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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 value. 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

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 dying 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 300 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 arial part, fruits are reported to contain several alkaloids like solanacarpine, [5] solanacarpidine, solanidine, solasodine, solasodamine [6], and solanargine [7]. Other constituents like caffeic acid [8], coquinolines like aesculin and aesculin [9], steroids carpessterol, diosgenin, campessterol, daucosterol and triterpenes like cloroxanthin and cloroxanthol 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 pherolic compounds [12]. Roots are well known in Ayurvedic preparation “Dasmitasava”. It is used as an expectorant, chest pain, cough and asthma in Ayurvedic medicine [13]. The petals of flower yielded apigenin and stamens contain quercitin, digitoxides and sitosterol. The stem, fruits and flowers are prescribed for relief in burning sensation in the feet accompanied by

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Article CS31204612 41
vesicular eruptions. The antispasmodic, cytotoxic activities, antitumor, hypotensive and antimalarial efficacy 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 in around 0.008.000 tons per annum [20]. The dye production and its application release large amounts of waste and unfixated 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 nightshade. 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.

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 °C for 30 min. Observed colouring materials from the leaves was extracted for dyeing of the fabric materials. The aqueous solution of leaves was filtered and leaves were enganged 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 color 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 1 hour. Effect of dye without mordant 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 mislead 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 °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 having 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 Figure 1.B and C and Figure 2.

The extracted dye produced superficial 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 authentic use in industrial preparation and it shall made commercially available.

![Figure 1](image1.png)

**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>
<thead>
<tr>
<th>Time (min)</th>
<th>Colour in dark</th>
<th>Colour in sunlight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No colour</td>
<td>No colour</td>
</tr>
<tr>
<td>40</td>
<td>Light red</td>
<td>Light red</td>
</tr>
<tr>
<td>60</td>
<td>Light brown</td>
<td>Dark yellow</td>
</tr>
<tr>
<td>80</td>
<td>Light Brown</td>
<td>Light yellow</td>
</tr>
<tr>
<td>100</td>
<td>Light brown</td>
<td>Light yellow</td>
</tr>
<tr>
<td>120</td>
<td>Dark brown</td>
<td>Light yellow</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Time (min)</th>
<th>Application of dye on paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
<td>No change in colour</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
<td>No change in colour</td>
</tr>
<tr>
<td>40</td>
<td>30</td>
<td>Fading in colour</td>
</tr>
</tbody>
</table>

**Table 2** Effect of time on colour of wool and cotton
The prepared dye by green extraction method may also modified by using different mordants 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, penetration 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 effective, 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.

References:

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A Review: Importance of Natural Dyes from Solanum xanthocarpum

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Abstract: Worldwide demand for natural dyes showed great interest which increased awareness on benefical properties of natural dyes in public. Natural dyes having several applications in textiles, cosmetics, inks, pharmaceutical paper industries etc. The natural dyes existing different shades of colours depends on metabolic functional groups and its testing reagents. The present review describes the information regarding the basic chemistry of plant pigments in relation to medicinal properties which may prove to be useful for further development of pharmaceutical formulations.

Keywords: Dyes, medicinal value, Natural colors, pigments

Introduction
Natural dyes are derived from natural sources such as plants, animals, minerals and insects without any chemical treatment. Nature has gifted more than 500 dye yielding plants species. Colouring agents are derived from roots, leaves, barks, trunk and fruits. The plants Henna, madder, pomegranate, turmeric, eucalyptus etc. are well known for its natural dyes. The first fiber dyes- direct dyes or substantive were already used in prehistoric times after the last ice age, around 1000 B.C. The synthetic dyes have been banned due to carcinogenic and toxic in nature. Research paid attention on synthetic dyes that are suspected to release harmful chemicals that are allergic, carcinogenic and detrimental to human health. Natural dyes are the colorants obtained from biological material by mechanical retention, covalent chemical bond formation or forming complexes with salts or metals or by physical absorption. The natural dyes from the plants have a great importance of medicinal values even in some cases nutritional values. From the ancient time people are using the many plants for curing the various types diseases as well as for dying. Today, natural colourants are safer and ecofriendly in nature are emerging globally leaving synthetic colourants behind in the race. It is the vital source from the plants and is related with cultural practices, crafts, rituals, arts and fabrics. The medicinal properties, protective properties, the structures of natural dyes have been recognized only in the recent few years. Natural dyes have demonstrated better biodegradability and are achieved from renewable sources. These are preferred mainly in developed countries, because of their non-allergic, non-carcinogenic, less-toxicity and better biodegradability nature than the synthetic dyes. Hence, it is important the product from the nature which play vital role in therapeutics. Henna, saffron, kesar, turmeric, the brightest of naturally occurring orange-red / scarlet red to yellow dyes are a powerful antiseptic which revitalizes the skin, while indigo gives a cooling sensation. The use of natural products together with their therapeutic properties is as ancient as human civilization. For a long time, mineral, plant and animal products were the main sources of drugs. In India, there are more than 450 plants that can yield dyes. In addition to their dye-yielding characteristics, some of these plants also possess medicinal values that are procured industrial applications and accessed occupation for vicinities where the plant source is existed.
Medicinal properties of natural dyes:

Many of the plants used for dye extraction have recently been revealed antimicrobial activity\textsuperscript{3}. \textit{Punica granatum} L. and many some other common natural dyes are reported to possess antimicrobial agents due to the presence of a large amount of tannins. Some other sources of plant dyes rich in napthoquinones such as lawsone from \textit{Lawsonia inermis} L. (hernea), juglone from walnut and lapachol from alkanet are reported to exhibit antibacterial and antifungal activity\textsuperscript{4-10}. Singh et al. studied the antimicrobial activity of some natural dyes.

Optimized natural dye powders of Acacia catechu (l.f) Willd Rubia cordifolia L. and Rumex martinus Kerria laca, were obtained from commercially and they showed antimicrobial activities. Lycopeno is a carotenoid pigment responsible for red colour in watermelon, carrot, tomato, and some other fruits; this is used as a colour ingredient in many food formulations in food industries. \textit{Solanum xanthocarpum} and the plant as a whole is used drug in Ayurveda. The drug is used as antiasthmatic, hypoglycaemic, antifungal, anti-inflammatory, antimitotic, anti-tussive, antipyretic, antiinflammatory, antihelminthic, hypotensive and cytotoxic activity\textsuperscript{11-19}.

In recent years it has received considerable attention because of its potential in the prevention of chronic diseases such as prostate cancer\textsuperscript{20-25}. The epidemiological studies proved that the consumption of lycopene-rich food such as tomatoes is related with a low risk of cancer\textsuperscript{26}. Pomegranate fruit not only used as natural dye it also having traditional medicinal value\textsuperscript{26} is now supported by data obtained from modern science showing that the fruit contains anticarcinogenic\textsuperscript{27-32} anti-microbial\textsuperscript{33} and anti-viral compounds\textsuperscript{34}. A beautiful spectrum of natural colours from yellow to black exists in the above sources. These colours are exhibited by pigments and due to the absorption of light in the visible region of 400-800 nm. This absorption of light depends on the constituents or structure of or the colouring pigment or molecules contain various chromophores present in the dye yielding plant. Natural dyes are nowadays in demand not only in textile industry but in cosmetics, leather, food and pharmaceuticals and offer an attractive alternative.

Chemistry of dyes:

A dye can generally be described as a coloured substance that has an affinity to the substrate to which it is being applied. The natural organic dyes and pigments cover a wide range of chemical classes. Classification of natural colouring agents on the basis of chemical structure shown in Table No.1. The dye is usually used as an aqueous solution and may require a mordant to improve the fastness of the dye on the fiber. Dyes are used for colouring the fabrics. Dyes are molecules which absorb and reflect light at specific wavelengths to give human eyes the sense of colour. Different dye molecules are unique. Each is shaped differently so that it absorbs light in a different way. Often a third molecule is added to a dye. This acts as a bond between the dye molecule and the molecule of the fabric that the dye is being applied on. Along with Chlorophyll, carotinoids, tannins, phenolics, flavonoids and curcumin were determined among the dye yielding plants from the solanaceae family; no report yet observed from \textit{Solanum xanthocarpum}. Natural product was isolated from it having medicinal values are shown various colours with different reagents used for identification. Its alkaloids showed creamish color with Mayer reagent, yellow in colour with Haeger's reagent, reddish brown color with Wagner's reagent and Dragendorff reagent used for precipitation and its tannic acid gave buff colour. Glycosides/ free sugar of \textit{Solanum xanthocarpum} showed blood red with Legal's test and yellow with bromine water test.

Tannin and phenolic compound from \textit{Solanum xanthocarpum} revealed white precipitation with gelatin test, blue green with ferric chloride, yellow –red with alkaline reagents\textsuperscript{35}. 
Moradant dyes also observed from nigrum species showing K, S, P, Ca, Mg, Mn, Za, Fe, Cu and Co etc. hence these naturally occurring dyes called as 'vegetative dyes' which was prepared simply in pot and applied in textiles. In Manipur, acidic and basic dyes which indigenous formed and used in various handlooms, fibrac, and household items. Based on the colours of surviving textile fragments and the evidence.

### Table 1. Classification of Natural colouring agents on the basis of chemical structure.

<table>
<thead>
<tr>
<th>Chemical Classification</th>
<th>Colors</th>
<th>Common Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavone dyes</td>
<td>Yellow and Brown</td>
<td>Weld, Quercitron, Fustic, Osage, Gush Chamomile, Tera, Sota, Marigold,</td>
</tr>
<tr>
<td>Naphthoquinone dyes</td>
<td>Brown and Purple grey</td>
<td>Henna, Walnut, Alkanet, Pith</td>
</tr>
<tr>
<td>Chromone dyes</td>
<td>Orange Yellow</td>
<td>Kamasal</td>
</tr>
<tr>
<td>Isoquinoline dyes</td>
<td>Polyene colorants Pyran colorants</td>
<td>Barberry, β-carotene, lycopen gentian</td>
</tr>
<tr>
<td>Indigo Dyes and Indigo colorants</td>
<td>Blue</td>
<td>Indigo</td>
</tr>
<tr>
<td>Chromone and Anthraquinone dyes</td>
<td>Red</td>
<td>Lac, Chromone dyes Geochinoid, Madder (Majhers) Sostofn</td>
</tr>
<tr>
<td>Benzophene dyes</td>
<td>purple</td>
<td>Black pepper</td>
</tr>
</tbody>
</table>

of actual dyestuffs found in archaeological sites as well as from dyers' house, ten natural dyes yielding plants which have unique uses in the Meitei society of Manipur were analyzed for the biochemical substances responsible for dyeing. Since, *Solanum xanthocarpum* leaves has dark glossy greenish in colour having hair and colouring flower prejudiced used treatment of in various diseases and disorders. *Solanum nigrum* plant fruits showed brown color dye was used to dye a cloth worn by the royals in early days known as 'Khamen chaupa'. All brown dyes are reported part of flavonoids and dying brown and black hues. Natural dyes are included in the categories of flavonoids, tannins, terpenoids, naphthoquinones, anthraquinones, and alkaloids. Terpenoids or naphthoquinones form important flavonoids from purple flowers of *Solanum xanthocarpum* are nothing but Flavonoid dyes that are usually moradant dyes that are precipitated with Shisaoda showed pink scarlet, crimson red as per the concentration of reagent used and changes in colour observed after 5-10 mins was greenish to blue. Also, it changes as per meals used in regatta preparation. It contains exogenous antioxidant compounds for animals and humans. It plays important roles in light harvesting, photo-protection and antioxidation flavonoids reduce pain perception. Naphthoquinones and anthraquinones are aromatic compounds that comprise a number of strong, red; Alkaloids contain nitrogen responsible for indigo and Tyrian purple. Glycosides basic positions in their protein molecules and also minimizes allergic reactions due to textile/fabric category of natural products. The kopentane, isoprene, or C5 unit is in the biochemical building stone for these compounds. Crocetin, from saffron, are equally important as a food ingredient. All colours are due to presence of functional group. *S. xanthocarpum* flavonoid shown the function group which are responsible for colour in flower.
Flavonoids and carotenoids are naturally occurring pigments present in the plants and other types of photosynthetic organisms. It plays important roles in photo-protection, light harvesting, and antioxidation. They are exogenous antioxidant compounds for humans and animals through daily consumption of a diet of vegetables, fruits and grains. Flavonoids reduce pain perception was due to free radical scavenging activity as these free radicals are involved during pain stimulation.

Proteins showed white precipitation with millones test while as amino acids exhibited violet colour with ninhydrin which is same in Molisch test indicating glycoprotein but Fehling solution has been showed the brick red colour. But Salkowski procured yellow color terpenoids. All whole as plant Solanum xanthocarpum extract changes its characteristic as per its preparation in various solvent such as aqueous, ethanol, methanol, petrolatum ether, ethyl acetate, chloroform etc.

CONCLUSION:
Natural dyes are more constructive, eco-friendly, renewable, cost efficient and observed harmless with soothing effect. They have various medicinal properties. Due to non-toxic, non-carcinogenic, and non-allergic nature it is popular among natives for dying textile, paper, cosmetics, and food. Hence to fill demand-supply gap of colour bearing plant production necessarily improved. Ultimately, natural dyes may be beneficial to medicinal, and environmental synthetic chemistry and enhance the severance to society for it large scale production and reducing pollution problems by synthetic dyes. Hence, recent years have seen renewed interest in dyes that are derived from natural sources.

REFERENCES:


Medicinal Alkaloids from *Solanum xanthocarpum* leaves.

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**Abstract:**

*Solanum xanthocarpum* is commonly known as kantkari. This prickly herb is also called as yellow berried night shade. It has great medicinal importance from ancient time. It is one of the member of Dasmula in Ayurveda. It possess various potential due to its medicinal properties. Every part of the plant has a great medicinal importance because of alkaloids are present in this plant. Solasodine solanine solanargine and solanidine alkaloids are present in this plant. These alkaloids are extracted by using solvent soxhlet and novel method of extraction. The awareness of importance of medicinal plant and their conservation should be create among people by selecting such a weed land plant for research work and to increase the economic growth.

**Keywords:** Alkaloids, Kantkari, solasodine

**Introduction:**

More than 3000 different types of alkaloids have been identified from leaves, fruits, bark, and root of the more than 4000 plant species. Phytochemical studies on the genus Solanum showed the presence of alkaloids, flavonoids, steroidal glycoside and steroidal sapenins. Natural products are originated in flowering plants that are pharmacogenically active. Solanum xanthocarpum is one of them from solanaceae family. It is commonly known as kantkari. The juice of berries is used in curing sore throat. The fruits of the plant used as folk medicines to treat throat infections and other inflammatory problems. In Ayurveda, Siddha and Unani the plant Kantkari is used in the treatment of variety of diseases. It is useful in the treatment of cough, cold, worms, fever, hoarseness of voice painful urination, muscular pain enlargement of the liver, and stone in the urinary bladder. Kantkari leaves juice is use through nasal in the treatment of headache, asthma and migraines. The paste of whole plant is applied on painful and swollen joints in arthritis. This gives relief in pain and the swelling.

Natural alkaloids are extracted by conventional methods such as Soxhlet and room temperature solvent extraction or by ultrasound or microwave supercritical solvents or other methods. A modern method was developed to extract alkaloids, which were the important groups of secondary metabolites.
Material and method:
All chemicals are analytically pure grade from S.D.Fine Chemicals. Glass distilled water used throughout the experiments.

Chemicals: silica gel, ceric sulphate, mercury chloride, potassium permagnate. Ethanol 99.9% A.R. grade. Phenol, Picric acid, sulphuric acid, iodine crystals from loba chemicals.

Plant material:
Solarium xanthocarpum plant was collected from Saraswati college of Engineering college campus Kanghar.
Air dried leaves powder was used.

Methods:
Conventional method: solvent and soxhlet methods were used for the extraction of alkaloids from air dried leaves of Solarium xanthocarpum.

Solvent method: In this method 10 gm leaves powder was wetted with 15 ml NH4OH at room temperature. Extraction was done with ethyl acetate for 72 hours.

Soxhlet method: 10 gm of powder was kept in thimble and extracted with 300ml ethyl acetate for 18 hours.

Novel method:
10 gm of leaves powder was extracted with EDTA. Golden colour crude alkaloid was obtained by extraction with alkaloids.

The obtained alkaloids were purified by column chromatography and characterized by UV, IR. And TL.
**Result and discussion**: From the weed land plant like Solanum xanthocarpum, various alkaloids were extracted by using different extraction method. Separation of alkaloids was done by column chromatography by loading crude alkaloids on silica gel column. Various fraction were collected from column and four alkaloids were discovered. It was confirmed by physical constant, UV, IR, and TLC.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Alkaloids</th>
<th>M.P</th>
<th>UV nm</th>
<th>IR in Cm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SOLASODINE</td>
<td>202</td>
<td>240</td>
<td>1580,1610,1630,1660,3360</td>
</tr>
<tr>
<td>2</td>
<td>SOLANIDINE</td>
<td>197</td>
<td>225</td>
<td>1760,1245,985,860,825</td>
</tr>
<tr>
<td>3</td>
<td>SOLAMARGINE</td>
<td>294</td>
<td>205</td>
<td>2400-3200,1646,1610,1450,1410,1375</td>
</tr>
<tr>
<td>4</td>
<td>SOLANINE</td>
<td>290</td>
<td>218.3</td>
<td>700,3500-3200</td>
</tr>
</tbody>
</table>

**Conclusion**: Solamargine, solasodine, solanine, and solanidine alkaloids were obtained from the fraction number 3, 5, 7, and 8 respectively. Confirmation and structural determination was done by UV, IR, TLC, and physical constant. Solanum xanthocarpum plant is using as medicine from the ancient time because of their therapeutic composition. The high alkaloids value should be well-known to everyone for the wide use of this medicinally important plant.

**References**: