in the aqueous extracts of both the plants. The phytochemicals Glycosides and reducing sugar were absent in both plants, while saponins and alkaloids were found in the aqueous extract of *C. pulcherrima* (Table.2)

These secondary metabolites have some uses including medicinal properties. Many research articles have suggested the presence of various phytochemicals like Alkaloids, Tannins, Glycosides, Resins, Steroids, Saponins, Flavonoids and Phenols when *Clitoria ternetea* and *Caesalpinia pulcherrima* leaves were extracted using various solvents [9,10]. The phytochemical tests performed in this current study were piloted only on the distilled water leaf extracts. The leaf extracts exhibited negative results for the tests of glycosides, reducing sugar, alkaloids and saponins. But this does not indicate the absence of these phytochemicals in the selected plants. Instead, it can be believed that these secondary metabolites might dissolve in other solvents. Therefore, for the complete analysis of the phytochemicals in these plants, the leaf extracts should be dissolved in various solvents in a polarity gradient separately.

Hence, the current project undertaken divulges the commercial as well as medical importance of the locally available plants – *Clitoria ternetea* and *Caesalpinia pulcherrima*.

Table.1 Absorption peaks obtained when the extracted dyes were analyzed in Spectrophotometer

Sl.No	Name of the dye	Absorption Peaks
1	*C.pulcherrima* dye	450nm-500nm 700nm-750nm.
2	*C.ternatea* dye	390nm-500nm 600nm-800nm

Table.2 Phytochemical Analysis of the Aqueous Leaf Extracts of *C.ternetea and C. pulcherrima*

Sl No	Phytochemicals	*C.ternetea*	*C.pulcherrima*
1	Phenols and Tannins	+	+
2	Flavonoids	+	+
3	Saponins	-	+
4	Alkaloids	-	+
5	Glycosides	-	-
6	Reducing sugar	-	-
7	Terpenoids	+	+

Figure.1.Images of the plants selected for study, *Clitoria ternetea* and *Caesalpinia pulcherrima*

Figure.2: Natural dye obtained from *C.pulcherrima* and *C.ternetea* via aqueous extraction method

Figure.3Hues obtained when the dye-mordant mixtures of *C.pulcherrima* were applied on the cotton fabric

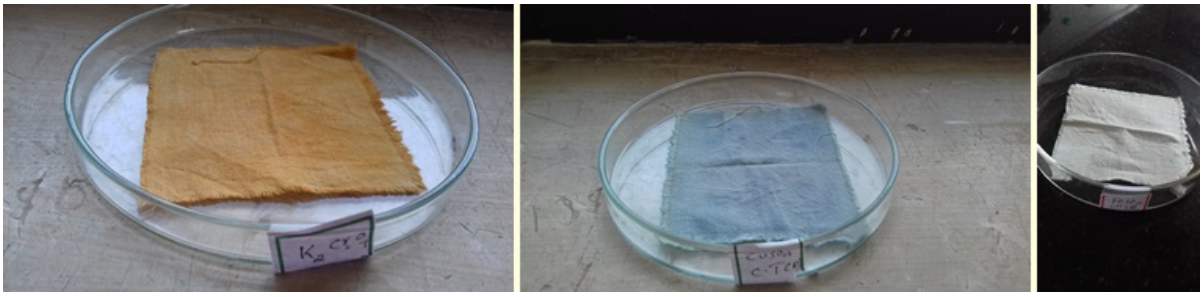

Figure.4Hues obtained when the dye-mordant mixtures of *C.ternetea* were applied on the cotton fabric

CONCLUSION

There are many varieties of plants around us and their uses are beyond expectation. Certain plants have more uses other than their medicinal property. Dyeing is one such property of these plants.Synthetic dyes are manmade dyes and they are widely used because of their certain features like low cost and easy availability. Even with these advantages, synthetic dyes possess an adverse effect on human life since it contains a lot of chemical contents. Modern researches proves that natural dyes are more useful as well as less harmful compared to synthetic dyes since it is natural and these dyes are mainly obtained from plants.Two such plants from which natural dyes can be obtained are *Caesalpinia pulcherrima* and *Clitoria ternatea.*In the present study, the dyes from the selected plants were extracted via aqueous extraction method. Further the dyes were mixed with three mordants (i.e. Copper Sulphate, Ferrous Sulphate and Potassium Dichromate) and applied onto the scoured cotton cloth. Both the dyes gave varying hues when mixed with different mordants.. The phytochemical analysis of the aqueous extracts of these plants also reveals the presence of many important secondary metabolites such as phenols, tannins, terpenoids,The qualitative analysis of these extracts thus validates the medicinal properties of the selected plants. Hence,

the current study divulges the commercial as well as medical importance of the locally available plants – *Clitoria ternetea* and *Caesalpinia pulcherrima*.

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