



## ANNATTO: ECO-FRIENDLY AND POTENTIAL SOURCE FOR NATURAL DYE

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Article Received on: 11/03/13 Revised on: 08/04/13 Approved for publication: 11/05/13

DOI: 10.7897/2230-8407.04623

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## ABSTRACT

India has a vital monopoly in their production and application of natural colors obtained from leaves, flowers and fruits. After the invention of synthetic dyes, natural dyes were forgotten and abandoned as a part from history because of its negligence. Due to the environmental and health hazard problems caused by the synthetic dyes, now people are more concerned about the usage of natural dyes during the last two decades. Botanists have identified more than 450 dye yielding plants that naturalized in India. The natural dyes are fast in staining, long-lasting, renewable, bio-degradable and eco-friendly. Now-a-days, natural dyes have entered into the textile, food, pharmaceutical, cosmetics, fiber, leather and paint industries. In the present study, the usage of the dye obtained from Annatto (*Bixa orellana*) is evaluated.

**Keywords:** Natural dye, *Bixa orellana*, mordant, solvents, fastness properties.

## INTRODUCTION

At present worldwide there is a growing trend towards the usage of natural colors in various industries due to the environmental hazards caused by the excessive use of synthetic dyes. Synthetic dyes are produced from cheap petroleum sources and show superior fastness properties<sup>1</sup>. It is estimated that nearly 10, 00,000 tones of synthetic dyes were used per annum. The usage of vast amount of synthetic dye causes pollution, disturbs the ecological balance and causes health hazards to human beings<sup>2</sup>. Because of this, Germania government was the first to ban the manufacturing of synthetic dyes. Netherlands, India and some other countries also followed the ban<sup>3</sup>. At present, research is focused to find out alternative dyes for food and clothing's and it should be ecofriendly, readily available, cost effective and safe to use both in food materials and fabrics. The only alternative way is to use natural dyes based on plant or animal origin. The usage of the plant based natural dyes is traced back to ancient civilization. The paintings of Ajanta, Ellora and Bagh caves are made by plant based natural dyes and still are preserved as valuable monuments by Archeological Survey of India. In India, nearly 450 plants are known to yield dyes<sup>4</sup>. Among this, 50 plant are found to be more efficient dye yielding plant<sup>5,6</sup>. The raw material for the production of natural dyes is mostly vegetable matter such as seeds, leaves, roots, barks and flowers. Out of 50 plants, ten of these are from the roots, four from barks, five from leaves, seven from flowers, seven from fruits, three from seeds, eight from wood, three from gums and three from resins<sup>7</sup>. In the present study, an alternative dye yielding plant, Annatto (*Bixa orellana* L.) was studied for its potentiality for dyeing food and fabrics. Annatto seed extract is a natural dye, which is obtained from the outer coatings of the seeds of *Bixa orellana* L., belonging to the family Bixaceae. Although the plant species originated in northern South America and now it is naturalized India and widely cultivated in tropical areas for commercial production<sup>8-10</sup>. Annatto extract has natural carotenoid and is used in the food industry, mainly in dairy products such as cheese and butter<sup>11,12</sup>. It has been considered safe for human consumption<sup>13,14</sup>. The two major components

of the extracts are oil soluble bixin and water soluble norbixin are widely used for the colouring of food, pharmaceutical and cosmetic products, to give yellow to red hues<sup>15</sup>. Siva and Krishnamurthy<sup>5,6</sup> studied the pigment content *Bixa orellana*. Mordants and dyes will have different effects depending on the fibers used (cellulosic or protein)<sup>16</sup>. In the present study, the seed extracts were applied to cotton fibre, cotton cloth, silk fiber and chart paper to evaluate their efficiency as a coloring material.

## MATERIALS AND METHODS

*Bixa orellana* L. fruits were peeled off to collect the seeds. The seeds were dried and powdered. The extraction of the dye from powdered *Bixa orellana* seed was obtained by using four different solvents namely acetone, ethanol, water and hexane with different polarity. 100g of sample was weighed and taken in a round bottom flask and 500ml of solvent was added to it. The seed was extracted with the four different solvents and kept in a separate bottle. To a part of the dye, 0.5ml of 1% mordant was added (potash alum) and the other part left as normal extract without mordant. Four different sample materials- cotton, gauze cloth, silk threads and chart paper (white) were used to evaluate the dyeing efficiency. A known weight of about 3grams of the 4 different sample materials were taken and dyed naturally with dye and mordant and dye without mordant of different solvent extracts. The materials were then dried in hot air oven at about 60°C for half an hour. Then the dyed material is washed with water and detergent to determine the retention of the color. Bright and dull shades were found out and rated. Light fastness was analyzed by exposing the dyed materials to direct sunlight for 24hrs.

## RESULTS AND DISCUSSION

Annatto seed extraction was found to be orange- red colour. The colour of the dye also depends on the solvent used for the extraction. In the present study, colours variation was noted for different solvent extraction. The proximate analysis of color identification in the extracted dye is given in Table 1. A rating of good, fair and poor is given to the materials on

the basis of retention of the stain after different treatments. The order of rating of fastness to detergent washing and rubbing among the four different solvents in general were shown in Table 1.

**Table 1: Proximate analysis of Color and rating of the dye in different solvent extracts**

Solvents	Colour	Rating
Acetone	Brick red	Good
Ethanol	Moderate red	Fairly good
Water	Red	Fair
Hexane	Pale yellow to golden	Poor

The rating of staining shades among the four different samples were found to be more in cotton cloth and less in chart paper. The rating of staining shades was found to be in a medium range in silk fiber and cotton fiber.

**Table 2: Rating of fastness properties of *Bixa orellana* dye**

Solvents	Cotton fiber	Cotton cloth	Silk fiber	Chart paper
Acetone	Fair	Good	Good	Fair
Ethanol	Good	Good	Good	Fair
Water	Fair	Good	Good	Fair
Hexane	Fair	Good	Good	Fair

**Table 3: Rating of fastness properties of dye + mordant**

Solvents	Cotton fiber	Cotton cloth	Silk fiber	Chart paper
Acetone	Good	Good	Good	Good
Ethanol	Good	Good	Good	Fair
Water	Good	Good	Good	Fair
Hexane	Fair	Good	Good	Fair

Table 2 and 3 give the details of fastness properties of dye towards washing. It is observed that the fastness of cotton cloth and silk fiber on acetone, ethanol, water and hexane extracts of the dye alone had a bright shade when compared with those of dye extracts with mordant which is in dull shade. Similarly the material treated with hexane extracted dye alone retains a bright shade on cotton fiber compared to dye with mordant. It was found that the acetone, ethanol and hexane extracted dye with mordant retains bright shade in chart paper compared to treatment with dye alone. This showed that the solvents used for dye extraction plays a significant role in fixing the dye indeed without the mordant. It is well known that colorants from synthetic sources can be harmful and cause allergic to humans<sup>17</sup>. 8/Therefore natural dyes have increased considerably during the last few years. Nowadays, fortunately, there is an increasing awareness among the people towards the use of natural products as a substitute for synthetic dyes. Due to their non-toxic property, low pollution and less side effects, natural dyes are used often in food products as well as fabrics. Natural dyes are considered to have less hazardous to health, non-carcinogenic and non-poisonous. It is a known fact that natural dyes were eco-friendly and can be recycled after use<sup>5,18</sup>. Henna was used even before 2500 BC, while saffron is mentioned in the Bible<sup>19</sup>. In Egypt, mummies have been found wrapped in dyed cloth. Primitive men used plant dyestuff for coloring animal skin and to their own skin during religious festivals as well as during wars. Soldier believed that the color would give them magical powers, protect them from evil spirits and help them to achieve victory in war<sup>20</sup>. Annatto is one of the foremost economically important natural dye yielding plant mainly used to color dairy products<sup>21,22</sup>. Annatto (*Bixa*

*orellana*) seeds contain high quantities of pigments, in that apocarotenoid bixin being the most abundant<sup>23</sup>. Bixin is the most commonly used natural industrial colorant<sup>24</sup>. Siva *et al* in 2008 reported the dye has characteristics similar to that of bromophenol blue and shows no interference with any of the test proteins. Besides, it can also be used for cell staining. Since the acetocarmine is a costly insect based dye commonly used for cell staining. Natural dye from annatto may serve as a best alternate to acetocarmine. In addition to the dyeing properties, annatto is noted for its medicinal value. The leaves and roots of Annatto is used in the treatment of diabetes<sup>25</sup>, hypertension, jaundice<sup>26</sup> dropsy<sup>27</sup> eye infection, heart pain, prostate inflammation, anorexia, diarrhea, wound healing, kidney-complaints and even to cancer. Annatto used to paint on the bodies and arrows<sup>28</sup>. The leaves and seeds of *Bixa orellana* also showed a broad spectrum of antimicrobial activity with the leaves showing higher activity. Dye obtained from Annatto is used in the preparation of lipstick, cosmetics and soaps<sup>29</sup>.

## CONCLUSION

The usage of synthetic dyes was done commercially for attractive colors but it is hazardous to skin and environment. Usage of natural dyes obtained from *Bixa orellana* in textile finishing has good light fastness and may help in keeping the skin healthy by preventing from allergy reduce the risk of skin cancer. The dye obtained is biodegradable and non-toxic. The natural dye obtained from *Bixa orellana* also has medicinal properties and finds its application traditionally in the preparation of sindhoors. Due to lack of the botanical knowledge and the precise technical knowledge on the extraction and dyeing procedure, the natural dye has not commercially succeeded like synthetic dyes. Natural dye from *Bixa orellana* is evaluated in the present study and showed better result in staining of cotton cloth, silk fiber and cotton fiber. The dye is cheap, soothing, long lasting and has anti- microbial property. Because of its antimicrobial property, its usage in dyeing Band-Aid cloth will be helpful for fast wound healing. The dye may find an effective use in advanced medical immunological field as a gel tracking dye. The application of annatto found to be easy, more practical and reliable. In future, the natural dye serves eco-friendly agent for the clean and green environment.

## ACKNOWLEDGEMENT

The author PN Prasad is grateful to DST for the financial support to carry out the research work. The authors are thankful to The Chancellor, Noorul Islam University for his constant encouragement for doing research work.

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**Cite this article as:**

Meena Devi. V. N., Ariharan V. N. and Nagendra Prasad P. Annatto: Eco-friendly and potential source for natural dye. *Int. Res. J. Pharm.* 2013; 4(6):106-108

Source of support: DST, Conflict of interest: None Declared