

Preliminary and Potentiality Assessment study on Natural Edible Colorant Plant Resources from Pyadahlin Cave Area

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Abstract

The present study deals with the natural colorant plants which are edible and traditionally used by local people from Pyadahlin Cave Area, Ywa Ngan Township, Shan State were studied. This research was a qualitative and quantitative system approaching with multidisciplinary survey such as ethnobotany, taxonomy and observation research particularly PAS. It was conducted at Department of botany, University of Mandalay. Pyadahlin Cave lies between North Latitude 20° 75' to North Latitude 21° 10' and East Longitude 96° 18' to East Longitude 96° 29'. It is situated in Panlaung - Pyadahlin Cave Wildlife Sanctuary. The plant specimens were collected from July 2017 to February 2018. Altogether 8 species belong to 7 genera of 6 families were classified, identified and obtained in this research. Among them, red color can be extracted from *Caesalpinia sappan* L., yellow color can be extracted from *Buddleja officinalis* Maxim and *Curcuma longa* L., pale yellow color can be extracted from *Pandanus odoratissimus* Lf., orange color can be extracted from *Michelia champaca* L., green color can be extracted from *Pandanus odoratus* Ridl. and blue or purple color can be extracted from *Clitoria ternatea* L. and *Aeginetia indica* L. This research revealed that *Buddleja officinalis* Maxim, *Pandanus odoratus* Ridl. and *Aeginetia indica* L. were especially utilized for colouring and flavouring agents and also have great potential for manufacturing commercially produced. The morphological descriptions of the collected species with figures, scientific names, family names, Myanmar names, part use and preparation of their traditional process were also stated and discussed preliminarily in this research.

Keywords: ethnobotany, edible natural colorants

Introduction

The present study deals with the natural colorant plants which are edible and traditionally used by local people from Pyadahlin Cave Area, Ywa Ngan Township, Shan State. It lies between North Latitude 20° 75' to North Latitude 21° 10' and East Longitude 96° 18' to East Longitude 96° 29'. It is situated in Panlaung-Pyadahlin Cave Wildlife Sanctuary, Ywa Ngan Township, Shan State. The sanctuary is an important watershed area for the Kingda dam. This site can easily be reached by car and 37 km away from the east of Kume. The main attractions are the two limestones Pyadahlin Caves located in the Panlaung Forest Reserve. The smaller cave contains paintings that are over 11,000 years old, dated between the Mesolithic and Neolithic periods. The soil type of Pyadalin Cave Area is mostly clay soil and some places near watershed areas are slightly sandy. It is 150 m above sea level. The climate is hot and dry in lower elevation and moderates in higher elevation, with average rainfall recorded between 1,250 - 2,000 mm per year. Vegetation types are Mixed Deciduous Forest (Moist Upper and Dry Upper) and Indaing Forest (Beffasti *et al.* 2011). There are many interesting wild plant resources in this area.

This area is inhabited by three ethnic groups such as Shan, Danu and Myanmar. This diversity of the ethnic group, the specific location varied landscape, an appropriate environmental creates not only rich in biodiversity, but also cultural

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diversity. The local communities who live in Pyadahlin Cave Area with rich natural resources have accumulated a lot of knowledge about the traditional utilization of plant at hand. During their long struggle against nature, local community created and developed their own culture and become splendid in ordinary and food processing.

These people are especially experienced in plant pigment utilization. Rice is the staple of most of the ethnic group especially glutinous rice. On festive occasion, they make all kinds of local flavored foods with glutinous rice. They are not only good at wrapping various shapes and tasting, but also have a custom of extracting edible dyes from plants. They colour the rice to be red, yellow, green, blue or violet, etc. then make them glutinous candies. Creating the five coloured glutinous rice is so bright that local Tai or Shan people think of it as the symbol of happiness and good luck. During the traditional festival on first week of March, Tabaung full moon day, new house-warming, wedding, parent's or grandparent's birthdays and baby first month of life, all families make five coloured rice according to the Tai Tradition. Tai and Danu 2 people in this area believe in many gods and worship their ancestors who have a sacred position in their belief. The Tai girls have a traditional of holding a competition of making five coloured rice very year. For the colour pigments they traditionally used various plant resources as dye yielding plant. For various colors of rice various source of plants have been used; *Caesalpinia sappan* L. for red; *Pandanus odoratissimus* Lf. for pale-yellow; *Buddleja officinalis* Maxim., *Curcuma longa* L. for yellow; *Michelia champaca* L., for orange; *Pandanus odoratus* Ridl. for green; *Clitoria ternatea* L. and *Aeginetia indica* L. for blue or purple.

The aims and objectives of present works are to get the record on useful plant resources for dyeing food to identify and classify these plants scientifically to provide the plant systemic data, integrating with ethanobotanical information and to fulfill the requirement of record of an edible dye yielding plant resources from the ethnobotanical points of view.

Materials and Methods

All the plants found in Pyadahlin Cave and its surrounding area were collected and studied from July 2017 to February 2018. The plant specimens were recorded by photographs and were labelled. Field notes of the collected specimens and the habitat of precise locations were taken and recorded. Plant collection and the preparation technique of herbarium specimens are followed by the methods of Lawrence (1964). Classification and identification of families, genera, and species were carried out by referring to the literature of Flora systematically documented by Hooker (1885-1887), Backer (1963), Lawrence (1964), Hutchinson (1967), Dassanayake (1980 to 2001). The systematic arrangement of families was according to the classification system of Byng *et al.* (2016). The Myanmar names have been stated by following to Hundley & Chit Ko Ko (1961) and Kress *et al.* (2003). The useful parts of the plant colorant resources and mode of use were mentioned individually. The design of the research in trended on ethnobotany and conservation of colourant plant resources. The works are mainly included qualitative and quantitative measures and will also include eco-environment observing, biodiversity inventory and local knowledge, Participatory Rural Approach (PRA) methodologies by means of questionnaire survey will carry

out to reveal the eco-friendly knowledge for long term sustainability. Available literature and source of information could increase the knowledge information of their traditional way of sustainability.

Results

All the plant specimens found in Pyadahlin Cave and its surrounding area were collected, identified and studied. A total of 8 species belonging to 6 families were included.

1. *Michelia champaca* L.

Family Name : Magnoliaceae Juss. 3

Perennial trees; stems and branches terete, stout, gray bark, glabrous. Leaves simple, alternate; stipule sheathing the young foliage, caducous; petioles terete, glabrous; blades obovate-oblong, cuneate at the base, entire along the margin, acute at the apex, glabrous on both surfaces. Inflorescences axillary or solitary. Flowers bisexual, actinomorphic, hypogynous, tetramerous, yellow, fragrant; pedicel terete, glabrous; bract triangular. Perianth 12, linear-lanceolate, pubescent. Stamens numerous, free, exserted spirally arranged on a conically elongate receptacle; filaments linear; anthers ditheous, basifixed, lanceolate, longitudinal dehiscing. Carpels numerous, many, free; ovary numerous, superior; gynophore stout, glabrous, unilocular, 2 ovules in the locule, marginal placentation; style short; stigma decurrent. Fruits follicles, forming aggregate. Seeds ovoid, bright red, glabrous.

Flowering Period - May to July

Myanmar Name - Sa ga wa

User clan group - Tai people

Part Used - Flower

Colour of pigmentation - orange

Mode of use

Flowers should be dried at room temperature at 10 days. Tepals and anthers are then taken off from the flower. 15 grams of dried floral parts were used in cooking for 1000 gm. or rice. After cooking fragrant and Orange-brown coloured foods can be obtained. Tai people regarded as *Michelia champaca* L. as holy flower and they usually stain with this pigments for the food preparation at religious festivals.

2. *Pandanus odoratissimus* L.f.

Family Name : Pandanaceae R.Br.

Perennial dioecious, every green, small tree with a dense cluster of leaves near the top of a slender stem, aerial roots near the base, grey, glabrous, stem and branches terete. Leaves simple, spirally arranged, exstipulate, Petiole sheathing at the base, glabrous; leaf blade ensiform, coriaceous, green and glabrous on both surfaces, truncate at the base, serrate along the margin, acuminate at the apex, many parallel - veined present. Male inflorescences terminal, solitary, globular head, many each flower, peduncle long, pale green, glabrous; staminate flower yellowish green, small, fragrant, sessile, ebracteolate. Stamens numerous, united into four bundles, free filament, short, pale yellow; anther ditheous, saggitate, introse. Female flower pale

yellow, small, sessile, ebracteate, bracts linear, lanceolate. Carpels many, free, ovary oblong, pale yellow, glabrous, unilocular, one ovules in a locule, basal palcentation; style sessile; stigma truncate. Fruits drupaceous.

Flowering period - October to December

Myanmar Name - Sutthapoo 4

User clan group - Tai people

Part use - Inflorescence and bracts

Colour of pigmentation - pale yellow

Mode of use

First, inflorescences and bracts of flowers are dried at room temperature, 20 gm. of flowers and bracts are extracted with boiling water of 100 ml for 20 minutes, then filtrate is removed. Glutinous rice is soaked with the juice extraction of *Pandanus odoratissimus* Lf. flowers for 5 hours. After the rice has well absorbed, the dyes enough to be coloured, pour off the water, steam the rice that has been dyed with yellow-coloured rice and fragrance. Tai Lian people valued the *pandanus odoratissimus* Lf. as sacred plant and they are accustomed to cultivating at the dooryard. This kind of rice is often entertained at festival of paying respect to village spirits (Yar Saunt Nut Pu Zaw Pwe).

3. *Pandanus odoratus* Ridl.

Family Name : Pandanaceae R.Br.

Perennial herbs, evergreen; stems branched; aerial roots present. leaves broadly linear, somewhat glaucous abaxially, keeled abaxially but unarmed, entire along the margin except at apex, there with very few minute prickles less than 1 mm, distinct twin lateral pleats at the apex; flowers probably never produced in small growth phase. Female inflorescence unknown; male inflorescence (rare) probably pendent, spikes cylindrical, upper ones much shorter, of numerous crowded, flat staminal phalanges; stamens mostly 3-6 per phalange; anthers oblong, apex bluntly convex, without or with a barely discernible apiculum.

Flowering Period - May to July

Myanmar Name - Soon Hmwe

User clan group - All groups of Tai or Shan, Danu and Myanmar

Part use - Fresh leaves

Colour of Pigmentation - Green

Mode of use

10 gm. of fresh leaves pounded into small pieces and mixed with 100 ml of water. The mixture is then filtered through the sieves. So the solution of leaves extraction is green and very fragrant. It can be dyed 1000 gm of glutinous rice. It is the most popular and favourite edible dye of all groups of Shan people. They also used in moat loot saung. The green glutinous rice or simple rice dyed with *Pandanus odoratus* Ridl. leaves are widely used.

4. *Curcuma longa* L.

Family Name : Zingiberaceae Martinov. 5

Perennial rhizomatous herbs; rhizomes yellow inside, elliptic, aromatic, fleshy. Leaves simple, alternate, sheathing petioles equaling leaf blade, leaf blades oblong or

narrowly lanceolate, dark green, pubescent on lower surfaces, attenuate at the base, entire along the margin, acuminate at the apex. Inflorescences terminal spikes on a leafy stem. Flowers zygomorphic, bisexual, epigynous, trimerous, pale yellow, bracteate. Calyx 3, split down on one side, white to pink, membranous, pink. Corolla funnel-shaped, pale yellow, lobes obovate, membranous. Fertile stamen 1, included, filament short, flattened, pale yellow; anther obovate, ditheous, dorsifixed, pale yellow, longitudinal dehiscence, spur present at the base of the anther; lateral staminodes obovate, labellum obovate, yellow. Carpels 3, united; ovary inferior, oblongoid, trilocular, pubescent, few ovules in each locule, axile placentation; style filiform, white, glabrous; stigma cup-shaped. Fruits loculicidal capsule.

Flowering Period - July to September

Myanmar Name - Sanwin, Nanwin

User clan group - Tai, Danu and Myanmar

Part use - Fresh rhizome

Colour of Pigmentation - yellow

Mode of use

Fresh rhizome was pounded into small pulps. Yellow paste about 5 gm. was mixed with 100 ml of water and then filtrated. Glutinous rice is soaked in the extracted yellow juice of rhizome for nearly 6 hours. Then well-absorbed rice was steamed and yellow coloured rice could be obtained. *Curcuma longa* L. is used by Shan people, when *Buddleja officinalis* Maxim. is not available.

5. *Caesalpinia sappan* L.

Family Name : Fabaceae Lindl.

Perennial, shrubs or small trees; stems and branches terete, recurved prickles, green, glabrous. Leaves bipinnately compound, alternate; stipules spiniform, brownish green, glabrous, caducous; petioles terete, brownish green, sparsely pubescent; rachae green, densely pubescent; stipels absent; petiolules terete, 0.2 densely pubescent; leaflets 8- to 12-paired, opposite, oblong, green, glabrous above, short densely pubescent beneath, oblique at the base, entire along the margin, truncate or rounded at the apex. Inflorescences supra axillary and terminal raceme, many-flowered; peduncles 10 to 40 cm long, glabrous, recurved prickle. Flowers yellow, zygomorphic; bracts lanceolate, green, puberulent, caducous; pedicels terete, yellowish-green, sparsely pubescent, articulated at the top. Sepals 4, unequal, ovate, yellowish-green, ciliate. Petals 5, caesalpinaceous, unequal, ovate or orbicular, yellow, glabrous, clawed. Stamens 10, all perfect, exerted; filaments filiform, yellowish-white, glabrous top, densely ciliated at the base; anthers uniform, dorsifixed, ditheous, dehiscing by longitudinal slits. Ovary linear, pale green, 6 glabrous, unilocular with few-ovules in the locule on the marginal placentae; style slender, yellowish-green, glabrous; stigma simple, ciliate. Pods oblong to elliptic, flattened, dehiscent, 2- to 4-seeded, black at maturity, glabrous.

Flowering Period - November to December

Myanmar name - Teimyet (or) Sunthe

User clan group - Tai people

Part use - Wood chip

Colour of pigmentation - Pink to red

Mode of use

About 20 gm of wood chip is boiled with 100 ml of water for 15 minutes. Alum is also added as mordant. The decoction can be obtained as the red coloured stain. This stain can be used to prepare the glutinous rice cake. Red coloured dye, extracted from *Caesalpinia sappan* L. is the most essential substance for Tai people in order to prepare to red coloured rice cake and 5 colour cake at their traditional festivals.

6. *Clitoria ternatea* L.

Family Name : Fabaceae Lindl.

Annual, scandent or twining herbs; stems and branches terete, green, pubescent, solid. Leaves unipinnately compound, imparipinnate, alternate; stipules linear-lanceolate, green, pubescent, persistent; petioles cylindrical, green, pubescent; rachae cylindrical, pale green, pubescent; stipels minute; petiolules cylindrical, pale green, pubescent; leaflets usually 5 to 7, ovate or elliptic, obtuse at the base, entire along the margin, retuse or often faintly emarginate at the apex, appressed-pubescent on both surfaces. Inflorescences axillary, solitary, simple raceme; peduncles cylindrical, pubescent. Flowers purplish-blue or bright blue, zygomorphic; bracts lanceolate, with 2 minute bracts at the junction; pedicels cylindrical, pale green, pubescent; bracteoles broadly ovate-orbicular, pubescent. Calyx 5-lobed; tubes campanulate, membranous, pubescent without, glabrous within, persistent; lobes lanceolate, subequal, pale green. Corolla papilionaceous, much exerted; standard broadly obovate, bright blue with a pale yellow blotch, glabrous or puberulent; wings oblong, clawed long, bright blue at the apex, glabrous, adhering to the keel; keels boat-shaped, pale yellow, pubescent without, glabrous within. Stamens 10, diadelphous; free filament filiform yellowish-green, glabrous; anthers ditheous, dorsifixed, uniform, dehiscing by longitudinal slit, oblongoid, yellow. Ovary superior, unilocular, few-ovules in the locule, marginal placentation, style terminal, filiform, curved, yellowish-green, densely woolly; stigma simple, flat. Pods linear, compressed, dehiscent.

Flowering Period - September to November

Myanmar Name - Aung Mae Nyo

User clan group - Tai people 7

Part use - Flower

Colour of Pigmentation - Blue to indigo

Mode of Use

15 gm. of fresh flowers from *Clitoria ternatea* L. are boiled with 100 ml of water for 15 minutes, 2 gm of alum is also put as mordant. The flowers decoction can be used as dye. Small amount of decoction can be made blue colour while more dosage can be caused the deep indigo colour. If the fresh flowers cannot be available, dried flowers can also be substituted. This natural dye is very popular among the Tai people and it is usually used for staining the rice cake at Tai's newyear day and wedding.

7. *Buddleja officinalis* Maxim

Family Name : Loganiaceae R.br. ex Mart.

Perennial shrubs, branchlets terete or slightly 4-angled. Leaves abaxially, petiolate; petioles long; leaf blade ovate to elliptic or narrowly so, adaxially glabrescent, cuneate to decurrent at the base, entire, sinuate, or repand-dentate along the margin, acuminate, acute, or obtuse at the apex; lateral. Inflorescences terminal paniculate or thyrsoid, densely stellate tomentose. Calyx campanulate, outside densely stellate tomentose and with some glandular hairs; lobes triangular to broadly triangular. Corolla pinkish, lilac, or pale purple, with an orange throat, 1-1.3 cm, outside densely stellate tomentose and with some glandular hairs; tube inside densely pilose; lobes suborbicular, inside glabrous. Stamens included, inserted just above middle of corolla tube; anthers oblong, 0.8-1.3 mm. Ovary ovoid, stellate tomentose and with some glandular hairs but glabrous below middle; style 1-1.5 mm, basal hairs like those of ovary; stigma clavate. Fruits capsule, ellipsoid, stellate tomentose or glabrous. Seeds narrowly elliptic, winged all around.

Flowering Period - December to February

Myanmar Name - Kyaung mai gu pan

User clan group - All groups of Shan

Part use - Dried flower

Colour of Pigmentation - Yellow

Mode of use

About 10 gm. of dried flower are added with 100 ml of water and boiled for 15 minutes. Juice extract from the flower are yellow colour with pleasant aroma. This yellow dye is used to being stained 1000 gm of glutinous rice at every special occasion. That particular yellow dye extracted from the *Buddleja officinalis* Maxim. is the most widely used among the Tai or Shan people and found to be preferred mostly. It is widely practiced both the traditional and religious occasions.

8. *Aeginetia indica* L.

Family name : Orobanchaceae Vent.

Annual saprophytic herbs; root slightly fleshy, stems unbranched or branched from near base. Leaves ovate-lanceolate or lanceolate, red, glabrous. Inflorescences solitary cyme. Flowers zygomorphic, bisexual, hypogynous, purple-red; ebracteate, pedicellate; pedicel very long, purple, twist. Calyx oblique, acute or acuminate at the apex, creamy to purple. Corolla indistinctly bilabiate, tubular-campanulate, purple-red striate; tube slightly curved; lobes subentire. Stamens 4, epipetalous; filaments purple, glabrous; anthers arrow head shaped, basifixed, pale yellow. Carpel 1; ovary superior, ovary unilocular, many ovules in a locule, parietal placentation; style stout; stigma capitate with three furrows, pale yellow. Fruits capsules, conical or long ovoid-globose. Seeds ellipsoid, yellow.

Flowering Period - October to December

Myanmar Name - Kauk Hlaing ti

User Clan group - Tai, Danu and Myanmar

Part use - Fresh flower

Colour of pigmentation - Purple

Mode of use

15 gm. of fresh flowers are pounded and then mixed with 100 ml of water. The mixture is boiled for 20 minutes. After being cooled, the extracted solution was filtered through fine cloth. Both filtrate and solution can be used as dyeing materials. Filtrate is mixed with 500 gm. of glutinous rice and dyeing solution is put into the cooking. *Aeginetia indica* L. is used for colouring and flavoring.

Discussion and Conclusion

The rich resources of living things in this area have supported human subsistence in this region. They have depended on the plant resources nearby for their lives and production activities for more than two thousand year.

Tai people have quite a rich traditional knowledge of extracting edible dye from plants (Linang 1978). Not only they utilized several species, but the method of extracting dye and colouring foods are very simple. In this area, Tai and Danu People stayed at Ywa Ngan area, Kanse village and they have to associate with sub-tropical flora in the use of pigmentation plant resources. Obtaining of yellow colour dye, all the Tai people used *Buddleja officinalis* Maxim. and *Carcuma longa* L.. According to most of the Tai people *Buddleja officinalis* Maxim. beings one of the most essential dye yielding plant resources, that can not be substituted for its flavor and colour. For the red dye, Tai and Danu people used *Caesalpinia sappan* L. for required red colour. For green dye, *Pandanus odoratus* Ridl. was widely used as colouring agent. It contributes not only the colour, but also the flavor. For this reason, it has become the most and favorite 9 dyeing plant materials among the Tai people. Another interesting feature of utilizing of dyeing plant materials can be studied at Tai food processing. Local communities are accustomed to making yellow glutinous rice with bracts and inflorescence of *Pandanus odoratissimus* Lf.. It provides pale yellow colour with very pleasant smell. As mentioned above, the arts of Tai people in utilization plant resources for dyeing food are very interesting. These pigments have not been polluted by harmful chemical dye. It has great potential for commercial production. *Buddleja officinalis* Maxim., *Caesalpinia Sappan* L., *Clitoria ternatea* L., *Pandanus odoratus* Ridl., can be cultivated as commercial scale at this study area. It is effective, healthier easily processed plants resources for the substitution of chemical dye especially used in confectionery.

Therefore, it is very significant to further study how to look for new natural traditional foods. The preparation of dyeing methods and plants resources are based on their tradition, when were found to be closely related to their cultural belief and not to be the random action. Further studies on the edible dye yielding plant resources can be resulted not only to develop scientific research, but also to add new useful information on the mode of life of modern societies for the substitution of harmful inorganic chemical dye. Local communities are very nature oriented and they have a magnificent accumulation of indigenous knowledge in cooking culture, distilled from past experiences and handed down by generation to generation. Now, these indigenous knowledge have become the common heirloom of local people, to be preserved and documented. Regarding the food dyeing culture, it can be considered as

culture-linked social entertainment, mostly celebrated at Newyear and Tabaung Full-moon festival as traditional enjoyment. They are probably like to have the Scene of Seasonal changes that they experienced by having these flower colour on the table in the form of food stained with multi flower colour.

In addition, local communities chose the dyeing plant resources not only for enjoying the beauty of nature, but for nutritional and medicinal value; become most of the dyeing plant resources are found to be pharmaceutically important by Ayuveda Traditional Myanmar. This result of discovering from local community of Pyadahlin Cave Area will provide an understanding of the value of that natural resource to the whole society and will eventually increase the use of dyeing plant resources for human food source. Although, food dyeing culture, belongs to local communities of Pyadahlin Cave Area, it is a very small component of cultural diversity, but it can contribute the uniqueness, traditional knowledge, artistic craftsmanship in culinary and nature-base-creation for the local society, which can be tangible in the field of ethnobotany.

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