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## Plant based folk treatments from North East India for jaundice. (An overview)

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### Abstract

Jaundice is a life threatening disease affects human liver, the symptoms manifested in the form of extreme weakness, constipation, nausea, yellowing of the eyes, tongue, skin and urine; dull ache in the liver region of stomach and possible itching all over the body. The yellow colour first appears in the cornea of eyes and then spreads to the whole skin. The excess of bile pigments circulating in the blood give yellow colour to the eye and skin. There are several conditions that may interrupt the elimination of bilirubin from the blood and cause jaundice.

The present work is focused on medicinal plants used to treat jaundice and hepatitis. A total of ninety seven plant species belonging to 48 families are used by the people of northeast India for the treatment of jaundice. Twelve plant species namely *Andrographis panicula* (Burm.f.) Nees, *Averrhoa carambola* L., *Curcuma zedoaria* Rosc., *Cuscuta reflexa* Roxb., *Eclipta alba* (L.) Hassk., *Eclipta prostrata* L., *Embolia officinalis* Gaertn., *Garcinia pedunculata* Roxb., *Momordica charantia* L., *Morinda angustifolia* Roxb., *Phyllanthus fraternus* Webster have been reported repeatedly by many worker of North East India. The most frequent used plant parts are: fruits (37%); leaves (28%); roots (14%); Bark and whole plant (11%). Part of the plant used, dosage, duration, restriction on intake of food etc. has been reported. This study would help the future workers to select and illustrate some plants enlisted for treatment of jaundice and hepatitis.

**Keywords:** Jaundice, medicinal plants, phytochemicals, North East India

### Introduction

The word jaundice comes from the French word jaune, which means yellow. When the yellow pigment bilirubin, a byproduct of old red blood cells rises above 3 mg per dL in the blood, jaundice appears as yellowish staining of skin, the mucous membranes, or the eyes. During the normal breakdown of old erythrocytes (red blood cells), their haemoglobin is converted into bilirubin. Normally the bilirubin is removed from the bloodstream by the liver and eliminated from the body through bile, which passes from the liver into the intestines. It arises for many reasons, including blood incompatibilities, blood diseases, genetic syndromes, hepatitis, cirrhosis, bile duct blockage, other liver diseases, infections, or medications<sup>1</sup>. There are several uncommon conditions that give rise to over-production of bilirubin. The bilirubin in the blood in these conditions usually is only mildly elevated, and the resultant jaundice usually is mild and difficult to detect. Many tests are available for determining the cause of jaundice, but the history and physical examination are important as well<sup>[2]</sup>.

Most causes of jaundice can be classified to one of three groups: pre-hepatic, hepatic or post-hepatic. An abnormal increase in bilirubin production characterizes pre-hepatic jaundice. Although the liver remains functionally normal, the rate of bilirubin production exceeds the rate at which the liver can process it and unconjugated bilirubin accumulates in the blood<sup>3</sup>.

Increased erythrocyte destruction (haemolysis) is invariably the cause of this increased bilirubin production so haemolytic jaundice is an alternative name for pre-hepatic jaundice. Increased red cell destruction sufficient to cause jaundice is a feature of several haematological diseases (e.g. sickle cell anaemia, autoimmune haemolytic anaemia, glucose-6-phosphate dehydrogenase deficiency) and incompatible red cell transfusion. The neonatal jaundice common in the weeks following birth is due to a physiological increase in red cell destruction around the time of birth. An immature liver not yet ready to process this extra bilirubin load exacerbates this<sup>4</sup>. A potentially much more severe jaundice occurs in haemolytic disease of the new born, in which red cell destruction is caused by incompatibility of red cell antigens

Between mother and baby [5]. Hepatic jaundice results from defects within the liver disturbing the rate at which bilirubin is excreted. If this does not keep pace with the normal rate of production, bilirubin accumulates in blood. This may be due to ineffective bilirubin conjugation or failure to excrete conjugated bilirubin from hepatocytes into bile canaliculi, or to obstruction of bile flow within the liver (intrahepatic cholestasis). Hepatic jaundice is a feature of liver cell inflammation (hepatitis) or cirrhosis caused by toxins (e.g. alcohol and some drugs) or infective agents (e.g. hepatitis viruses). Malignant liver disease (either primary or metastatic liver cancer) can obstruct bile flow within the liver and cause hepatic jaundice. A common inherited defect in the liver enzyme UDP glucuronyl transferase required for bilirubin conjugation is responsible for the slight increase in unconjugated bilirubin that characterizes the mild and benign hepatic jaundice of Gilbert's disease [6]. Post-hepatic jaundice results from obstruction to bile flow after it has left the liver, sometimes called post-hepatic cholestasis or obstructive jaundice. Examples of conditions that cause post-hepatic jaundice include gall stone disease and pancreatic cancer [7].

However, there are several forms of treatment and diagnostics tests available in different system of treatment in India and world. Beside all these modern system of treatment today, major percent of the non-severe jaundice patients are been treated generally involving the herbal resources in the Northeast Indian states [8]. Peoples are having good faith and believe on the traditional and indigenous folk medicine and are claimed to be having outstanding results too.

The various parts such as roots, rhizomes, tubers, bulbs, leaves seeds, flowers, fruits and barks of plants are used for treating jaundice and associated liver ailments. A list of such plants are listed with method of application and active ingredients present in the plants (may be or may not be involve as active principal of the drug, but are reported to be present in the plant by various workers [9].

The review of literature of North East India indicated that the available information is fragmented. Therefore, this study is an attempt to study the available plants diversity and also to collect, compile and document the information in detail of the plant species used for treating jaundice in northeast India.

#### ***Plant based remedies for Jaundice***

From literature survey of medicinal plant of North East India it has been observed that many plants are used for the remedial purpose of jaundice directly or indirectly. Out of these 97 plants which have been enlisted based on personal interview, questionnaire and reports of medicinal claims of these areas are presented in Table 1. However, most plants have similar mode of administration but having different results and dosing regimen. It has been observed that all plants are not 100% efficient in curing but are having one or other way of action towards liver improvement.

#### ***Remedies through nutritional supplements***

A diet consisting mostly of raw foods and juices, such as diluted lemon, carrot, beet or watercress juices, will help fight jaundice. They cleanse the blood and rebuild the liver. Turnips, onions and garlic are sulfur-containing foods that promote the detoxifying action of the liver, shredded into The mashed potatoes with shredded unpeeled black radishes without salt or fat added is used to strengthen the liver and relieve symptoms [10].

If jaundice is caused by haemolytic anaemia, where the red blood cells disintegrate before they become old, insufficient

vitamin E is part of the problem. Vitamin E strengthens these red blood cells. Additional nutrients are needed to support the building of red blood cells<sup>11</sup>. During hepatitis, jaundice can be avoided or treated with large amounts of choline and vitamin C. These supplements should be added for all jaundice conditions, since the liver needs extra support to carry out its detoxifying function at this time. Choline supports liver function and is necessary for lecithin production, a substance which breaks down fats and oils. Vitamin C is used in the treatment of viral hepatitis [12]. It also reduces the effects of toxins on the body and helps relieve jaundice. During acute attacks of jaundice, the need for vitamin C increases dramatically.

Nutrients for nerve support and relaxation are necessary. These include calcium, magnesium and vitamin B6. Detoxification of the liver and gall-bladder is necessary to alleviate jaundice permanently [13]. Proper diet is a brilliant means of controlling and curing Jaundice. Diet provides adequate nutrition as well as rest for the needed organs. Jaundice patients are advised to go for a boiled & spice less diet with large quantities of vegetables including radish leaves, tomatoes and lemon [14]. All types of dry fruits including dried dates are recommended. Patients should have plenty of sugarcane juice, orange juice and barley water. This enhances urination which helps eliminate excess bile pigments in the blood. Drinking lots of water becomes necessary, as this removes poisonous wastes from the body and prevents over toxicities of the liver.

#### **Materials and Methods**

All research papers, including books, journals and documents of different universities and institutes of North East India are collected for information about medicinal plants and herbal remedies and therapies used for cure and elimination of jaundice. Any data or references to plants used for jaundice are carefully inserted into a template and botanical name and classification are re-examined and confirmed with the flora of North East India and Flora of India.

#### **Results and discussion**

The North East India is known for its rich bio-resources and ethno cultural diversity. It is also a source of various medicinal plants and diverse ethnic communities having valuable heritage of herbal remedies. A wide range of plants with ethno-medicinal value against some very important disease have been reported but much large number of folk medicine have remained endemic to certain tribal pockets in North East India. The belief, practices and treatment of various diseases by different communities inhibiting in this part of India help us to understand the human- nature relationship from its long past. The traditional medicines are diverse in their historical background, theoretical logic and practice their contemporary social realities and there dynamics<sup>15</sup>. The traditional healthcare system of 80% population of the developing countries is still dependent upon the plants of their local vicinity, pastures and forest. Most of the ethnic communities rely on medicinal plants because of their effectiveness, lack of modern healthcare alternatives and cultural preferences (Taid *et al*, 2014) [16].

The traditional healers before treatment confirms the disease by practical examination and other signs and symptoms of Jaundice like fatigue, headache, fever, loss of appetite, constipation, nausea, yellow discoloration of the eyes, tongue, skin and urine, dull pain in liver region, itching with obstructive jaundice, respiratory distress, circulatory shock, GCS, flapping tremor, chronic liver disease, liver and spleen

enlargement, oedema, ascites bleeding and bruising, depth and color of jaundice. Beside all these some of them search for evidence and cause of the disease also- flu-like antecedent illness of viral hepatitis, biliary obstruction (dark urine, pale stools, itching, biliary colic), recent anaesthetic, surgery or blood transfusion, foreign travel, alcohol history, illicit drugs or unsafe sexual practice, prescription drugs (anticonvulsants, testosterone, rifampicin etc), relevant family history, contact with other unwell persons etc.

After thorough literature survey, it can be confirmed that 98 species of plants belonging to 48 families are used by the people of North East India for the treatment of jaundice (Table 1). Out of the 48 families studied *Euphorbiaceae* (9), *Rubiaceae* (9), *Cucurbitaceae* (6), *Acanthaceae* (5), *Asteraceae* (4), *Gentianaceae* (3), *Rutaceae* (3), *Zingiberaceae* (3) are predominated families in terms of number of species used to treat jaundice. Twelve plant species namely *Andrographis panicula* (Burm. f.) Nees, *Averrhoa carambola* L., *Curcuma zedoaria* Rosc., *Cuscuta reflexa* Roxb., *Eclipta alba* (L.) Hassk., *Eclipta prostrata* L., *Embllica officinalis* Gaertn., *Garcinia pedunculata* Roxb., *Momordica charantia* L., *Morinda angustifolia* Roxb., *Phyllanthus fraternus* Webster have been reported by more than one worker from different parts of North East India. The species reported to be used for the treatment of jaundice were either found around the vicinity of their habitation and in the forest area of North East India. More than fourteen authors have reported medicinal plants for treatment of jaundice from North East India. Ramashankar<sup>17</sup> from Arunachal Pradesh., Pandey<sup>[18]</sup> and Sharma<sup>[19]</sup> reported species from Assam, Sinha reported<sup>[20]</sup> from Manipur, Mahanti<sup>[21]</sup> and Lalramnghinglova reported<sup>[22]</sup> from Mizoram etc.

Most of the plants were reported from Assam, Manipur,

Mizoram, Tripura and Arunachal Pradesh, whereas Nagaland and Sikkim is not yet been explored. The plants recorded in this survey are used in the treatment of the disease and not as prophylactics. The majority of the plant is used as decoctions and some plants are used both internally and externally. Herbs and shrubs are found to be dominantly used as drugs for jaundice in North East India. The most frequently used plant parts are: fruits (37%); leaves (28%); roots (14%); bark and whole plant (11%)<sup>[23]</sup>. The enormous frequency of the fruits and leaves in traditional compounds is related to their abundant availability and easy collection.

The medications which are used for jaundice and hepatitis may be of single plant or more than one plant species. Majority of them are extracted with water as a medium or administrated along with water. In relation to the condition of the patients these preparations are used once or twice daily for a week to months till the problem is cured. Jaundice affects liver due to viral hepatitis A, B, C, D and E, liver cirrhosis and liver cancer. Some plant species mentioned in the present study which are used to cure jaundice and hepatitis are also found to show anti-bacterial, anti-viral and anti-fungal activities like *Punica granatum* L.<sup>[16]</sup>, *Eclipta alba* (L.) Hassk<sup>[17]</sup>. and *Taraxacum officinale* Wigg<sup>[24]</sup>.

After comparative study with available pharmacological reports from other parts of India and World it has been observed that many anti-jaundice plants reported from North East region are new and are not reported from other locations like *Ardisia paniculata* Roxb, *Boerhaavia diffusa* L., *Bridelia monoica* (Lour.) Merr, *Clerodendrum serratum* Spreng, *Ficus semicordata* Buch. Ham, *Inula cappa* (F. Ham. ex D. Don) DC., *Lagerstroemia speciosa* (L.) Pers., *Litsea monopetala* (Roxb.) Pers., *Sonchus arvensis* L., *Smilax ovalifolia*, *Argemone mexicana* L., *Mussaenda frondosa* L.

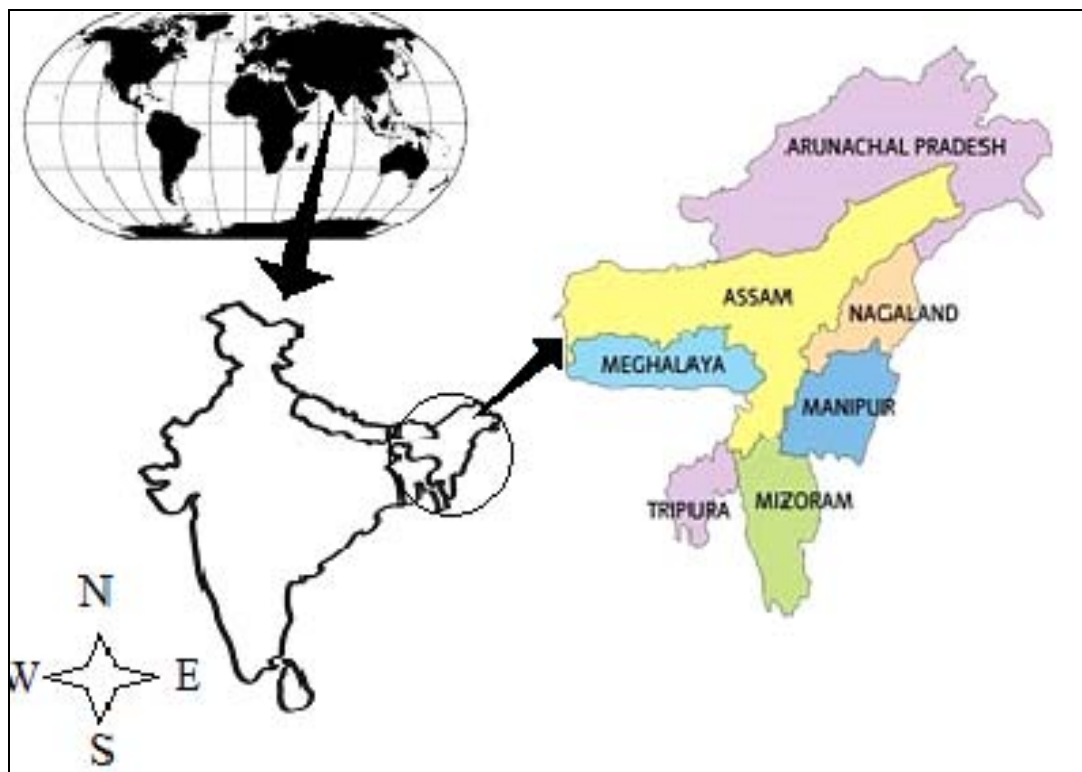


Fig 1: Map of the North Eastern States of India

**Table 1:** List of plants known to have reputed action against Jaundice and associated liver disorders from North east India

Sl. No	Scientific name	Family	State	Part used	Methodology	Reported Active Compounds
1	<i>Abrus precatorius</i> L.	Fabaceae	MA	Root	Useful in cough, colds and colic complaints, for gonorrhoea, jaundice and haemoglobinuric bile. Powdered seeds are said to disturb the uterine functions and prevent conception in women. The oil extracts from seeds is said to promote the growth of human hair. (Sinha, 1996) <sup>[20]</sup>	Abrine, Abraline, Abrasine, Abricin, Abrin, Abrusgenic-acid, Abrusgenic-acid-methyl-ester, Abruslactone, Abrussic-acid, Anthocyanins, Campesterol, Choline, Cycloartenol, Delphinidin, Gallic-acid, Glycyrrhizin, Hypaphorine, N,n-dimethyl-tryptophan, N,n-dimethyl-tryptophan-metho-cation-methyl-ester, P-coumaroylgalloyl-gluco-delphinidin, Pentosans, Picatorine, Polygalacturonic-acids, Precasine, Precatorine and Protein Trigonelline. (Mohana & Janardhanan, 1995 <sup>[30]</sup> ; www.rain-tree.com <sup>[31]</sup> )
2	<i>Adhatoda vasica</i> Nees	Acanthaceae	MA	Leaves	Bronchial congestion, used in Jaundice, asthma, muscular pains and rheumatic complaints. Insecticidal. Used in diarrhea, dysentery and glandular tumors. Skin infections. (Sinha, 1996) <sup>[20]</sup>	Alkaloids, phenolics, flavonoids, sterols and their glycoside derivatives Vasicinone, Peganidine, and Taraxerol (Sultana 2000 <sup>[32]</sup> ; Singh <i>et al.</i> , 2011 <sup>[33]</sup> )
3	<i>Alstonia scholaris</i>	Apocynaceae	AP	bark	Pieces of bark are worn in a garland for curing jaundice. (Borthakur and Gogoi, 2003) <sup>[23]</sup>	Alkaloids like echitamine, tubotamine, ditamine, echitenine, picrinine and essential oil. (Pankti <i>et al.</i> , 2012 <sup>[34]</sup> )
4	<i>Andragraphis paniculata</i> (Burm.f.) Wall.ex Nees	Acanthaceae	AS	Whole plant	Leaves and young twigs are smashed and made paste; 20-30gms paste taken three times daily after meal for 2-3 weeks to cure jaundice. (Sahrma, 2004; Pandey <i>et al.</i> , 1986; Sinha, 1996) <sup>[19,24,20]</sup>	Andrographilides. (Kulyal <i>et al.</i> 2010 <sup>[35]</sup> )
6	<i>Ardisia paniculata</i> Roxb	Myrsinaceae	MI	Root	The root in combination with those of <i>Smilax ovalifolia</i> and <i>Bridelia tomentosa</i> are crushed and boiled and the water is drunk 1 cup (100ml) twice daily for jaundice. (Lalramnghing-Lova, 2003) <sup>[22]</sup>	3-hydroxy-5-tridecyl-methyl phenyl ether, 5-pentadecyl-1, 3-benzenediol, 2-methoxy-6-tridecyl-1, 4-benzoquinone, 2-methoxy-6-pentadecyl-1, 4-benzoquinone, glutinol, ardisicrenoside A, ardisiacrispin B, 24-ethyl-5a-cholesta-7, 22(E)-dien-3-one, 24-ethyl-5alpha-cholesta-7, 22(E)-dien-3beta-ol, daucosterol, vanillin acid and tetrahydrocontanoic acid. (Zhongguo, 2006) <sup>[36]</sup>
7	<i>Argemone mexicana</i> L.	Papaveraceae	MA	Leaves	Plant extract is applied; Decoction of leaves is used in jaundice. (Sinha, 1996) <sup>[20]</sup>	Protopine, berberine, tannin and resin. (Bose <i>et al.</i> , 2006) <sup>[37]</sup>
8	<i>Asplenium adiantoides</i> C. Chr.	Aspleniaceae	MA	Whole plant	Plant decoction is used in jaundice. (Sinha, 1996) <sup>[20]</sup>	Kaempferol 3-O-gentiobioside, kaempferol 3,7-O-glycoside and kaempferol 3-O-glycoside (Iwashina, 2011) <sup>[38]</sup>
9	<i>Asteracantha longifolia</i> Nees	Acanthaceae	MA	Root, leaves	Plant extracts and decoction of leaves is used in jaundice. (Sinha, 1996) <sup>[20]</sup>	$\beta$ -sitosterol, Lupeol, tenacious mucilage and potassium salts (Patra <i>et al.</i> , 2009) <sup>[39]</sup>
10	<i>Averrhoa carambola</i> L.	Averrhoaceae	MA, AS, MI	fruits	3-4 slices of the fruit are taken for jaundice or juice of crushed fruit is taken orally for jaundice @ 1/2-1 cup (50 ml-100ml) 3 times daily. (Sinha, 1996) <sup>[20]</sup> ; Pandey <i>et al.</i> , 1986 <sup>[24]</sup> ; CCRAS, 1999 <sup>[25]</sup> ; Mahanti, 1994 <sup>[21]</sup> ; Lalramnghinglova, 2003 <sup>[22]</sup> ; Sahrma, 2004 <sup>[19]</sup>	Reducing sugars, Starch, Oxalic acid, benzodiazepines, Calcium, Iron, Magnesium, Phosphorus, Sodium, Potassium, Zinc, Copper, Manganese, Selenium, Vitamin C, Vitamin E, Vitamin K, Vitamin B12, Thiamin, Riboflavin, Niacin, Pantothenic acid, Vitamin B6, Folate, Folic Acid, Food Folate, Dietary Folate Choline, Lycopene and Lutein+zeaxanthin. (Macleod., 1990) <sup>[40]</sup>
11	<i>Benincasa hispida</i> (Thunb.) Cogn.	Cucurbitaceae	MA	Fruit, seed	Boiled extract of fruit is given in stomach ulcers and jaundice. (Sinha, 1996) <sup>[20]</sup>	Triterpenes: alnusenol, multiflorenol, iso-multiflorenol; flavone: iso-vitexin; and sterols: lupeol, lupeol acetate, and beta-sitosterol. (Han <i>et al.</i> , 2013) <sup>[41]</sup>
12	<i>Bixa orellana</i> L.	Bixaceae	MA	Fruit, Leaves, root	Leaves are useful in jaundice. (Sinha, 1996) <sup>[20]</sup>	(Z,E)-farnesyl acetate, occidentalol acetate and spathulenol. (Pino & Correa, 2003) <sup>[42]</sup>
13	<i>Boerhaavia diffusa</i> L.	Nyctaginaceae	MI	plant	Root is used in various ways in jaundice. (Mahanti, 1994) <sup>[21]</sup>	Punarnavine-1, Punarnavine-2, $\beta$ -Sitosterol, $\beta$ -Sitosterol-D-glucoside, Sitosteryl oleate, Sitosteryl palmitate, C-methyl flavone, Kaempferol, Quercetin, Boerhaavinone A,B,C,D,E and F, Liriodendrin, Stringarsionol, Mono-D-glucoside and $\beta$ -D-glucoside. (Christian, 2012) <sup>[43]</sup>
14	<i>Bridelia stipularis</i> (L.) Bl.	Euphorbiaceae	MA	Bark, leaves,	Leaves are used for jaundice. (Sinha, 1996) <sup>[20]</sup>	Bridelioside as (isolariciresinol 2a-O- $\alpha$ -l-arabinopyranoside). (Hatusima, 2007) <sup>[44]</sup> .
15	<i>Bridelia monoica</i> (Lour.) Merr.	Euphorbiaceae	MI	root	The root in combination with the root of <i>Smilax ovalifolia</i> and <i>Ardisia paniculata</i> are rubbed on grindstone and the	Stigmasterol, sitosterol, friedelan-3-ol and Glutin-5-en-3-ol, Friedelin (Ngueyem <i>et al.</i> , 2014) <sup>[45]</sup>

					paste is collected in a cup of water. The mixture is boiled and taken orally for jaundice. (Lalramghinglova, 2003 <sup>[22]</sup> )	
16	<i>Capsicum annuum</i> L.	Solanaceae	AS	Fruit and root	10-15 gms splitted fruit of the species without seed are kept in 100-150 ml. water for 3-4 hours and after removing the fruit, water is taken against jaundice; also used as mentioned under <i>Croton oblongifolius</i> . (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Neutral-detergent fibre, D-glucose, D-fructose, sucrose, vitamin C, organic acid, starch, pectin and major pigment contents of <i>Capsicum annuum</i> . (Lopez-Hernandez <i>et al.</i> , 1996 <sup>[46]</sup> )
17	<i>Carthamus tinctorius</i> L.	Asteraceae	MA	fruit	Oil extracted from fruits is applied to sores and rheumatic swellings, capitula are laxative and diaphoretic, used in Jaundice. (Sinha, 1996 <sup>[20]</sup> )	Linoleic acid, phosphatidylinositol, phosphatidylinositol, Phosphatidylethanolamine, Tocopherols and tocotrienols. (Lee <i>et al.</i> , 2004 <sup>[47]</sup> )
18	<i>Cissampelos pareira</i> L.	Menispermaceae	AS	Root	Root is placed in water for overnight and extract in taken orally in jaundice. (Sahrma, 2004 <sup>[19]</sup> )	hydrocolloid fraction, anhydrouronic acid, methoxyl and glucono- $\delta$ -lactone, (Vardhanabhatia & Ikeda, 2006 <sup>[48]</sup> )
19	<i>Citrus aurantifolia</i> (Christm.) Awingle	Rutaceae	AS	Fruits	Fruit juice is taken orally in jaundice. (Sahrma, 2004 <sup>[19]</sup> )	5,7-dimethoxycoumarin, 3-methyl-1,2- cyclopentanedione, 1-methoxy-cyclohexene, corylone, palmitic acid, terpineol, umbelliferone, and $\alpha$ 5,8-dimethoxypsoralen. (Sandoval-Montemayor, 2012 <sup>[49]</sup> )
20	<i>Citrus medica</i> L.	Rutaceae	AS	Root, fruits	Fruit juice is taken orally in jaundice. (Sahrma, 2004 <sup>[19]</sup> )	Limonene, limonene/ $\gamma$ -terpinene and limonene/geranial/neral. (Bairagi <i>et al.</i> , 2011 <sup>[50]</sup> )
21	<i>Clerodendrum indicum</i> (L.) a.Kuntze	Verbenaceae	AS	root	200-300 gms roots of the species are crushed and boiled in water and bathed with the extract for 15 days to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Cleroidicin A – F, Hispidulin, Scutellarein, and Scutellarein-7-O- $\beta$ -D-glucuronide. (Shrivastava and Patel, 2007 <sup>[51]</sup> )
22	<i>Clerodendrum serratum</i> , Spreng.	Verbenaceae	MI	Juice of leaves	Decoction of leaves-in jaundice and in high blood-pressure. (Mahanti, 1994 <sup>[21]</sup> )	Carbohydrates, flavonoids, terpenes, phenolics and steroids (Singh <i>et al.</i> , 2012 <sup>[52]</sup> ).
23	<i>Coriandrum sativum</i> L.	Apiaceae	AS	Leaves, fruits	Leaves and fruits are taken orally in jaundice. (Sahrma, 2004 <sup>[19]</sup> )	$\beta$ -sitosterol, D-mannitol, flavonoid glycoside, chlorogenic acid, caffeic acid, rutin, umbelliferone, scopoletin, coriandrinediol, palmitic, petroselinic, oleic, linolenic acid, lauric, myristic, myristoleic, palmitoleic acids, quercetin-3-O-caffeyl glycoside, kaempferol-3- glucoside, octadecenoic acid, $\alpha$ -pinene, limonene, $\beta$ -phellandrene, 1, 8-cineole, linalool, borneol, $\beta$ -caryophyllene, citronellol, geraniol, thymol, linalyl acetate, geranyl acetate, caryophyllene oxide, elemol, methyl heptenone, petroselinic acid, triacontane, triacontanol, tricosanol, psoralen, angelicin, coriandrinol, glucoside, butyl phthalides-neoenidilide, Z-ligustilide, coriandrin, dihydrocoriandrin, coriandrone A to E, Nonane, C9-16 alkenals, C7-17 alkanals, C10-12 primary alkenols, alkanol9, oxalic acid, vitamin C, carotene, calcium, Gnaphalolide A, gnaphalolide B, quercetin, isorhamnetin, rutin, luteolin, and furfural. (Paarakh <i>et al.</i> , 2009 <sup>[53]</sup> )
24	<i>Costus speciosus</i> (Koenig ex Retz.) Sm.	Costaceae	AS	Stem, leaves, root	Fresh juice of rhizome is taken orally in jaundice. (Sahrma, 2004 <sup>[19]</sup> )	Diosgenin and tigogenin (Dasgupta and Pandey, 1970 <sup>[54]</sup> ).
25	<i>Croton oblongifolius</i> Roxb	Euphorbiaceae	AS	Stem, bark	Stem bark of <i>Croton oblongifolius</i> , <i>Prunus triflora</i> and root of <i>Capsicum annuum</i> and rhizome of <i>Curcuma domestica</i> and ripened fruits of <i>Averrhoa carambola</i> are crushed together and boiled in water; extract is taken three times daily to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Triterpenoids, sterols, phenolic compounds, flavonoids, lignans, coumarins, tannins, phenanthrenes, quinones, phenolic acids, alkaloids, cyanogenic glucosides and glucosinolates. (Rizk, 1987 <sup>[55]</sup> )
26	<i>Cucumis sativus</i> L.	Cucurbitaceae	AS	Fruit	Fresh fruit is administered during jaundice. (Sahrma, 2004 <sup>[19]</sup> )	24-ethylcholesta-7, 22, 25-trienol, 24-ethylcholesta-7, 25-dienol, avenasterol, spinasterol, aronidiol, isokaronidiol, myristic acid, palmitic acid, palmitoleic acid, heptadecanoic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, and alpha-linolenic acid. (Wu <i>et al.</i> , 2012 <sup>[56]</sup> ).
27	<i>Curculigo orchoides</i> Gaertn	Amaryllideae	ME, MA, AS	Rhizome	Rhizome is prescribed in piles, jaundice, asthma, diarrhoea and gonorrhoea, considered demulcent tonic; used as poultice for itches and skin diseases. (Biswas & Chopra, 1982 <sup>[26]</sup> ; Sinha, 1996 <sup>[20]</sup> ; Sahrma 2004 <sup>[19]</sup> )	Glycosides, tannins, polysaccharides, calcium oxalate, yuccagennin, sapogennin and alkaloid lycorin. (Irshad <i>et al.</i> , 2006 <sup>[57]</sup> )
28	<i>Curcuma domestica</i> Valetton	Zingiberaceae	AS	Rhizome.	40-50 gms rhizome pounded and made extract; extract is mixed with <i>Piper Longum</i> L. and taken daily for 20-25 days	Curcumin, demethoxycurcumin and bis- demethoxycurcumin. (Bizunch, 2012 <sup>[58]</sup> )

					to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	
29	<i>Curcuma Longa L.</i>	Zingiberaceae	AS	Rhizome	40-50 gms rhizome pounded and made extract is mixed with fruits of <i>Piper longum L</i> and taken daily for 20-25 days during jaundice. (Sahrma, 2004 <sup>[19]</sup> )	L-curcamene, sssquiterpene, camphor, camphene, curcumin, curzerenone, curzenene, furanodienone, furanodiene, zederone, curculone, curcumol, procurcumenol, curcumadiol, curdione. Curcumin as major active increases glutathione-S-transferase hepatic level and acid-soluble sulfhydryls; can reverse aflatoxin-associated liver damage. Inhibits 12-lipoxygenase and cyclooxygenase activity. (Leela <i>et al.</i> , 2002 <sup>[59]</sup> )
30	<i>Curcuma zedoaria Rosc.</i>	Zingiberaceae	AS, AP	Rhizome	40-50 gms rhizome pounded and made extract is mixed with fruits of <i>Piper longum L</i> and taken daily for 20-25 days during jaundice. (Sahrma, 2004 <sup>[19]</sup> ; Rama Shanker, 2007 <sup>[27]</sup> )	Curcumin, furanodiene, furanodienone, zedorone, curzerenone, curzeone, germacrone, 13-hydroxygermacrone, dihydrocurdione, curcumenone, zedoaronediol, curcumenol, zedoarol, curcumanolide-A, curcumanolide-B, ethyl para-methoxycinnamate, 18, b-turmerone, epicurzerenone, curzerene, 1,8-cineole; 22, b-eudesmol, zingiberene, dihydrocurcumin, curdione and neocurdione, a-phellandrene. (Richard <i>et al</i> , 2009 <sup>[60]</sup> )
31	<i>Cuscuta reflexa Roxb.</i>	Cuscutaceae	AS; MA	Whole plant	Boiled decoction of plant is given in chronic fevers and jaundice. (Sinha, 1996 <sup>[20]</sup> ; Sahrma, 2004 <sup>[19]</sup> )	1,2,3 Propanetriol, 1- acetate, Benzofuran, 2,3- dihydro, Glycerol 1,2-diacetate, 1H-1,2,4-triazol-5-amine 1-ethyl, 2-methoxy-4-vinylphenol, Triacetin, D-Glucitol, 4-O-hexyl 3,4,5-trimethoxy cinnamic acid, Hexadecanoic acid, ethyl ester 3,6-di methoxy phenanthrene 3, 5- di-tert-Butyl-4-hydroxyanisol, Vanillin, 3-aminopyrrolidine, Cetene, Sarcosine, N-isobutyryl, tetradecyl ester, 4-((1E)-3-hydroxy-1-propenyl)-2-methoxy phenol, 1,5-diphenyl-2H-1,2,4-triazoline-3-thione, 1-octadecene, Heptanamide, N-(1-cyclohexylethyl) -2-methyl, Scoparone and 3-Methyl-2-benzylidene-coumaran-3-one. (Bais & Kakkar 2013 <sup>[61]</sup> )
32	<i>Desmodium laxiflorum DC.</i>	Papilionaceae	AS	Roots.	50-100 gms roots are crushed and boiled in water; 50 ml extract mixing with powder of three fruits of <i>Piper Longum L.</i> is taken daily for 10-15 days to cure jaundice. (Pandey <i>et al.</i> 1986 <sup>[24]</sup> )	Flavonoids, alkaloids, phenols and sterols. (Vaghela <i>et al.</i> , 2013 <sup>[62]</sup> )
33	<i>Desmostachya bipinnata (L.) Stapf.</i>	Poaceae	AS	Roots	50 ml extract is mixing with powder of three fruits <i>Piper longum</i> is taken daily for 10- 15 days for cure jaundice. (Sahrma, 2004 <sup>[19]</sup> )	Coumarins (scopoletine and umbelliferone), kaempferol, quercetin, quercetin-3-glucoside, trycin and trycin-7-glucoside. (Amani <i>et al.</i> , 2008 <sup>[63]</sup> )
34	<i>Eclipta alba (L.) Hassk.</i>	Asteraceae	AS; AP	Whole plant	20-30 gms paste of the whole plant mixed with salt is taken once daily for 15-20 days to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> ; Rama Shanker & Rawat, 2004 <sup>[28]</sup> )	Wedololactone, demethylwedololactone, desmethyl-wedololactone-7glucoside and other constituents are ecliptal, $\beta$ -amyrin, luteolin-7-O-glucoside, hentriacontanol, heptacosanol, and stigmasterol. (Jadhav <i>et al.</i> , 2009 <sup>[64]</sup> )
35	<i>Eclipta prostrata L.</i>	Asteraceae	AS; AP	Leaves and plants	20-30 gms paste of whole plant mixed with the salt is taken once daily for 15- 20 days to cure jaundice. (Sahrma, 2004 <sup>[19]</sup> ; Rama Shanker, 2007 <sup>[27]</sup> )	Sesquiterpenoids, the stem bark was comprised of sesquiterpenoids, straight chain hydrocarbons and monoterpenoids, P-caryophyllene and a-humulene. (Ogunbinu <i>et al.</i> , 2009 <sup>[63]</sup> )
36	<i>Elaeagnus caudata Schlecht</i>	Elaeagnaceae	AS	Stem bark and fruit	200-250 gms stem bark and fruit of the species are pounded and boiled in water; 100 m. Extract mixing with <i>Piper Longum L.</i> is taken daily for 2-3 weeks to cure jaundice and other liver troubles. (Pandey <i>et al.</i> 1986 <sup>[24]</sup> )	Alkaloids, tannins, saponins, steroids and flavonoids. (Shantabi <i>et al.</i> , 2014 <sup>[66]</sup> ).
37	<i>Emblica officinalis Gaertn.</i>	Euphorbiaceae	MA, MI	Fruits, Leaves	Fruits are given in diarrhoea, dysentery, haemorrhage, in anaemia, jaundice, etc. Fermented liquor from fruit used in jaundice. (Sinha, 1996 <sup>[20]</sup> ; Mahanti, 1994 <sup>[21]</sup> )	Emblicanin A and B, Punigluconin, Pedunculagin, Chebulinic acid (Ellagitannin), Chebulagic acid (Benzopyran tannin), Corilagin (Ellagitannin), Geraniin (Dehydroellagitannin), Ellagotannin, Phyllantine, Phyllembin, Phyllantidine, Gallic acid, Methyl gallate, Ellagic acid, Trigallayl glucose, Glutamic acid, Proline, Aspartic acid, Alanine, Cystine, Lysine, Pectin, Ascorbic acid, Quercetin, Kaempferol and Citric acid. (Dasaroju & Gottumukkala, 2014 <sup>[67]</sup> )
38	<i>Erythrina variegata</i>	Fabaceae	AP	bark	25 gm of the poultice made of the herb of <i>Euphorbia hirta</i> and rot of <i>Diplazium esculentum</i> , <i>Musa balbisiana</i> and <i>Sida cordifolia</i> once a day for three week. (Borthakur and Gogoi, 2003 <sup>[23]</sup> )	Alkyl ferulates, alkyl phenolates, stigmasterol, sitosterol, campesterol and citrostadienol/24-methylenelophenol., erysovine and stachydrine. (Singh <i>et al.</i> , 1975 <sup>[68]</sup> )

39	<i>Euphorbia ligularia</i> Roxb	Euphorbiaceae	AS	Pith of the young branch	100-150 gm pith of young branches are boiled in cow milk and made extract. 100 gm of extract is taken one time daily in the early morning for 20 days to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Euphol, monohydroxy triterpene, nerifoliol, taraxerol, beta-amyrion,, glut-5-(10)- ene-1-one, nerifolione and cycloartenol (Ahmed <i>et al.</i> , 2011 <sup>[69]</sup> )
40	<i>Ficus semicordata</i> Buch.Ham	Moraceae	MI	Leaf	Decoction of the leaves (in combination with that of <i>Byttneria pilosa</i> Roxb. And <i>Phyllanthus fraternus</i> Webs and the bark of <i>Callicarpa arborea</i> Roxb.) is taken orally for jaundice. (Lalramghinglova, 2003 <sup>[22]</sup> )	Gallic tannins, saponins, reducing sugars, alkaloids and flavone aglycones. (Sandabe <i>et al.</i> , 2006 <sup>[70]</sup> )
41	<i>Garcinia pedunculata</i> Roxb.	Guttiferae/ Clusiaceae	MA, AS	Fruits	Young fruits are prescribed in jaundice. (Sinha, 1996 <sup>[20]</sup> ; Sahrma, 2004 <sup>[19]</sup> )	Hydrocitric acid, Cyanidin-3-glucoside, Cyandin-3-sambubioside and L-leucine and DNP -L-leucine hydrochloride. (Dhiman., 2006 <sup>[71]</sup> )
42	<i>Gardenia jasminoides</i> Ellis	Rubiaceae	MA		Fruits are stimulant, emetic and diuretic, used in jaundice and pulmonary and renal troubles. (Sinha, 1996 <sup>[20]</sup> )	Four glycosides, (6S,9R)-roseoside, (+)-lyoniresinol 3.alpha.-O-.beta.-D-glucopyranoside, 2-phenylethyl .beta.-D-apisyl-(1.RAR.6)-.beta.-D-glucopyranoside and 2-phenylethyl and beta.-D-xylopyranosyl-(1.RAR.6)-.beta.-D-glucopyranoside. (Hiroko <i>et al.</i> , 2002 <sup>[72]</sup> )
43	<i>Glycosmis pentaphylla</i> (Retz.) Correa	Rutaceae	MA	Roots	Plant is considered as medicine for cough, rheumatism, anaemia and jaundice. Wood is used in snake bite. (Sinha, 1996 <sup>[20]</sup> )	Atalaphyllidine, atalaphyllinine, and des-N-methylnoracronycine. (Kawaii <i>et al.</i> , 1999 <sup>[73]</sup> )
44	<i>Hedyotis auriculata</i> L.	Rubiaceae	MA	Leaf	Leaf extract is given in dysentery and cough. Boiled extract of plant is prescribed in jaundice. (Sinha, 1996 <sup>[20]</sup> )	Glycoside, 1'-deoxy-6'-O-(1-hydroxymethyl-2-hydroxy-1-methoxy) ethylglucopyranoside, 1'-0-ethyl-beta-D-galactopyranoside, 2-formyl-5-hydroxymethylfuran, stigmasta-5, 22-diene-3-O-beta-D-glucopyranoside, ursolic acid and oleanolic acid. ( <a href="http://www.stuartxchange.com/Hedyotis">http://www.stuartxchange.com/Hedyotis</a> <sup>[74]</sup> )
45	<i>Hedyotis corymbosa</i> (L.) Lamk.	Rubiaceae	AS	Whole plant	40 gms paste of whole plant are taken daily for 15-20 days to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Flavonoids, alkaloids, terpenoids and tannins. (Fatema and Hossain, 2014 <sup>[75]</sup> )
46	<i>Hedyotis diffusa</i> Willd.	Rubiaceae	MA		Decoction of plant is given in intermittent fever and jaundice.(Sinha, 1996 <sup>[20]</sup> )	Hentriacontane, stigmasterol, ursolic acid Oleanolic acid, flavonoid glycosides and a coumarine analoge compound. (Yang <i>et al.</i> , 2008 <sup>[76]</sup> )
47	<i>Homalomena aromatic</i> Schott.	Araceae	AP	rhizome	Rhizome juice is taken orally in jaundice and other liver complaints. (Ramashanker, 2007 <sup>[27]</sup> )	The major component was linalool, followed by terpinen-4-ol, $\alpha$ -terpineol, $\gamma$ -terpinene, $\alpha$ -cadinol, geraniol, nerol, $\alpha$ -terpinene, spatulenol and T-cadinol, linalool. (Singh <i>et al.</i> , 2000 <sup>[77]</sup> )
48	<i>Houttuynia cordata</i> Thunb.		AP	leaves	3-4 fresh leaves eaten twice daily in case of jaundice. It is also used as condiment. (Ramashanker, 2007 <sup>[27]</sup> )	Methyl nonyl ketone, bornyl acetate and .BETA.-myrcene. (Hongmei <i>et al.</i> , 2006 <sup>[78]</sup> )
49	<i>Hydrocotyle rotundifolia</i> Roxb.	Apiaceae	AP	whole plant	Pounded whole plant is taken orally. (Ramashanker, 2007 <sup>[27]</sup> )	Vellarin, vitamin C, triterpenoid saponins, hydrocotylosides I-VII, udosaponin B, stigmasterol, daucosterol, hibalactone, genistein, daidzein, methyl-3, 4-dihydroxybenzoate, protocatechuic acid, caffeic acid, isorhammetin, quercetin, hyperin, chlorogenic acid methyl ester, 5-hydroxymaltol, (-)-angelicoidenol 2-O- $\beta$ -D-glucopyranoside, n-butyl- $\beta$ -D- fructopyranoside, apigenin, kaempferol, 4,2',4'-trihydroxychalcone, and oleanolic acid. ( <a href="http://www.stuartxchange.com">www.stuartxchange.com</a> <sup>[79]</sup> )
50	<i>Hygrophilla salicifolia</i> Nees	Acanthaceae	MA	Plant, leaves, seeds	Plant extract is used for stomach complaints and jaundice. (Sinha, 1996 <sup>[20]</sup> )	phytosterols, fatty acids, minerals, polyphenols, proanthocyanins, mucilage, alkaloids, enzymes, amino acids, carbohydrates, hydrocarbons, flavonoids, terpenoids, vitamins and glycosides. Some of the reported phytoconstituents are lupeol, lupenone, 25-oxo-hentriacontanyl acetate, stigmasterol, betulin, $\beta$ -carotene, hentriacontane, apigenin-7-O-glucuronide, apigenin-7-O-glucoside, 3-methylnonacosane, 23-ethylcholesta-11(12), 23(24)-dien-3 $\beta$ -ol, luteolin, asteracanthine, asteracanthicine, luteolin-7-rutinoside, methyl-8-n-hexyltetracosanoate, $\beta$ -sitosterol, histidine, phenylalanine, lysine, ascorbic acid, nicotinic acid, n-triacontane, glucose, mannose, rhamnose, arabinose, xylose, maltose, myristic acid, oleic acid, palmitic acid, stearic acid and linoleic acid. (Patra <i>et al.</i> , 2009 <sup>[80]</sup> )
51	<i>Imopoea aquatica</i> Forssk.	Convolvulaceae	AS	Whole plant	Arial plant is taken orally for jaundice cure. (Sahrma, 2004 <sup>[19]</sup> )	Alanine, glutamine, $\beta$ -carotene and hentri-acontane, $\beta$ -sitosterol, and glucoside of $\beta$ -sitosterol in seeds, $\beta$ -carotene, xanthophyll, taraxanthin, nicotinic acid, riboflavin, vitamin A, vitamin B1, vitamin C, vitamin E, anthocyanins, 3'-methoxy quercetin, 4'-methoxy quercetin, and 7-O- $\beta$ -D-glucopyranosyl-dihydroquercetin-3-O-a-D-glucopyranoside (DHQG). 1-(14-

						methylhexadecanoyl pyrrolidine, N-trans and N-cis feruloyltyramines (cinnamoyl- $\beta$ -phenethylamine, N-caffeoyl- $\beta$ -phenethylamine); 1-hexadecanoylpyrrolidine; and 1-octadecanoylpyrrolidine; lutein, $\beta$ -carotene, violaxanthin, neoxanthin a, neoxanthin b, antheraxanthin, mutatoxanthin, cryptoxanthin, lutein epoxide, zeaxanthin, flavoxanthin, auroxanthin, palmitic acid, (z)-3-hexen-1-ol, alpha-humulene, n-hexacosane, and bis (2-ethyl-hexyl) sebacate, myricetin, quercetin, luteolin, apigenin, and kaempferol (Manvar and Desai, 2013 <sup>[81]</sup> )
52	<i>Inula cappa</i> (F.Ham.ex D. Don)DC	Asteraceae	MI	Leaf	The leaves are crushed with those of <i>Plantago asiatica</i> and <i>Lobelia angulata</i> and the juice is taken orally for jaundice 2 table spoonfuls (10 ml) twice or thrice daily. (Lalramnghinglova, 2003 <sup>[22]</sup> )	Steroids, flavonoids, phenolics, aminoacids and alkaloids. (Ojha <i>et al.</i> , 2011 <sup>[82]</sup> )
53	<i>Lagenaria siceraria</i> (Mol.) Standl.	Cucurbitaceae	AS	Whole plant	Plant decoction mixed with sugar is taken as protective agents during jaundice. (Sahrma, 2004 <sup>[19]</sup> )	Oleanolic acid, $\beta$ sitosterol, campesterol, isoquercitrin and kaempferol. (Gangwal <i>et al.</i> , 2010 <sup>[83]</sup> )
54	<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae	MI	root	Decoction of root. (Mahanti, 1994 <sup>[21]</sup> )	Corosolic acid, gallic acid, 4-hydroxybenzoic acid, 3- O-methyl protocatechuic acid, caffeic acid, p-coumaric acid, kaempferol, quercetin, isoquercitrin and ellagitannins. (Chan <i>et al.</i> , 2014 <sup>[84]</sup> )
55	<i>Lawsonia intermis</i> L.	Lythraceae	MA	bark, leaf	Bark is given in jaundice and enlargement of spleen. (Sinha, 1996 <sup>[20]</sup> )	Lawsonicin, and a new naphthaquinone, lawsonadeem and vomifoliol. (Siddiqui <i>et al.</i> , 2003 <sup>[85]</sup> )
56	<i>Leucas plukenetii</i> (Roth) Spreng.	Lamiaceae	AS	Whole plant	30-40 gms paste of the whole plant is taken three times in meal for 2-3 weeks to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Lignans, flavonoids, coumarins, steroids and terpenes (Chouhan and Singh, 2011 <sup>[86]</sup> )
57	<i>Ludwigia adscendens</i> (L.) Hara	Onagraceae	AS	Young twigs	200-300 gms of young twigs are smashed and boiled in water; 100 ml extract is taken orally for 15-20 days to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Pentadecane, hexadecane, heptadecane, octadecane, nonadecane, eicosane, heneicosane, docosane, Tricosane, Tetracosane, Pentacosane, hexacosane, heptacosane, octacosane, nonacosane, tricontane, hentriacontane, dotriacontane, tritriacontane, tetratriacontane, pentatriacontane and Hexatriacontane. (Barik <i>et al.</i> , 2004 <sup>[87]</sup> )
58	<i>Litsea monopetala</i> (Roxb.)Pers	Lauraceae	MI	Bark	The bark is grinded with the bark of <i>Vitex pennuncularis</i> , 3 leaves of Piper bettle, 4 clones of <i>Allium sativa</i> , 2-3 grains of gulmori (sold in market) and added 2 spoonfuls (10 gms) of sugar. The mixture is ground to paste and the paste is made into pills. One pill is taken orally for jaundice associated with hepatitis 2 times per day for a week. (Lalramnghinglova, 2003 <sup>[22]</sup> )	Alkaloids, Glycosides, Tannins, Steroids, Flavonoids, Saponins, Redicing sugars, $\beta$ -sitosterol and actinodaphnine (Ali <i>et al.</i> , 2012 <sup>[88]</sup> ).
59	<i>Melothria heterophylla</i> (Lour.) Cogn.	Cucurbitaceae	AS	Root	Fresh roots inhaled reduce jaundice; also the fresh roots are cut into pieces and tied with root of <i>Plumbago indica</i> and rhizome of <i>Curcuma domestica</i> and worn around neck for 15 to 20 days to reduce the jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	carbohydrates, steroids, flavonoids, and saponins. (Mondol <i>et al.</i> , 2010 <sup>[89]</sup> )
60	<i>Melothria purpusilla</i> (Blume) Cogn.	Cucurbitaceae	MA	Shoot, root	The plant is useful in the treatment of jaundice and kidney affection other than stone. (Sinha, 1996 <sup>[20]</sup> )	Terpenoids, alkaloids, Flavonoids and phenolics ( <a href="http://shodhganga.inflibnet.ac.in/bitstream/10603/29060/1/11/11_chapter2.pdf">http://shodhganga.inflibnet.ac.in/bitstream/10603/29060/1/11/11_chapter2.pdf</a> <sup>[90]</sup> )
61	<i>Mentha arvensis</i> L.	Lamiaceae	AS	Leaves	Plant extract is used during jaundice. (Sahrma, 2004 <sup>[19]</sup> )	menthol, menthone and menthyl acetate (Naeem <i>et al.</i> , 2016 <sup>[91]</sup> )
62	<i>Momordica charantia</i> L.	Cucurbitaceae	AS, MI	Leaves	The leaves are boiled with that of <i>Benincasa hispida</i> (mainpawl) in the proportion of 5:100 gs, and the water is taken orally against jaundice. (Sahrma, 2004 <sup>[19]</sup> ; Lalramnghinglova, 2003 <sup>[22]</sup> )	vacine, mycose, 3-O-(beta-D-glucopyranosyl)-24 beta-ethyl-5 alpha-cholesta-7, trans-22E, 25 (27)-trien-3 beta-ol, momorcharaside A and momorcharaside B (Zhu <i>et al.</i> , 1990 <sup>[92]</sup> )
63	<i>Morinda angustifolia</i> Roxb	Rubiaceae	AS, MI	Root	100 gms pounded roots are boiled in water and made extract; 100 ml extract is orally taken daily for 15 days to reduce jaundice. (Pandey <i>et al.</i> 1986 <sup>[24]</sup> ; Lalramnghinglova, 2003 <sup>[22]</sup> )	Morindone (Aobchey <i>et al.</i> , 2002 <sup>[93]</sup> )
64	<i>Morus alba</i> L	Moraceae	AP	Roots	Root decoction is taken orally for 10-12 days during jaundice.(Sabat, 2003 <sup>[29]</sup> )	Two lupeol-type pentacyclic triterpenoids characterised as lup-20 (29)-en-3 $\beta$ -ol-27-oic acid (moroslupenoic acid A) and lup-12, 20 (29)-dien-3 $\beta$ -ol-26-oic acid (moroslupenoic acid B) and lanst-5, 24-dien-3 $\beta$ -yl acetate (moruslanosteryl



						acetate) (Ali and Ali 2013 <sup>[94]</sup> )
65	<i>Mussaenda glabra</i> Vahl	Rubiaceae	MA	Leaf	Juice of fresh leaves is good for jaundice. (Sinha, 1996 <sup>[20]</sup> )	Alkaloids, phenols, tannins, and saponins. (Menon & Sasikumar, 2011 <sup>[95]</sup> )
66	<i>Mussaenda frondosa</i> L.	Rubiaceae	AS, ME	Root	The root in 80 grains doses is given with cow's urine, Half total juice extracts of root mixed with cow's urine when applied externally cures leucoderma. (Biswas & Chopra, 1982 <sup>[26]</sup> )	4H-Pyran-4-one, 2,3- dihydro-3,5-dihydroxy-6- methyl, Butanedioic acid, diethyl ester, 2-Furancarboxaldehyde, 5- (hydroxymethyl)-, $\alpha$ -D-Glucopyranoside, O- $\alpha$ -D-glucopyranosyl- (1.fwdarw.3)- $\alpha$ -D-fructofuranosyl, 2-Methoxy-4-vinylphenol, 9-Acetoxyanonal A, 1,2,3-Benzeneetriol, Benzaldehyde and 3-hydroxy- 4-methoxy-[Isovanillin] Isovanillin, Caryophyllene. (Gopalakrishnan, 2011 <sup>[96]</sup> )
67	<i>Nymphoides indicum</i> (L.) O. Kuntze	Gentianaceae	MA		Plant is used as substitute for chiretta in fever and jaundice. (Sinha 1996 <sup>[20]</sup> )	carbohydrates, glycosides, phenolic compounds, flavonoids, saponins, tannins, gums and mucilage and phytosterols (Madhaban <i>et al.</i> , 2011 <sup>[97]</sup> )
68	<i>Nymphoides hydrophyllum</i> (Lour.)	Gentianaceae	MA	Seeds, leaves, stalk	Plant is used as substitute for chiretta in fever and jaundice. (Sinha, 1996 <sup>[20]</sup> )	Alkaloids, saponins, flavonoids and phenols (Bharati <i>et al.</i> , 2014 <sup>[98]</sup> )
69	<i>Nymphoides indica</i> (L) O. Ktze.	Gentianaceae	MI	Plant	Used as substitute for chiretta, in fever and jaundice. (Mahanti, 1994 <sup>[21]</sup> )	Saponins, carbohydrates, glycosides, flavonoids, proteins, amino acids, gums and mucilage. (Madhaban <i>et al.</i> , 2011 <sup>[97]</sup> )
70	<i>Nymphoides indicum</i> Kuntze.	Menyanthaceae	MI	Plant	Plant is used as substitute for Chiraitta in fever and jaundice. (Mahanti, 1994 <sup>[21]</sup> )	Glycosides, phenolic compounds, flavonoids, saponins, tannins, gums and mucilage and phytosterols. (Madhavan <i>et al.</i> , 2009 <sup>[99]</sup> )
71	<i>Oroxylum indicum</i> (L.) Vent.	Bignoniaceae	AS	Stem and root bark	Half kg crushed bark is boiled in water and 100 ml extract is taken thrice daily for 2-3 weeks to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Flavonoids: oroxylinA, baicalein, chrysin, baicalein and tetuin. (Harminder, 2011 <sup>[100]</sup> )
72	<i>Oxystelma secamone</i> (L.) Karst.	Asclepiadaceae	MA	Roots	Roots are useful in jaundice. Latex is used as wash for ulcers. (Sinha, 1996 <sup>[20]</sup> )	Tannins, flavonoids, cardiac glycosides, terpenoids, alkaloids (Poornima <i>et al.</i> 2009 <sup>[101]</sup> )
73	<i>Passiflora edulis</i> Sims.	Passifloraceae	MI	Fruit	Fruit eaten during jaundice. (Mahanti, 1994 <sup>[21]</sup> )	Alkaloids, phenolic compounds, tannins, saponins, cardiac glycosides, flavanoids, steroids and terpenoids (Razia <i>et al.</i> , 2014 <sup>[102]</sup> )
74	<i>Pavetta indica</i> L.	Rubiaceae	MA	Flower	Roots are tonic, purgative and diuretic, used for visceral obstructions, urinary diseases, jaundice and dropsical affection. (Sinha, 1996 <sup>[20]</sup> )	Carbohydrate, glycoside, phytosterols, saponin, flavonoids, alkaloids, $\beta$ -pinene, $\beta$ -eudesmol and tricyclic (Ramamoorthy <i>et al.</i> , 2010 <sup>[103]</sup> ; Prasad <i>et al.</i> , 2011 <sup>[104]</sup> )
75	<i>Peltigera canina</i> Willd	Peltigeraceae	SI	whole plant	Plant juice is recommended for cure of jaundice and other liver disorder. (Biswas & Chopra, 1982 <sup>[26]</sup> )	Not found
76	<i>Phyllanthus fraternus</i> Web.	Euphorbiaceae	MA	Whole plant	Sinha (1996) <sup>[20]</sup>	Tannins, Alkaloid, terpenoids, steroids and saponins. (Mehta <i>et al.</i> , 2013 <sup>[105]</sup> )
77	<i>Phyllanthus amarus</i> K. Schum. & Thonn	Euphorbiaceae	AS	Whole plant	In Jaundice, the decoction of the plant is used. The herb also treats diabetes, dyspepsia, ulcers, sores, swellings, ophthalmia, and chronic dysentery. (Sahrma, 2004 <sup>[19]</sup> )	Alkaloids, flavonoids, saponins and balsam. (Okolo <i>et al.</i> , 2012 <sup>[106]</sup> )
78	<i>Phyllanthus emblica</i> L.	Euphorbiaceae	SI, AS	fruit	Powdered <i>Emblica</i> 32 tolas, prepared iron 32 tolas, liquorice powder 16 tolas, mix them together and soak in the juice of <i>Tinospora cordifolia</i> seven times successively. This preparaton is given in jaundice, anaemia and dyspepsia in doses from 20-40 grains. (Biswas & Chopra, 1982 <sup>[26]</sup> )	Alkaloids, oil, fat, glyceroids, Phenolics, Tannins, lignin, saponins, flavonoids and Terpenoids (Dhale and Mogle, 2011 <sup>[107]</sup> )
79	<i>Phyllanthus fraternus</i> Webster	Euphorbiaceae	AS, AP, MI	whole plant	20-30 gms paste of the whole plant is taken three times daily for two weeks to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> ; Rama Shanker & Rawat, 2004 <sup>[28]</sup> ; Lalramghinglova, 2003 <sup>[22]</sup> )	Alkaloids : Phyllanthin, Hypophyllanthin, Nirphyllin, Phyllinurin, Phyllanthol, Phyllanthanol, Rhamnopyrenoside, Phyllanthone, Lintetralin, Astragaline, Cymene, Niranthin, Nirtetralin, Niruridine, Phyllochrysin, 4-Methoxy-Securinine, 4-Methoxy-Nirsecurinine, Limonene, Niruretin, Nirurin, Phyllochrysin and Steroids : $\beta$ -Sitosterol, Cholesterol (Christian, 2013 <sup>[108]</sup> )
80	<i>Picrorhiza kurroa</i> Benth.	Scrophularineae	SI	roots	It is combined with aromatics and is given in dose of ten to twenty grams. It is considered to be specially indicated in those cases in which the secretions are scanty and the bowels costive, and is often prescribed for children suffering from worms, jaundice and dropsy. Its febrifugal property is a little less than quinine and it is a tonic. (Biswas & Chopra, 1982 <sup>[26]</sup> )	Luteolin-5-O-glucoside and Picein (Kant <i>et al.</i> , 2013 <sup>[109]</sup> )

81	<i>Piper caninum</i> Blume	Piperaceae	MA		Plant extract is given in jaundice.(Sinha,1996 <sup>[20]</sup> )	Safrole, $\beta$ -caryophyllene, $\beta$ -pinene and germacrene D (Wan Mohd, 2011 <sup>[110]</sup> )
82	<i>Plumbago indica</i> L.	Plumbaginaceae	AS	Root	2-3 pieces of root of the species of 4 cm length are tied together and wear in the neck with cotton thread for 15 to 20 days to cure. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Alkaloids, saponins, flavonoids, tannins, glycosides, phenols and steroids (Binil Eldhose, 2013 <sup>[111]</sup> )
83	<i>Polygonum glabrum</i> Willd.	Polygonaceae	MA	Leaves, root-stock	Rootstock is used for piles, jaundice, debility and consumption.(Sinha, 1996 <sup>[20]</sup> )	Alkaloids, flavonoids, tannins, cardiac glycosides and phenols (Swadhini, 2011 <sup>[112]</sup> )
84	<i>Polygonum glabrum</i> Willd.	Polygonaceae	AS	Leaves, roots	Root juice is given in jaundice and other disorder. (Sahrma, 2004 <sup>[19]</sup> )	Alkaloids and flavonoids (Sivakumar, 2011 <sup>[113]</sup> )
85	<i>Prunus triflora</i> Roxb	Rosaceae	AS	Fruits	Ripened fruits are useful for jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Flavonoids, Flavanones, Flavonols, Dihydroflavonols, Isoflavonoids, Biflavones and Biflavanols, Proanthocyanadins, Anthocyanins, Steroids and Terpenes (Poonam <i>et al.</i> , 2011 <sup>[114]</sup> )
86	<i>Psidium guajava</i> L.		AS	Fruit	Juice from one fruit and 1/4 litre of goat milk and root of <i>Sida cordifolia</i> all are mixed together thoroughly. On alternate days such one dose is administered orally, 3 doses are sufficient. It will indicate through the symptoms like clear urine and removal of yellowness from the eyes of the patients.(CCRAS, 1999 <sup>[25]</sup> )	Flavonoids, tannins triterpenoids, saponins, sterols and alkaloids. (Vikrant Arya, 2012 <sup>[115]</sup> )
87	<i>Punica granatum</i> L.	Punicaceae	AS	Roots bark flowers fruits seeds	Powder of entire fruit is taken during jaundice. (Sahrma, 2004 <sup>[19]</sup> )	delphinidin-3-glucoside, cyanidin-3-glucoside, delphinidin-3,5-diglucoside, cyanidin-3,5-diglucoside, pelargonidin-3,5-diglucoside and pelargonidin-3-glucoside with delphinidin-3,5-diglucoside. (Sreekumar, 2014 <sup>[116]</sup> ).
88	<i>Saccharum officinarum</i> L.	Gramineae	MI	Juice stem	Cane juice is taken during jaundice. (Mahanti, 1994 <sup>[21]</sup> )	Anthocyanin, flavanoids and polyphenol antioxidants. (Singh, 2015 <sup>[117]</sup> ).
89	<i>Sida cordifolia</i> L.		AS	Root	Juice from one fruit and 1/4 litre of goat milk and root of Bala all are mixed together thoroughly. On alternate days such one dose is administered orally, 3 doses are sufficient. It will indicate through the symptoms like clear urine and removal of yellowness from the eyes of the patients. (CCRAS, 1999 <sup>[25]</sup> )	Steroids, Fatty acids, Alkaloids, Tannins, Flavonoids, saponons, Trterpenoids (Pattar, 2012 <sup>[118]</sup> )
90	<i>Sida rhombifolia</i> L.	malvaceae	AS	Root	Root of <i>S. rhombifolia</i> , <i>Urena lobata</i> , <i>Elaeagnus raudata</i> and stem bark and root of <i>Bixa orellana</i> and <i>Randia dumetorum</i> are pounded together and boiled in water; 100 ml extract is taken three times daily to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Tannins, phenolics and flavonoids (Sarangi <i>et al.</i> , 2010 <sup>[119]</sup> )
91	<i>Sonchus arvensis</i> , L.	Compositae	MI	Root	Root juice in water is administered. (Mahanti, 1994 <sup>[21]</sup> )	Kaemferol, quercetin, orientin, rutin, hyperoside, catechin and myricetin. (Nurianti, 2014 <sup>[120]</sup> )
92	<i>Smilax ovalifolia</i> Roxb	Smilacaceae	MI	root	The roots with those of <i>Bridelia tomentosa</i> and <i>Ardisia paniculata</i> are grinded on grindstone and the paste is collected in a cup of water. The water is boiled and drunk for jaundice. (Lalramnghinglova, 2003 <sup>[22]</sup> )	Glycosides, tannins, phytosterols, saponins (Shah, 2015 <sup>[121]</sup> )
93	<i>Spinaceae oleracea</i> L. (Spinach).	Chenopodiaceae	MI	Seeds	Seeds boiled in water and extract is taken for 7-10 days. (Mahanti, 1994) <sup>[21]</sup>	Flavanoids, glycosides, saponins, tannins, phenolic compounds (Farah <i>et al.</i> , 2012 <sup>[122]</sup> )
94	<i>Tabernaemontana divaricata</i> (L.) R. Br.	Apocynaceae	AS	Root	100-200 gms roots are crushed and boiled in water; extract is taken three times to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Indole alkaloids, viz., (3S)-3-cyanocoronaridine (2), (3S)-3-cyanoisovoacangine, conolobine A, conolobine B, conolidine, and (3R/3S)-3-ethoxyvoacangine. (Toh-Seok, 2004 <sup>[123]</sup> )
95	<i>Taraxacum officinale</i> Wigg	Compositae	SI, AS	roots	It can be used as tonic or adjuvant. (Biswas & Chopra, 1982 <sup>[26]</sup> )	Chlorogenic, caffeic, p-coumaric, sinapic, ferulic and cichoric acid (Ivan, 2014 <sup>[124]</sup> )
96	<i>Urena lobata</i> L.	malvaceae	AS	Root.	100-200 gms roots are pounded and boiled in water; extract is mixed with <i>Piper longum</i> L. powder and taken one time daily for 20 days to cure jaundice. (Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	Triglycerides and Polyunsaturated fatty acids (Morellia <i>et al.</i> , 2006 <sup>[125]</sup> )
97	<i>Xeromphis spinosa</i> (Thunb.) Keya	Rubiaceae	AS	Stem bark and root bark	Decoction of 200-300 gms of stem and root bark of the species is mixed with <i>Piper longum</i> L. powder and taken thrice daily for 2-3 weeks to relieve jaundice.(Pandey <i>et al.</i> , 1986 <sup>[24]</sup> )	$\beta$ -D-glucopyranosyl-(1-3) quinovic acid, 3-0-[0- $\beta$ -D-glucopyranosyl-(1-4)- $\beta$ -D-glucopyranosyl] pomolic acid, and 3-0-[0-a-L-rhamno-pyranosyl-(1-2) - 0- $\beta$ -D-glucopyranosyl-(1-2) - $\beta$ -D-glucopyranosyl] oleanolic acid. (Bashir, 1996 <sup>[126]</sup> ).

## Conclusion

Many plants are being used by ethnic communities of tribal as a source of herbal remedy for jaundice and other human ailments since ancient times. This paper is an attempt to compile a comprehensive details of the ethno-medicinal information on hepato-protective plants available in demographical area of North East India.

The information on 97 species which are used against jaundice is given in Table no 1. The species are arranged alphabetically as per their botanical names which are followed by the family name, state from where it has been reported or are in traditional use, plant part used along with method of application and the active ingredients reported in scientific literatures.

Investigation of traditional medicine is very important for the welfare of rural and tribal communities for the treatment of conventional illness. This may add to expensive and inadequate health care facilities in the rural areas. Ethno-medicinal documentation of tribal health system for the treatment will be a great advantage to pharmacologists to develop economical and herbal medicines for the treatment of several diseases and disorders.

There is a need to generate reliable scientific data to determine whether the plants currently used to treat jaundice are actually effective. In the long term, this should help to prevent complications and deaths due to ignorance and the misuse of plants for self-medication in the absence of advice from a qualified medical professional. Individual plants are rarely used alone. In most cases, they are used as mixtures. It will never be easy to determine which plants are likely to be the most useful and should be examined to isolate pure active compounds.

Some plants are used for preparing baths or tropical application, while some are added as supportive ingredients in the preparation of these medicines. It might, therefore, be useful to test the anti-bacterial, anti-viral and anti-inflammatory activities of these groups of plants. The present literature survey has provided information about the range of species of plants used in the treatment of jaundice in North East India. Accordingly researchers should observe ethno-medical information of all species before deciding which kind of screening should be used in the search of medicinal plants of importance for developing drugs for jaundice.

It is also important to know that like any medicine, herbal or traditional must be manufactured in correct way following acceptable procedure and manufacturing methods to ensure maximum effectiveness and safety. However, a full spectrum method of extraction which retains the benefits of all active ingredients within the herb must be ascertained for processing of these drugs.

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