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Study on traditional food plant resources and bioactivities of product as dye from fruits of *Basella alba* L. (Ceylon Spinach) plant

Simana Bora*, Porismita Borah and Runjun Gogoi Rajkumari
Department of Botany
J B College, Jorhat-785001, Assam, India

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Basella alba L. commonly known as Ceylon Spinach and *Puroi* in Assam is used as pot herb in N E Region of India. Its dark blue fruits having deep red-violet flesh are a potential source of natural colorants. It is a potent natural antioxidant and stable at 60°C and beyond 60 °C it goes to be gradually unstable. Its fruits have great potentialities for application in the cosmetics, food dye, official ink and fabric industry. The aim of the present study was to evaluate the economical cultivation of the plant and selection of part of plant species useful for dye extraction. The colour pigment from fruits can be extracted (40.5%) with water by constant stirring for 1-2 h at room temperature. Thermal stability of dye solution and dyeing of beaten rice with this dye was studied.

Keywords: *Basella alba ,* Ceylon Spinach fruits, Economical plant, Traditional edible colour, Thermal stability, Food colour.

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Introduction

Synthetic dyeing is characterized by high environmental pollution and high health risk factor. Synthetic colorants are generally harmful and cause allergies to human[1]. Dyes are becoming important commodities in today's global economy. Because of environmental and high health hazards in the production and use of synthetic dyes and pigments, the use of natural colour has been increasing globally. There is a great prospect of economic growth in the field of natural colour's business. Particularly, the rural economy of underprivileged rural people can be enhanced through the practice of the using natural colour. There has been a limited research into natural dyes over last 150 years. In view of consumer demand for natural products incorporating natural ingredients, search for the study of new sources of natural colorants and its use has became a subject of research.

Ceylon Spinach, commonly known as *Basella alba* L. belonging to the family Basellaceae is locally known as *puroi*. The climate of Assam is suitable for its easy cultivation and widely available fruits can be harvested 3-4 times in a year. This plant is traditionally used as vegetable. Its leaves and flowers contain vitamin A and C, iron and calcium. The fruits contain a red dye which is used as food colorant as well as cosmetic. The chemical constituents of the red dye are gomphrenin 1, betanidin dihexose and isobetanidin dihexose molecules[2-3]. The aim of the present study was to evaluate the economical cultivation, propagation and selection of this plant part(s) useful for the extraction of natural dye as well as the use of dye as natural food colorant, colour stability in the liquid state.

Originally from India, Ceylon Spinach is very common, fast growing perennial vegetable. It is a climbing tropical vine, growing up to 3-4 m in height. It has thick heart shaped leaves and bears white flowers. Only leaves and young stem are eaten, they are used in salads or steamed with tofu and ginger.

Cultivation

The area of cultivation of Ceylon spinach requires a well-drained moisture retentive soil, with sun light shade; it grows well in a variety of soil, but prefers humus rich soil with acidic and neutral pH range 5-7(Ref.4). Both the cold and spring seasons are ideal for its cultivation. The preferential climatic temperature for its fast growing is within 20-30°C. The harvesting of fruit starts within 5-6 weeks.

*Correspondent author:
E-mail: simbora94@rediffmail.com
Mob.-+91- 9435450604

Leaves on lateral branches are smaller than those on runners (Plate 1). The flowers are self-pollinated (bisexual) white, pink or purple. The purplish black ripe fruit, a sub-globose pseudo-berry within size of 4-10 mm in diam. have fleshy perianth and contain a violet juice. The fruit contain one seed of 3 mm diam.[5]. Ceylon Spinach usually begins to bear fruits in mid January at 21° C and ripens in early March or after the last frosts.

Ceylon Spinach is not an endangered species because local selections are commonly grown in home gardens and for the market. It has been included in the traditional vegetable mandate list for conservation. No germplasm collection by natural gene bank is reported[6]. Germplasm is being conserved *in situ* in custody of the farmers. Collection and screening of local material is advisable. The plant has good prospects as a leafy vegetable with good nutritional values having a remarkable resistance to diseases.

Materials and Methods

Ceylon spinach fruits were collected from local area (Jorhat, Assam) of N E region in India. Ethanol and hexane (AR grade) were procured from BDH Mumbai. The plant samples for extraction of dye were collected after identification of the plant species; the local and scientific names were also taken into account. The collected samples have been found to be economically viable and eco-friendly for dye extraction.

Plate 1—Ceylon spinach plant

The moisture content of the fruit samples was determined on air dried basis. Drying of the sample was continued until constant mass was obtained. A definite mass of each sample was treated with proper solvent (water/alcohol/hexane, etc.) repeatedly to get complete extraction of raw dye.

Extraction of dye

The extraction method of natural dye basically depends on medium in which the dye is extracted. The solvents used for present extraction purpose were water, alcohol and hexane. A definite mass of the sample was treated with proper solvent repeatedly to get complete extraction. The selection of solvent for total extraction of dye was made by studying the parameters e.g. ratio of solvent to sample, time, temperature, stirring speed, etc. and ultimately the proper solvent that does not lose the properties of the dyes during extraction was selected.

Ceylon spinach fruits (10 g) were digested with distilled water/ethanol (100 mL) and magnetically stirred for 1 h at room temperature. The experiment was repeated until the solvent became colourless. The red-violet colour was separated from the seed by separating funnel. The extract was concentrated under vacuum rota evaporator. Percentage of extraction of dye from fruits was determined by specific density method.

Sun fastness test

The degree of sun fastness was determine by exposing the dye solution in test-tube and kept in sun light up to 120 minutes at different temperature range 25°C to 28° C[7].

Thermal stability determination

As aqueous dye solution (1.5 mg/100 mL) were transferred into the three numbers of test-tubes and subjected to thermal stability testing at different temperature. The three test tubes containing dye solution were introduced in water bath/oil bath and heating at 25, 60, 100 and 120 °C for constant time 10 minutes[8]. The tubes were quickly cooled in an ice bath followed by ambient temperature. Its colour fadedness was determined by U V spectroscopy (using Thermo Scientific Instrument).

Dyeing of food

The dyeing of food material was done by studying the absorbance of coloured dye extracted from Ceylon

spinach fruits on beaten-rice. Water solution of dye was prepared (1.5 mg/100 mL). The beaten–rice put into the dye-bath for 5 minutes wherein the absorption of dye on the beaten–rice takes place. After withdrawing the coloured beaten-rice from the dye-bath, the beaten-rice were air-dried at room temperature[9].

Results and Discussion

Degree of extraction

In the fruits 40.1 % of moisture content was determined. The concentration of the dye extracted from fruit was found to be 40.5% (on dry basis). This percentage of dye extraction was determined by specific density method. This method is the comparison of the density of dye solution with the density of the distilled water as shown in Plate 2.

Degree of Sun fastness

The result shows that the dye solution has no change in colour at temperature upto 28°C. Thus, the sun fastness of the dye has good stability Plate 3.

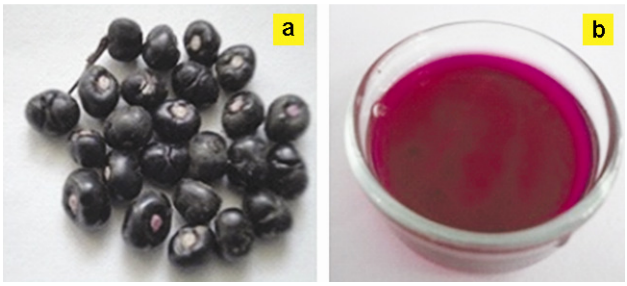

Plate 2—*Basella alba;* a. Fruit (moisture 40.1%), (b) dye extraction with water (40.5%).

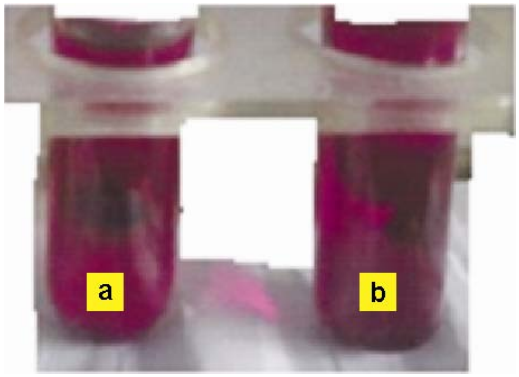

Plate 3—Effect of physical interpretation no degree of colour changed after keeping (a) With out Sun rays, (b) in presence of Sun rays.

Thermal stability

Aqueous dye solutions were subjected to various temperature for 10 minutes, their colour absorbance were detected at 536.9 nm in a UV spectrophotometer at 25°C and 60°C. Result shown that up to 60° C colour of the dye was stable as shown in Plate 4 (1, 2).

Above 100°C colour absorbance decreased and colour found to be unstable. Colour absorbance was not detected at 120°C as a result red-violet colour vanished. (Plate 4 (3, 4). At 25°C and 60°C colour was stable as observed from UV spectroscopy data, both having same absorbance.

Evaluation of dyeing of food material

The colour co-ordinates were positive with fruits colour in the space diagram as shown in Plate 5. It indicates a good coloration of beaten-rice and essay formation of food colour complex.

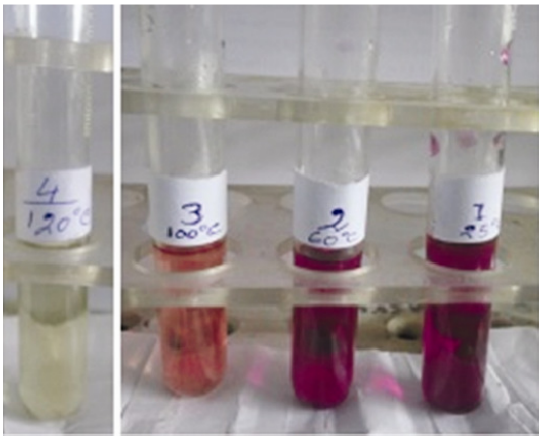

Plate 4—Effect of physical interpretation of thermal stability effect of colour changed, 1.- 25°C , 2.- 60°C, 3.- 100°C and 4.- 120°C.

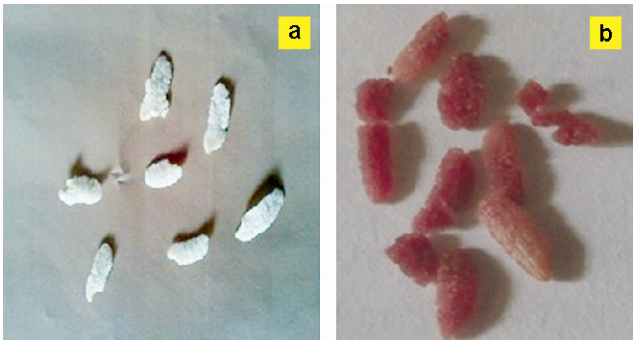

Plate 5—Beaten-rice photographs-(a) before dyeing and (b) after dyeing

Conclusion

Ceylon spinach plant species which is commonly available in NE region is used as traditional edible vegetable. The fruits of this plant have great demand for its colour content that can be used as natural dye for food coloration because of its antioxidant properties and thermal stability up to 60 °C. Scientific conservation, propagation and cultivation of the species is recommended for sustainable use.

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