Research Article

Green Extraction of Dyes from Solanum xanthocarpum Leaves

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Abstract

Green techniques for extraction of dye from *Solanum xanthocarpum* leaves were evaluated finest colour. Now-a-days highly toxic and carcinogenic chemicals used to produce dyes which cause harmful effect on human health and disturb an ecosystem. Thus, the worldwide demand for natural dyes is increased due to beneficial properties of natural dyes and awareness among people. The natural dyes, has a great importance for dyeing as well as in pharmaceutical due to its medicinal values. This paper concerns with green extraction of natural dye from Solanum *xanthocarpum* leaves and used to dye cotton and wool.

Keywords: Natural Dyes; eco-friendly; Green extraction; Solanum *xanthocarpum*

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Introduction

Globally, significantly increase in demand of natural dyes due to its cheaply available, easily extract from natural resources without any chemical treatment [1,2], and non toxic in nature. Since, India has a rich biodiversity with wealth of useful natural products, dyes is most vital product from natural sources such plants, minerals, animal, insects etc. All extracted dyes are related with cultural practices, crafts, rituals; arts fabrics provide economical dependency for women and tribal youth too.

Recently, interest in the use of natural dyes has been growing rapidly due to eco-friendly and nontoxic nature not only in pharmaceuticals, in textile industry, but also in food, cosmetics, leather and art of dyeing spread widely as civilization advanced [3]. Also, due to the result of stringent environmental standards imposed by many countries in response to toxic and allergic reactions, carcinogenic and detrimental to human health and nature associated with synthetic dyes [3].

Nature has gifted to society more than 500 dye-yielding plant species, [4] and medicinal plants also to seal slit demand of industries. Among it, whole *Solanum xanthocarpum* plant is medicinally important. Its aerial part, fruits are reported to contain several alkaloids like solanacarpine, [5] solanacarpidine, , solasodine, solasonine [6], and solamargine [7]. Other constituents like caffeic acid[8],coumarins like aesculetin and aesculin [9],steroids carpesterol, diosgenin, campesterol, daucosterol and triterpenes like cycloartanol and cycloartenol are also stated by researchers from fruits [10] .The use of natural products with their therapeutic properties is as ancient as human civilization, plants minerals and animal products were the main sources of drugs [11].The leaves contains phytoconstituent like alkaloids, tannins, glycoalkaloids, proteins, flavonoids, carbohydrates, fats and phenolic compounds[12] .Roots are well known in Ayurvedic preparation "DasmulAsava".It is used as an expectorant, chest pain, cough and asthma in Ayurvedic medicine[13]. The petals of flower yielded apigenin and stamens contain quercetin, diglycosides and sitosterol. The stem, fruits and flowers are prescribed for relief in burning sensation in the feet accompanied by

vesicular eruptions. The antispasmodic, cytotoxic activities, antitumor, hypotensive and antianaphylactic antibacterial, antifertility, antidyslipidemic, antifungalactivities are also reported [14-18].The leaves and stem of solanum *xanthocarpum* shows antioxidant properties [19].Dyeing is an ancient art. At present there is an excessive use of synthetic dyes is around 10,000,000 tons per annum [20]. The dye production and its application release large amounts of waste and unfixed colorants which cause serious health problems and disturbing the eco-systems and balance of nature. Several synthetic dyes are banned because of their carcinogenic and toxic nature. Yet extraction of dyes was not reported by researchers from *Solanum xanthocarpum* leaves, hence present study deals with the extraction of natural dye from this species, commonly known as Yellow berried night shade. Three different techniques/methods for extraction of dye from the leaves were evaluated to determine the best extraction method. Wool and cotton were used in the experiment to observe the strength of dye.

Methods and Materials:

Source:
For the extraction of dyes, fresh leaves of *Solanum xanthocarpum* plant was collected from Kharghar, NaviMumbai India in the month of September'2015.

Green Extraction methods of dyes:
Dyes were extracted by using three different methods and the results were evaluated to conclude the best extraction method:

The first method used for extraction:
In this method, dye from leaves (10 g of leaves in 100 mL distilled water) was extracted by preparing an aqueous solution of leaves. The extraction process was carried out at a temperature range of 70-80 ^{o}C for 30 min. Observed colouring materials from the leaves was extracted for dying of the fabric materials. The aqueous solution of leaves was filtered and leaves were engaged out from the liquor for recycling process of extraction for the second time.

Second method of dye extraction/ oxidation reaction:
The uncrushed leaves (10 g) were placed in 100 mL distilled water as a solvent for extraction of dye. This pasty mass was kept for 10 days to get colour of dye. This extract was then filtered and used for dyeing.

Third method of dye extraction / photo-oxidation reaction:
The effect of light was observed on extraction of dye in relation time and divided in to two parts. First part Solanum *xanthocarpum* leaves (10 g) were crushed in 100 ml of distilled water in an earthen pot. The earthen pot was kept undisturbed for 2 hours in dark. For second part leaves (10 g) were crushed in 100 ml of distilled water in an earthen pot. The earthen pot was kept undisturbed for 2 hours in sunlight especially between 12 noon to 2.00 pm. The extract from both beaker were filtered by using cloth to get natural dye. Change in colour and yield was observed.

Application of dyes on wool and pure cotton cloth:
Dying procedure:
The extract obtained from above green extraction methods was filtered and used for dying cotton cloth and wool. The selected materials for dying were boiled in NaOH(10%) for 10 min to remove starch from cloths. Then wool and pure cotton cloths were transferred for treatment in the dye bath for 30 min. After the processing and dye fixation the materials were sunlight dried for 1hour.Effect of dye without mordent on wool and cotton was also observed.

Result and Discussion:
After collection *Solanum xanthocarpum* leaves, washed well to get rid of foreign particles from leaves to avoid interference of it in the pigmentation reaction. Number of foreign material may change the colour of dyes which may be miss-leaded the interpreted data. Three ideal methods were used for extraction dyes to check the change in characteristics. In first extraction method after aqueous solution and maintaining temperature at 70-80 ^{o}C for 30 min light red colour was observed (**Figure 1A**) while as the colour was constant up to 10 days though leaves were uncrushed. Reaction indicates that the observed dye was produced hiking colour at 30 min and there is not at all

oxidation procured after 30 min. Third method of extraction process was carried out in dark and light to observe the free radical reaction of dyes and UV–irradiation reaction. In sunlight shade of colour was light red and in dark, wine red colour was appeared. The second methods of dye extraction uncrushed leaves were kept for 10 days to get colour. The colour of dye observed in both cases was same. The effect of light and dark was observed on extraction of dye in relation time shown in **Figure1.B** and **C** and **Figure 2.**

The extracted dye produced superlative colouration and the best extraction method was suitable for secure the colour. When colour applied on wool and pure cotton cloth samples showed dark yellowish-brown and brown colour shown in **Figure 3.**

The intensity of colour produced on cloth and wool by dyeing without mordant was observed slightly less than that obtained for and dye used successively. Effect of dark and sunlight on formation of colour and effect of temperature on colour of paper are shown in Table No.1 and 2 respectively. Dying of wool and cotton with dye under exposure of sunlight and dark shown in **Figure 3** which indicates that the naturally prepared dye authentically use in industrial preparation and it shall made commercially available.

Figure 1 A.Light red colour obtained in first extraction method;
B and **C** Effect on colour in earthen pot in presence of dark and light

Table 1 Effect of time on formation of colour from *Solanum xanthocarpum* leaves in dark and sunlight

Time (min)	**Colour in dark**	**Colour in sunlight**
20’	No colour	No colour
40’	Light red	Light red
60’	Light brown	Dark yellow
80’	Light Brown	Light yellow
100’	Light brown	Light yellow
120’	Dark brown	Light yellow

Table 2 Effect of time on colour of wool and cotton

Temperature (^{0}C)	**Time (min)**	**Application of dye on paper**
20	10	No change in colour
30	20	No change in colour
40	30	Fading in colour

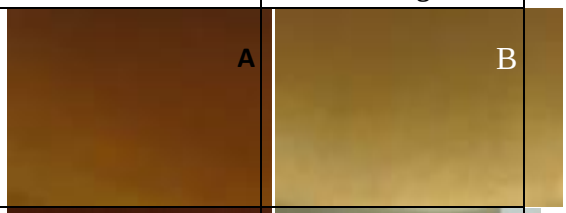
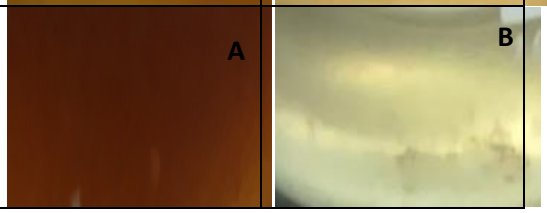
Time	In dark	In sunlight
Exposed A and B for 60’ min		
Exposed A and B for 120’ min		

Figure 2 Effect of sunlight and dark on formation of colours on Leaves of *Solanum xanthocarpum*

	Untreated	Dyeing with dye from dark condition	Dyeing with dye from sunlight
Dyeing with wool without mordant			
Dying with cotton without mordant			

Figure 3 Dying with dye from sunlight and dark on wool and cotton

The prepared dye by green extraction method may also modified by using different metals to have its huge applications and employment. Since, India has its rich biodiversity and produced huge amount of raw material and Solanum *xanthocarpum* is waste land weed also occurs roadside. Its dye/pigments have compensation from the industries because different shades of colour are observed from its aerial part. Using different mordants ,dyes properties also enhance such as colour fastness, washing fastness, perspiration accordingly it is employed throughout India for dyeing silk and cotton fabrics on a commercial scale. The obtained dye is safe and green extraction process is cost free.

Conclusion:

To seal slit of worldwide demands of natural dyes increase due to their non-toxic properties, less side effects, cost effectives, easily available raw material and green extraction techniques. Natural dyes are environmentally benign and employed in number of pharmaceutical preparation and also in cosmetics. The selected plant has clinical potential of medicinal properties along with dye producing properties. Due to the availability Solanum *xanthocarpum* ,the

utilization of plant for extraction of dyes, is beneficial to society. More detailed scientific investigations are needed to assess the real potential of plant.

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