Natural dye yielding plants and indigenous knowledge of dyeing in Manipur, Northeast India

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The people of Manipur, which lies under the Indo-Burmese region, have been using indigenous dyestuffs from plants since time immemorial, in handicrafts, handlooms, fine arts, etc. There are more than 50 plants species in Manipur, which are used as dyes right from ancient times, before chemical dyes were introduced in the state. *Strobilanthus flaccidifolius* is one such plants being traditionally used by the people of the state for preparing dye. Many tribes and Meitei community of Manipur have been using species like *Parkia javanica*, *Melastoma malabathricum*, *Pasania pachyphylla*, *Solanum indicum*, *Bixa orellana*, *Tectona grandis*, etc. The Maring tribes still uses the fruit of *Melastoma malabathricum* for staining teeth in dark blackish red; it strengthens the teeth and protects from gum diseases and cavities. These plants are used traditionally in combination with other plants for extraction and preparation of dyes utilizing indigenous processes. The compounds isolated from these dye yielding plants and the indigenous knowledge on dye preparation in Manipur is reported.

**Keywords**: Meitei tribes, Maring tribes, Natural dye, Manipur, Indigenous knowledge

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Manipur, a Northeastern Indian state lying at 23°49′ - 25°41′ N latitudes and 92°59′ - 94°45′ E longitudes is rich in plant diversity of ethnobotanical and economical importance. The people of the state have been using indigenous dyestuffs from plants since time immemorial, in handicrafts, handlooms, fine arts, etc., as mentioned in the old literature of the state like the Royal Chronicle (*Cheitharol Kumbaba*). The total geographical area of the state is 22,327 sq. km with the forest area covering about 15,154 sq km (67.8% of the total geographical area). The state neighbours Nagaland in the North, Myanmar in the East, Mizoram and Chin Hills of Myanmar in the South, and Cachhar district of Assam in the West. The mean temperature varies between 5°C and 32°C, while relative humidity varies between 43% and 92%, respectively. The average annual rainfall measures about 146.71 cm.

Different ethnic groups and communities inhabit the state, giving rise to a rich mosaic of culture and tradition. According to 2001 census, 29 recognized tribal communities (30% of the total state population) belongs to Kuki and Naga groups, and 57% of the population is constituted by the Meiteis, an Indo-Mongoloid group speaking Tibeto-Burman language. Besides these, Meitei Muslims (7% of the state population) and 7 schedule caste communities also inhabit the state. A tribe can be recognized by its dress and custom. There has been a linguistic and cultural affinity between Meiteis and the hill tribes, and has played equally important roles in the long ambiguous process of accumulating the present artistic and cultural heritage of the state, despite the geographical separation. The Northeast India falls under the Indo-Burmese region, which is the sixth among the 25 mega diversity hot spots of the world. There are more than 50 plants species in Manipur, which are used as dyes right from ancient times, before chemical dyes were introduced in the state, around 1905 AD. Fast chemical dyes were found to be available in the Imphal market since 1930 AD.

The process of dyeing was started during the reign of King Taothing-Mang (264-364 AD). The system of dyeing progressed during the reign of King Yanglao Keiphaba (969-984 AD), who introduced the beautiful textile *Hij Mayek* (later known as *Hijam mayek*) colourfully dyed, and worn by the women folk of Manipur. During the reign of King Loyumba (1074

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AD –1133 AD), the traditional system of dyeing cloths using different varieties of plants leaves, flowers, fruits, and barks was at its best. It was during his reign that better designs of costumes were introduced, and different clothes worn for different occasions. He distributed the duty of dyeing of yarns with plant parts to different clans, where each was assigned for a particular colour of yarn and cloth.

Enumeration

Some plants, which were used by the people of Manipur for dyeing are:

**Acacia catechu** Willd. (Mimosaceae); Local name—*Kabokhajee*

A fast reddish black dye is obtained from the heartwood by boiling in water for about one hour. The dye is used in the preparation of local ink and dyeing cotton fabrics.

**Achyranthes aspera** Linn. (Amaranthaceae); Local name—*Khujumpere*

Whole plant is dried, burnt to ashes and mixed with water. This is used as adhesive for various colours and making the colour brighter. Betaine, ecodysterone (polypodine A), and edcsyone were isolated from roots; two oleanolic acid based saponins from fruits; a new aliphatic dihydroxyketone – 36,47-dihydroxybenzenecotan-4-one, 17-pentaacylactone, 27-cyclohexyl- heptacosan-7-ol, 16-hydroxy-26-methylheptacosan-2-one from shoots; penta triacanthone, pentatracontanone, hexatracontane, and tritriacontane were isolated from stems; whereas hentriacontane, 10-octacosanone, 10-triacosanone and 4-tritriacontane were also isolated from seeds\(^1\).\(^7\).

**Amoora spectabilis** Miq. (Meliaceae); Local name—*U-ngang*

A pale scarlet colour is obtained from the heartwood by boiling with water and it is used for dyeing cotton fabrics.

**Basella alba** Linn. (Basellaceae); Local name—*Urok sumbal*

A deep purple dye is obtained from the ripe fruits. Different colours obtained from the leaves, and stems are used for dyeing fabrics and in painting. Betacyanins–isogomphrenin I, isogomphrenin II, gomphrenin I, gomphrenin II, and gomphrenin III were isolated from fruits\(^8\).

**Bauhinia purpurea** Linn. (Caesalpiniaaceae); Local name—*Chingthrao angangba*

A rose purple dye is obtained from the fresh flowers. Fresh petals are directly applied on the cloth or surface to be dyed. The dye is also used in painting. Isoquercitrin, astragalin, and querecin were isolated from the fresh flowers; pelargonidin-3-glucoside, pelargonidin-3-triglucoside, and a new chalcone – butein-4′-O-L-arabinopyranosyl-O-β-galactoside were also isolated\(^9\).\(^11\).

**Berberis manipurana** Ahr. (Berberidaceae); Local name—*U-napu*

A beautiful yellow dye is obtained from the stem and roots by boiling in water. It is mainly used for dyeing mulberry silk fabrics (*Kabrang*)\(^12\).

**Bixa orellana** Linn. (Bixaceae); Local name—*Ureirom*

A pale red dye obtained from the seeds soaked in cold water, the dye is used for dyeing clothes or yarn threads. Tomentosic acid a tetracyclic sesquiterpene-ishwarane, geranlyleranial, bixin, farnesylactone, geranlygeranyl octadecanoate, geranlygeranyl formate, δ-tocotrienol, apocarotenoid, isoscutellarein, and 3,5-dicaffeoylquinic acid were isolated from the seeds\(^13\).\(^16\).

**Carthamus tinctorius** Linn. (Asteraceae); Local name—*Kusumlei*

A golden yellow dye (*Sana Phige machu*) is extracted from the flowers using different extraction techniques. The flowers especially the petals are collected and kept until they become decayed or fermented. The decayed or fermented petals are mixed with water and filtered. The yellow dye so obtained is concentrated and mixed with alkalis, and add the ash of *Achyranthes aspera* Linn. (*Khujumpere*) to yield a pink red dye. The dye is used for dyeing of cotton and silk clothes, and also in painting. Carthamin (6-glucosidoxo-2,4,5-tetrahydrochalcone), neo-carthamin (5-glucosidoxo-4,6,7-trihydroxyflavanone), tracheloside (2-hydroxyarctin), and a steroid cellobioside were isolated from flowers. Polycetylenes–1-tridecane-3,5,7,9,11-pentayne, (11Z) trideca-1,11-diene-3,5,7,9,11-pentayne, (3Z,11Z)-trideca-1,3,11-tetranene-5,7,9-triyn, (3E,5Z,11E) trideca-1,3,5,11-tetraene-7,9-diyne and (3Z,5E,11E) trideca-1,3,5,11-tetraene-7,9-diyne were also isolated from the flowers\(^17\).\(^19\).
Yellow and red pigments isolated from the flowers were found to be safflower yellow A and carthamin, respectively. Astragalin, 6-hydroxykaempferol, its 3-glucoside, 3,6-diglucoside, 3,6,7-triglucoside and 3-rutinoside-6-glucoside from dried petals; a new N-containing quinochalcone glucoside – tinctormine – from safflower; another new quinochalcone C-glucoside – hydroxy safflower yellow A along with safflower yellow B and safflower yellow C from dried flowers; in addition, a C31 alkanediol – (6S,8R)-erythro-hentriacontane-6,8-diol and 6,8-diols of eicosane, tricosane, pentacosane, heptacosane, octacosane, nonacosane, triacontane, dotriacontane, tritriacontane, tetratriacontane and pentatriacontane were also isolated.

_Celosia argentea_ Linn. (Amaranthaceae);
Local name— _Haorei angangba_
A pink red is obtained from the flowers and is used for painting. Celosianin (10-coumaroyl-betaanicin-5-O-glucoronosylglucoside) and isocelosianin (10-feruloyl-isobetanidine-5-O-glucoronosylglucoside) were isolated from the plant. 

_β_-sitosterol, cholesteryl palmitate, 3,5-dihydroxybenzaldehyde, 4-hydroxybenzoic acid, 3,4-dihydroxybenzoic acid, n-butyl-β-D-fructoside and sucrose were also isolated from seeds.

_Clerodendrum odoratum_ D. Don (Verbenaceae);
Local name— _Kuthap._
A pale green dye is obtained from the leaves. The fresh leaves are crushed and boiled in water until the dye is fairly concentrated. After cooling, acidic dye mordants are added before use. Then, the cloth or thread to be dyed is soaked overnight.

_Clitoria ternatea_ Linn. (Papilionaceae);
Local name— _Aprajita_
A blue dye is obtained from the dried flowers by extracting with water and the dye is used for painting. A lactone, aparajitin from leaves; taraxerol from roots; a phenol glycoside, 3,5,7,4-tetrahydroxy-flavone-3-rhamnoglycoside, an alkaloid, ethyl α-D-galactopyranoside and p-hydroxyxycinnamic acid polypeptide from defatted seeds were isolated. Hexacosenol, β-sitosterol, and an anthoxanthin from seeds were also isolated. Kaempferol-3-O-rhamnopyryl(1→2)-glucoside and kaempferol-3-O-rhamnopyryl(1→6)-glucoside, kaempferol-3-O-rutinoside, kaempferol-3-O-neohesperidoside and kaempferol 3-O-rhamnopyryl(1→2)-O-rhamnopyryl(1→6)-glucoside, (clitorin) were isolated from the leaves. Malvidin-3β-glucoside, delphinidin-3β-glucoside, and 3′-methyl ether of delphinidin-3β-glucoside from blue flowers were isolated.

Six new anthocyanins – ternatins A1, A2, B1, B2, D1 and D2 – were isolated from flowers. Structure of ternatin D1 was established as 3-O-(6-O-malonyl-β-D-glucopyranosyl)-3,5′-di-O-(6-O-E-4-O-(6-O-E-p-coumaryl-β-D-glucosyl)-p-coumaryl)-β-D-glucopyranosyl)delphinidin.

_Curcuma domestica_ Valeton syn. _C. longa_ Linn. (Zingiberaceae);
Local name— _Yaingang_
A yellow dye is obtained from the rhizomes which are crushed into pieces and allowed to soak in water. By adding lime water or alkali, a red dye could also be obtained. Campesterol, stigmasterol, β-sitosterol, cholesterol, and fatty acids comprised of saturated straight chain, saturated iso, monoenoic and dienoic acids. Two novel compounds, 4′-(3′-methoxy-4′-hydroxyphenyl)-2′-oxo-3′-enebutanyl-3-(3′-methoxy-4′-hydroxyphenyl) propenoate (calebin-A) and 1,7-bis(4-hydroxy-3-methoxyphenyl)-1,4,6-heptatriene-3-one. In addition to seven known compounds, 1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione (curcumin), 1-(4-hydroxy-3-methoxyphenyl)-7-(4-hydroxyphenyl)-1,6-heptadiene-3,5-dione (demethoxycurcumin), 1,7-bis(4-hydroxyphenyl)-1,6-heptadiene-3,5-dione (bisdemethoxycurcumin), 1-hydroxy-1,7-bis(4-hydroxy-3-methoxyphenyl)-6-heptene-3,5-dione, 1,7-bis(4-hydroxyphenyl)-1-heptadiene-3,5-dione, 1,7-bis(4-hydroxyphenyl)-1,4,6-heptatrien-3-one and 1,5-bis(4-hydroxy-3-methoxyphenyl)-1,4-pentadiene-3-one were also isolated from the rhizome.

_Emblica officinalis_ Gaertn. (Euphorbiaceae);
Local name— _Heikru_
A black dye is obtained from the barks or fruits which are soaked in water for 4 to 5 days or boiled. The dye is used for dyeing fishing nets. Trigalloylglucose, terchebin, corilagin, ellagic acid were isolated from fruits.

_Iris bakeri_ Wall. (Iridaceae);
Local name— _Komberei_
A blue colour is obtained from the flowers. The flowers are also offered to God on Manipuri New Year’s Day (Local name – Cheiraoba).

Melanorrhoea usitata Wall. (Anacardiaceae); Local name—Khe-U
An oily blackish dye is obtained from the woods and roots. The tree is used for furniture as it gives natural colour. Two sesquiterpene hydrocarbons, calarene and α-gurjunene along with 4-methyl-7-isopropylazulene were isolated41.

Melastoma malabathricum Linn. (Melastomataceae); Local name—Yachubi
Locally called Yachubi, the literal meaning being “colouring/staining teeth”, the dark blackish red fruits of the plant were basically used for staining teeth in olden days by the Meiteis and the Maring tribes of Manipur. Though the practice has ceased in present Manipur among the Meiteis, the Maring tribe still uses the fruit for staining teeth in dark blackish red till date. It strengthened the teeth and protect from gum diseases and cavities. However, the method that can be successfully employed for the extraction of dye from the fruit in a similar way as that employed for other dye plants is documented, where the ripe fruit is boiled in water and filtered.

Leaf paste acts as a styptic, when applied to cuts and wounds. The flowers are used to ease stomachache and root decoction is taken for measles. Scars left by small cuts are rubbed on with the plant’s purple flowers and also used in a face wash. A semi-solid compound of red colour, 2,3-[(S)-4,4,5,5,6,6-hexahydroxydiphenoyl]-4,6-[(S)-4,4,5,5,6,6-hexahydroxydiphenoyl]-5-ga-lloyl-1-methoxy-D-glucopyranoside was found to be the main colourant component, besides another tannin compound methyl derivative of Punicacorterin A, which was dark red solid was also isolated at higher polarity than the other colourant42.

P. roxburghii G. Don (Mimosaceae); Local name—Yongchak
The leaves are bi-pinate with numerous small curved leaflets and flowers in dense turbinate or clavate heads hanging on long peduncules. The fruit comprises bunches of green pods which may be up to 50 cm in length. On maturation, the pods turn black and contain yellow dry powder pulp in which are embedded several black seeds43. It is a tropical medium size to tall tree, whose fruits and pods are eaten as one of the favourite delicacies cooked or roasted and raw. Locally called Yongchak, the plant grows abundantly in the foothills of the State as well as in the backyard of houses in the valley. The fruits are reported to be useful in bleeding piles and the concoction of the bark in dysentery and diarrhoea. Various other works on the plant’s morphology, nutritional content of the fruit/pod and the medicinal values of the various other plant parts have been reported44,45.

Fruit skin of Parkia javanica was known to give brown colour but it was not extensively used for dyeing fabrics. Though not documented, it was used to give a permanent brown colour when used along with water in pichkari during Holi (colour festival). In olden Manipur, dye extracted from tree bark and fruit skin was also used in different fishing nets called Nupa eel (fishing net of male), Nupi eel (fishing net used by female), and Longthraugi eel (fishing net used by throwing), etc. The main principle isolated in significantly high amount from the fruit skin extract is myricetin 6-C-glucopyranosyl-3-O-d-L-rhamnoside42.

Pasania pachyphylla (Kurz.) Schottky (Fagaceae); Local name—Kuhi
The Bark has been used as a source of reddish-brown to brown dye. Though its main use is as firewood, the brown dyes from its bark extract have been used in potteries and in fishing nets. From the methanol extract of the bark, oleanolic acid, taraxastenol, stigmasterol glucoside, 3-methoxy-oleana-12-en-1-one, ursolic acid, 23-O-gallloyl-3,24-doublehydroxydiphenoyl-23,24-tetrahydroxy-olean-12-en-1-one, ursolic acid, 23-O-galloyl-3,24-
hexahydroxydiphenoyl-23,24-tetrahydroxy-olean-12-en-28-oic acid were isolated42.

Solanum incidum Linn. (Solanaceae); Local name—Khamu
Purple dye was prepared from the plant was used for making the artistic design of Khamenchappa (a specific cloth which was reserved for the use of kings and noblemen). The term Khamenchappa is believed to be derived from two words, viz., Khamu, meaning a kind of small plant, the juice of which is used as printing ink, Chappa, meaning pressing (here pressing the garments with a wooden block of curved out patterns for pouring the liquid of Khamu). The colour of Khamenchappa was based on the colour used by each of the seven clans of Manipur (Fig. 1). Besides serving as an identification mark of a clan, it is used as a costume of the noblemen. It is also used
as dance costume of Lai-Haraoba (festival of worshipping Gods), martial arts and sports like wrestling (Mukna), Polo (Sagol Kangjei), and hunting games.

The process of collecting the deep chocolate dye from the plant Solanum incidum (Khamu) is depicted as follows. The ripen fruits of Khamu are made into pieces or powdered to which water is added (about 1 litre of water into half kg of the sample). The solution is stirred with the help of a wooden spoon or stick. The solution is kept for about six hrs and is then filtered using a coarse cloth. The filtrate could be used as such or it is concentrated. To make the dye fast in colour, a mordant usually an alkaline mordant derived from the plant, Achyranthus aspera (Khuchumpere) could be added. The alkaline mordant is obtained as ash by burning the plant. The ash solution of the mordant and the solution of Khamu are mixed in equal amounts and the mixture is boiled till the desired colour is obtained. The Khamu-dye thus obtained is usually used for dyeing turban, dhoti and chadar which are used by noblemen. The process of dyeing clothes using Khamu-dye is known as Khamu Chappa which is more commonly known as Khamen chappa.

Strobilanthes flaccidifolius Nees. syn. S. cusia (Nees) Imlay (Acanthaceae);
Local name—Kum

The plant is used for imparting indigo colour and black (Figs 2,3). Different lighter and darker shades of black are obtained by adding other dye plants. For instance, for obtaining a deeper shade of black, bark of dye plant Pasania pachyphylla (kuhi), bark of Emblica myrobalan (heikru) and even an amount of a type of mud (leitan) is added to Kum dye. In Manipur, the preparation of the various dye-stuffs is based on the traditional methods being practiced by the people of the State. The process of dyeing is also different for different dye-stuffs, depending on the nature of the dye to be prepared and the plants to be used. More than one type of plant could be used for preparing a particular dye. As an illustration, the preparation of the various components of the Kum dye derived from the plant, Strobilanthus flaccidifolius is given. Of all the natural dyes used in the State, use of and preparation of dye-stuff from Kum plant was considered the most important, elaborate and most carefully conducted. The buds and leaves of the plant which sprout during January- March were plucked, cut to pieces and put into a pitcher (kharung), in which water was poured. (2 Kg of leaves in 8 litres of water). The pitcher was then kept for about a week at yenakha (outer southern side) of the house where there is sunlight, so that the leaves undergo proper fermentation. When proper sunlight is not available, the number of days of fermentation can be extended to about 20 days or so.

This pitcher was regarded as Leiremma (goddess) and a social taboo of not allowing women in their menstrual period to touch the pitcher was strictly observed. After the fermentation, the cover of the pitcher was removed and stirred with a multi-pronged stick, called Yabi or Kumsu chei. After careful stirring, the solid things as leaves were removed and oyster lime (kum sunu, prepared by burning oyster shell along with dry cow-dung and hay, the traditional fashion of calcination) was added and properly stirred. The bubbles so formed were removed from time to time. The stirring was continued until the solution became reddish in colour. The whole solution was then allowed to settle down so that proper sedimentation took place; the clear liquid was then decanted. The residue was filtered through a piece of thick cloth placed over some required amount of ash (utti), which acted as absorbent of water contained in the residue, the prepared Kum dye. To make the
colour dye fast, ashes taken from burning of leaves of Achyranthes aspera (Khujumpere) or the dried barks of banana (Laphu chanang) were added. The colour of the prepared dye was greyish-blue.

Dye-stuffs of different colours can also be prepared from the kum dye. For deep black colour, the material after dyeing in the kum, is dipped in the clay water and kept for one or two days, and then dipped in the liquid infusion of Emblica myroblam (Heikru). The black colour can also be made by mixing the liquid taken from the bark of Pasania dealbata (Shahi), soaked in water and the kum-dye. The liquid taken from the leaves of Clerodendron adoratus (Kuthup) is added to make the colour of the dye fast. Lupeol, betulin, lupenone, indirubin, 4(3H)-quinazolinolone and 2,4(1H, 3H)-quinazolimedione were isolated. The main compounds isolated from the leaves and young shoots of the plant are β-sitosterol, β-sitosterol-α-D-glucoside, cyanidin-3-O-(6-O-malonyl)-β-D-glucopyranoside, stigmasterol glucoside, 3′-hydroxy-5,7-dimethoxyflavone-4′-O-β-D-apio-furanoside and indigotin42.

_Tectona grandis_ Linn. f. (Verbenaceae);
Local name—Chingshu

The leaves are used as source of red dye for dyeing silk, though it is generally used as timber. Teak leaves are reported to contain a yellow or red dye; red dye is mainly obtained from young leaves, whereas the yellow dye is obtained from mature ones. The dye content of the young leaves also vary depending on the region it was collected from. For instance, the young leaves collected from parts of Imphal, Manipur, were found to contain more of the red dye than those collected from regions near Kanpur (Bithoor). In Manipur state, the boiled extract of young leaves along with fish (Puntins phutunio) is reported to be useful in circulation. Dyes from _T. grandis_ were extracted both from leaves as well as bark47. Leaves gave shades of red dyes whereas the bark yielded black dye. The dyes in olden days were extracted either by storing the plant parts in water for not less than two hours, and also by boiling for not less than fifteen minutes. The extract was then filtered; liquor from _Garcinia anomala_ (Heibung) and sodium chloride were added to it before using for dyeing fabrics. The main colouring principles in the young leaf-extract of the plant were found to be tectograndone and 9,10-dimethoxy-3-hydroxy-2-isopentenylanthra-1,4-dione12,48. Another compound (yellow) isolated from the same extract was 1,4,5,8-tetrahydroxy-2-isopentadienyl-anthraquinone42.

**Conclusion**

Combining two or more plants could also derive various dyes of different colours. Different techniques are used for collecting dyes from various plants and the processes of dyeing are also different. Two types of mordants, acidic and alkaline are used for the fastness of the colour. The acidic mordants are derived from the plants—_Garcinia anomala_ (Heibung), _Citrus sintesis_ (Heijang), _Citrus hystrix_ (Heiribop), _Rhus succedanea_ (Heimang), etc. The alkaline mordants can be obtained from the plants—_Achyranthus aspera_ (Khuchumpere), _Terminalia chebula_ (Manahi), _Musa sapientum_ (Laphu), _Alpinia nigera_ (Pullei), _Hydechium coronarium_ (Loklei), _Hydechium spicatum_ (Takhellei), etc. The acidic or alkaline mordant from plants could be collected either by dissolving the portion of the plant in water or by boiling in water. Though the history of the state witnesses the extensive use of natural dyes since ancient times, documented systematic investigations are few49,50. The people of Manipur can produce these dyes in large scale, commercially by opening factories and can compete with chemical dyes, which are harmful from environmental point of view. It can, thus, be concluded that the study will serve as a source for socio-environmental development of the people of Manipur in particular and for the Nation in general.

**References**


