## 2.1. Literature review

Greek words 'Ethnos' and 'Botane' (meaning 'people' and 'herb' respectively) make the word ethnobotany. The term ethnobotany was coined in the year 1895 by John. W. Harshberger, an American taxonomist, who defined it as 'the study of the utilitarian relationship between human being and vegetation in their environment' (Choudhary et al., 2008). Now it is defined more precisely as 'the study of the interaction between plants and people with a particular emphasis on traditional tribal culture' (Mesfinet al., 2013). Ethnobotanical studies are conducted to explore the traditional knowledge and plants or natural resources used for human benefits and for therapeutic purposes.

### 2.1.1. The Indian heritage of using medicinal plants

In India the medicinal use of plants is as old as civilization itself, and is a part of our cultural tradition. Ancient religious literature has mentioned the great heritage of treating human and domestic animals with herbs. Several ethnic indigenous groups in India possess vast knowledge and experience of using medicinal plants and in their own way (Jain, 1994; Kala, 2005). People of olden times were wise enough to have the knowledge of usage and preservation of natural resources and plant kingdom in sustainable manner, and prevention of their extinction by offering such natural resources divinity, connecting them with customs and rituals, and growing them nearby (Kala et al., 2006). The knowledge of medicinal plants is based on interactions, observations and experiences; those are confined in the indigenous population verbally, generated, preserved and carried out generation after generation as a secret and community specific functional knowledge. Very few literary evidence has depicted proper identification of characteristics and utility of medicinal plants which are used year after year by the people.

### 2.1.2. Conservation of plant resources

In recent times, the pharmaceutical world has understood the importance of use of natural resources to avoid and treat different life threating diseases. Efforts of cultivation and conservation of naturally growing medicinal plants are made worldwide to ensure uninterrupted supply of good quality raw drugs which are pre-requisite to invent new biomolecules and open new lines of

treatment to the modern world. In developing countries, there is an increasing attempt to incorporate traditional medicines, especially herbal preparations, in the local health care systems. Many modern researchers are involved today to explore the huge potential of ethnobotanical knowledge for treatment of various diseases (Dutta and Dutta, 2005; Jain et al., 2010; Jeyaprakash et al., 2011). However, the ethnomedicinal plants are under threat due to deforestation, overgrazing and reckless utilization, indicating the urgent need of their conservation. Conservation of biological resources as well as their sustainable use is important in preservation of traditional knowledge (Payyappallimana and Fadeeva, 2013).

### 2.1.3. Documentation of traditional knowledge

Study on plants is part of history in India. Relevant evidence has been traced in Vedic literature, Charak, Shusruta and Ayurveda. Except all the written evidence, huge information about plants and their therapeutic uses are traditionally carried on verbally generation after generation among indigenous people in different tribal communities. In modern era, scientists have shown efforts to assimilate this traditional knowledge and explore the vast botanical resources in India to reveal a new direction to the science of medication. Scientific researches are also being initiated to explore, preserve and conserve the indigenous line of medication from the end of Government of India and different non-Government or educational bodies throughout the country. Traditional Knowledge Digital Library (TKDL) in one of the major initiatives taken by Government of India to preserve all traditional knowledge on Ayurveda, Oname, Siddha and Yoga, to prevent the misuse of this knowledge and to protect it from exploitative activities such as bio piracy or unethical patents (https://www.csir.res.in/documents/tkdl). In recent times, several such investigations have been made on traditional medicine and medicinal plants in different places throughout India. This includes Meghalaya (Rao, 1981); Rajasthan (Katewa et al., 2003); Rajasthan (Choudhary et al., 2008); Himachal Pradesh (Prakash and Aggarwal, 2010); Arunachal Pradesh (Das and Tag, 2006); Arunachal Pradesh (Khongsai et al., 2011) and Haryana (Yadav and Bhandoria, 2013).

### 2.1.4. Ethnobotanical studies from North East India

North-East India, comprising of seven states *viz*. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, is the hot spot for wild variety of medicinal plants. More than 250 tribes of different ethnic groups with distinct cultural entities inhabit this region, who have immense knowledge on forest, plants and there uses (Mao and Roy, 2016).

There are studies on the use of different plant parts by different tribal communities in Assam (Shankar et al., 2012). Traditional herbal treatment of jaundice (Borthakur et al., 2004; Bora et al., 2012), malaria (Paul et al., 2013), or anaemia (Nath and Choudhury, 2009) are reported in different ethnomedicinal studies of present time. Even some studies reveal use of different plant species by tribal population in Assam, for pest control during harvesting and post-harvest storage (Majumdar et al., 2013). Different ethnobotanical studies in Manipur on tribes like Mao, Kabui, Meitei, Tang Khul-Naga, Paite, Thadou and Zou (Mao and Roy, 2016) show extensive use of plants in curing diseases, agriculture, pest control, or in dye preparation. There are reports on potential anticancer medicinal plant (Mao, 2002) and herbal vapour therapy (Ningombam et al., 2012). Singh et al., 2012 reported about using *Stemona tuberosa* Lour., a wild medicinal plant, for treating malaria by the Garo tribe in Meghalaya. Typical usage of plants as agricultural season indicators is a very popular practice in tribes of North-Eastern states (Jeeva et al., 2006; Mao and Hynniewta, 2011). Lalramnghianglova (2011) reported on knowledge of tribal population in Mizoram on use of plants on cattle for the treatment of snake or insect bite.

Nagaland is the land of very primitive tribes like Ao, Angane, Lotha, Konyak, Rengma, Phom, Sangtan, Zeliang, Yaumchungar and Sum, but very few studies are there on these population. Pioneeringethno-medicinal study by Rao and Jamir (1982), and a more recent study by Kichua et al. (2015) revealed immense knowledge of these indigenous population on medicinal and regular use of different wild plant species. Darlong, Halaim and Reang are some of the tribal communities residing in the state of Tripura. Report on use of traditional

antifertility active plants (Das et al., 2014) shows the diversified utilization of natural resources in these indigenous population.

### 2.1.5. Ethnobotanical studies in Jalpaiguri, West Bengal

In West-Bengal, very few ethnobotanical studies have been conducted till date. 'Study on medicinal plant used by Rajbangshi community in Cooch Behar' by Sushmita Roy published in 2015 is one of such few studies. Other few studies done by Sinhababuand Banerjee (2013) and Hussain and Hore (2007) at Darjeeling are also reported.

Jalpaiguri is a district in North-Bengal habitat of many tribal populations, but any ethnobotanical study has rarely been done in this area. Covered with dense forests and riverine grasslands, Jalpaiguri is the harbour of one of the richest bounties of Wild life. In Jalpaiguri district, we can see heavy concentration of all the major Chhotanagpur tribes, the hill tribes and many other tribes like the Mech, Toto, Rabha, Garo, Magh, Hajang etc. The later mentioned tribes are the ones which are usually found in the states of North-east India (Roy, 2005). All these various tribes brought along with them their culture and beliefs. Although Jalpaiguri is known for its rich floristic diversity, no serious scientific research work was done on medicinal plants in this area before 90's. Even those earlier studies either documented all the plants with medicinal value in the wild (Nandi, 2005) or tabulated the medicinal plants used by a few tribes in a particular zone of the district (Chaudhuri et al., 1982; Das et al., 1983). So, we designed this study to survey the use of medicinal plants among tribal people of entire Jalpaiguri district. At mid phase of this study (2014) the district has been divided in to two parts, Jalpaiguri and Alipurduar. The aim of present study is to first conduct ethnobotanical investigations in the vast areas of this district inhibited by tribal population. Based on initial findings, almost 50 plant species have been studied at the preliminary level; subsequently four medicinal plants have been chosen for further studies for antioxidant, antileishmanial and anti-fungal screening and also for phytochemical analysis. They are also analysed and purified for isolation of novel molecules.

## 2.2. Materials and methods

### 2.2.1. Study Area

The district of Jalpaiguri in West Bengal is located in the foothills of the Eastern Himalayas. At the time of initiation of the study, it was the largest district of North Bengal covering an area of 6, 245 $km^2$. It is situated between 26°16' and 27°0' North latitudes and 88°4' and 89°53' East longitudes. On 2014, Jalpaiguri district was divided in to two parts, Jalpaiguri and Alipurduar. The entire topography of the area is crisscrossed with several rivulets and rivers, and is lying between the Sikkim – Darjeeling Himalayas and the Gangetic West Bengal. Main forest cover comprises of semi-moist deciduous vegetation. Sal forest is predominant with pockets of various other types like evergreen forests, savannahs, riverain forest and swamps (Fig. 2.1).

The climate of the district is characterized as sub-tropical and humid type. The average annual humidity in the district is of 82%. The average maximum temperature is 37°C and the average minimum temperature is 6°C. The average annual rainfall of this district is about 3300 mm, with an average of more than 100 rainy days.

### 2.2.2. Data Collection

A simple but very basic work plan was adopted for this survey work. At first various government departments like Forest Department, Department of Backward Classes, Panchayat Offices etc. of the erstwhile Jalpaiguri District were approached for getting information about checklist of forest villages with relevant demographic information, and to get detailed information about tribal population and tribal villages of the district. Relevant information was also collected from various websites. On the basis of that information a plan of work was chalked out for our survey. Then extensive survey was conducted during the period of July, 2012 to December, 2012 and some of the places were revisited again during July to December of 2013.

During field survey, detailed information on types, traditional method of preparation, mode of consumption, shelf life and ethnic value of the medicinal plants were collected from elderly persons and traditional healers of tribal

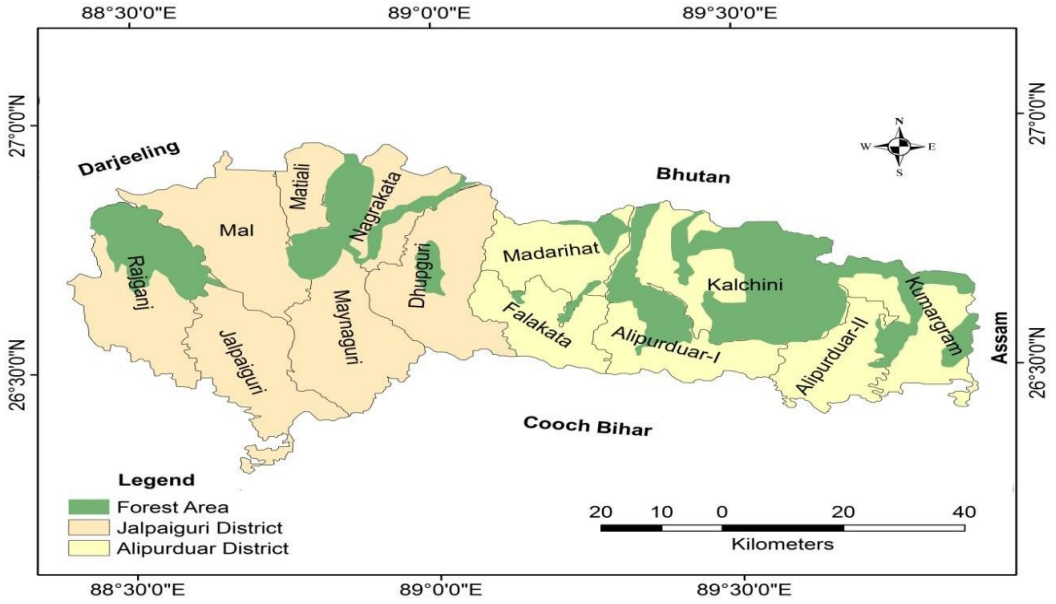


**Figure: 2.1.** Geographical map of Jalpaiguri and Alipurduar districts (area of study)

(Prepared using ***ArcGIS 10.3.1*** *software*)

communities. Information was collected through well-structured pre-tested questionnaires and discussions among the informants in their local language.

The plant specimens were collected as directed by the resource persons in flowering and fruiting conditions. Digital photographs of the plants were also taken. Collected specimens were dried, chemically treated, and herbarium sheets were prepared for possible identification. Identifications were made using available literature (Prain, 1903; Bhattacharyya, 1997). The herbarium sheets were deposited in the Herbarium of Ananda Chandra College and in West Bengal State Council of Science and Technology Department.

## 2.3. Results

In this study 50 plant species of 30 families (Table 2.1) were found to be used for medicinal purposes by various tribes of Jalpaiguri and Alipurduar districts. Most of this knowledge was transmitted from one generation to the next. The traditional medicine-men are integral part of the community and take care of the common ailments of the folks in their home settings. The reported plants were arranged according to their scientific name, family, local status on availability, parts used, therapeutic uses and method of usage of herbal preparations. However, we were not able to collect information about method of usage of herbal preparations in all cases; because many of the traditional healers believe that upon disclosure of the knowledge (particularly to urban people) the effect of medicine will diminish.

The tribal populations use these 50 species of medicinal plants to treat 56 various types of physical ailments. Most of the plants reported in this study were collected from natural vegetation (76%) and few of them from home gardens (24%). Of the 30 families, Lamiaceae is represented by the highest number of species (6 species), followed by Apocynaceae which has five species and Asteraceae which has four species. Acanthaceae, Euphorbiaceae, and Malvaceaeis represented by 3 species in each family. Amaranthaceae, Fabaceae and Rutaceaehave two species each. Ancardiaceae, Apiaceae, Annonaceae, Cucurbitaceae, Cleomaceae, Cyperaceae, Caryophyllaceae, Heliotropiaceae, Meliaceae, Myrtaceae, Moringaceae, Menispermaceae,

Onagraceae, Oleaceae, Pedaliaceae, Plantaginaceae, Plumbaginaceae, Phyllanthaceae, Rutaceae, Solanaceae and Zingiberaceae are represented by only one species each.

**Table: 2.1**. Medicinal plants used by tribal population of districts of North Bengal (Jalpaiguri and Alipurduar)

| Name of Plants (Common name/Local name) | Family | Local Distribution | Use |
|---|---|---|---|
| *Ageratum conyzoides* L. (Uchunti) | Asteraceae | Common wild | Leaf used to treat cut |
| *Alstonia scholaris* (L.) R. Br. (Saptparni) | Apocynaceae | Common wild | Bark extract used to treat intestinal worm; bark juice used to treat fever |
| *Amaranthus spinosus* L. (Kantanotya) | Amaranthaceae | Common wild | Leaf used to treat anaemia; root paste applied on stomach to treat urinary disorder |
| *Andrographis paniculata* (Burn.f.) Wall. ex Nees (Green Chireta) | Acanthaceae | Commonly cultivated | Leaf extract to treat jaundice; dried leaf extract to treat body pain |
| *Azadirachta indica* A. Juss. (Neem) | Meliaceae | Common wild | Extract used to treat jaundice; dried leaf extract to treat body pain |
| *Calotropis gigantea* (L.) W.T. Aiton | Apocynaceae | Common wild | Leaf used to treat Rheumatism |
| *Calotropis procera* (Aiton) W.T. Aiton (Rubber-bush) | Apocynaceae | Common wild | Leaf used to treat rheumatism and cuts; latex used in dog bite |
| *Centella asiatica* (L.) Urb. (Thankuni) | Apiaceae | Common wild | Leaf used to treat diarrhea and dysentery; leaf extract to treat eczema |
| *Chenopodium album* L. (Bathua) | Amaranthaceae | Common wild and cultivated | Leaf used to treat intestinal worm |
| *Clausena excavata* Burm. f. (Agnijol) | Rutaceae | Common wild | Used in abdominal pain, detoxifying agent and also in snake bite |
| *Cleome rutidosperma* DC. (Fringed spider flower) | Cleomaceae | Common wild | Seeds used in menstrual problems |
| *Coccinia grandis*(=*indica*) (L.) Voigt. (Tindora) | Cucurbitaceae | Common wild | Leaf used to treat hypertension |
| *Croton bonplandianum* Baill. (Ban tulsi) | Euphorbiaceae | Common wild | Leaf extract used to treat cut and wounds |
| *Curcuma longa* L. (Turmeric) | Zingiberaceae | Commonly cultivated | Rhizome paste applied in cuts and wounds |
| *Cyperus rotundus* L. (Nutgrass) | Cyperaceae | Common wild | Root extract used to treat cuts |

| Name of Plants (Common name/Local name) | Family | Local Distribution | Use |
|---|---|---|---|
| *Dalbergia sissoo* Roxb. ex DC. (Indian rosewood) | Fabaceae | Cultivated for timber | Leaf juice used to treat stomach disorder |
| *Drymaria diandra* Blume (West Indian Chickweed) | Caryophyllaceae | Common wild | Dried leaf smoked to treat cough |
| *Eclipta prostrata* (L.) L. (Bhringaraj) | Asteraceae | Common wild | Leaf extract used to disinfect cuts and wounds |
| *Emblica officinalis* Gaertn. (Amla) | Phyllanthaceae | Common | Fruits used to enhance digestion, health and intellect, strengthen the heart, purify bloody eyes. Also used against constipation, fever and cough and promote longevity. |
| *Eupatorium odoratum* L. (Christmas bush) | Asteraceae | Common wild | Fresh leaf juice externally applied to cuts and wounds to stop bleeding |
| *Euphorbia hirta* L. (Asthma weed) | Euphorbiaceae | Common wild | Leaf used to treat menstrual problems and extract used to stop irregular periods |
| *Glycosmis arborea* (Roxb.) DC. (Orange Berry / Ash-sheora) | Rutaceae | Uncommon wild | Root powder used in fever, hepatopathy, eczema, skin diseases, wounds and liver problems |
| *Gmelina arborea* Roxb. (Gamhar) | Lamiaceae | Commonly cultivated for timber | Root extract used in stomach disorder |
| *Heliotropium indicum* L. (Hatisura) | Heliotropiaceae | Common wild | Juice of plant used to treat eye infection |
| *Hibiscus rosa-sinensis* L. (Hibiscus Joba) | Malvaceae | Commonly cultivated | Leaf used to treat burning sensation, fatigue and skin diseases |
| *Hygrophila schulli* (Buch.-Ham.) M.R. Almeida & S.M. Almeida (Gokulakanta) | Acanthaceae | Restricted wild | Leaf extract used to treat anaemia |
| *Justicia adhatoda* L. (Vasaka) | Acanthacea | Common in wild and also cultivated | Leaf juice taken as expectorant to treat chronic bronchitis, cough and cold |
| *Leonurus sibiricus* L. *(Guma)* | Lamiaceae | Common | Anti-inflammatory, anti-diarrhoea. Leaf extract used in haemorrhage, weakness. |
| *Leucas plukenetii* (Roth) Spreng. syn *L. aspera* (Willd.) Link (Dondokolosh) | Lamiaceae | Common wild | Leaf extract used in jaundice |
| *Ludwigia perennis* L. (Paddy Clove) | Onagraceae | Common wild | Boiled plant extract used externally to reduce fever |
| *Malvaviscus arboreus* Cav. (Lanka Joba) | Malvaceae | Common cultivated | Flower buds are used to stop bleeding |

| Name of Plants (Common name/Local name) | Family | Local Distribution | Use |
|---|---|---|---|
| *Mangifera indica* L. (Mango) | Ancardiaceae | Common wild and cultivate | Bark used for the treatment of loose motion |
| *Moringa oleifera* Lam. (Drumstick) | Moringaceae | Common in wild and cultivated | To get relief from stress and pain, nutrient supplement |
| *Nyctanthes arbor-tristis* L.(Seuli) | Oleaceae | Common wild | Juice of leaf is used as antidote to reptile venom, laxative digestive element and diuretics |
| *Ocimum basilicum* L. (Ram tulsi) | Lamiaceae | Cultivated in marshy places | Seed paste applied against stings of wasps, bees and other venomous insects |
| *Ocimum gratissimum* L. (Tulsi) | Lamiaceae | Uncommon wild | Leaf extract applied on cut to stop bleeding |
| *Plumbago zeylanica* L. (Leadwort) | Plumbaginaceae | Uncommon cultivated | Root used to treat high fever; leaf used to treat cut |
| *Polyalthia longifolia* Var.*pendula* (Devdaru) | Annonaceae | Common | Powder of stem bark is given orally to cure diarrhea and in the treatment of gout. |
| *Psidium guajava* L. (Common Guava) | Myrtaceae | Common in wild and cultivated | Bark used as contraceptive; young leaf used to treat stomach pain |
| *Rauvolfia serpentina* (L) Benth. exKurz (Sarpagandha) | Apocynaceae | Rare wild | Root extracts used in stomach pain and to treat intestinal worm |
| *Rauvolfia tetraphylla* L. (Devil-pepper) | Apocynaceae | Uncommon cultivated | Root extract used in stomach pain and to treat intestinal worm |
| *Ricinus communis* L. (Castor oil plant) | Euphorbiaceae | Common wild | Seed oil is used as painkiller |
| *Scoparia dulcis* L. (Sweet-broom) | Plantaginaceae | Common wild | Leaf juice used against stomach disorder |
| *Sesamum indicum* L. (Sesame) | Pedaliaceae | Cultivated | Fried fruit taken in case of fever |
| *Sesbania grandiflora* (L.) Pers. (Humming bird tree) | Fabaceae | Cultivated | Extract of leaf used in jaundice |
| *Sida acuta* Burm. f. (Clock Plant) | Malvaceae | Common wild | Root extract used against blood urea, boils and nephritis |
| *Solanum indicum* L. (Brihati) | Solanaceae | Common wild | Seed applied on teeth and gum to treat infection |
| *Stephania glandulifera* Miers. (Jaluko) | Menispermaceae | Common wild | Root used in headache |
| *Vitex negundo* L. (Nishinda) | Lamiaceae | Common wild | Extract of leaf used against whitening of hair and memory loss |
| *Xanthium strumarium* L. (Cocklebur) | Asteraceae | Common wild | Used as anti rheumatic, appetizer and laxative. |

Among different plant parts used for the preparation of medicine, leaf (33.9%) was found to be the most frequently used plant part followed by root (18.2%), whole plant (14.7%), seed (10.4%), rhizome (9.5%), fruit (9.5%), latex (3.4%), flower (3.4%), and in rare occasion, fleshy scale, flower bud, root bark and only stem. Different plant parts of a single medicinal plant may have multiple medicinal use and importance. An important example of such plant is *A. spinosus* (Kantanotya).Additionally, several plants were used for the treatment of multiple diseases. *G. arboroea* is used for the treatment of six diseases; *H. rosa-sinensis* for the treatment of four diseases; *S. acuta* and *V. negundo* are used for the treatment of three diseases each; and 14 other plants are used to treat two diseases.

Most of the ethno botanical studies confirmed that leaves are the major portion of the plant used in the treatment of diseases. The methods of preparation of the botanicals fall into four categories, viz. plant parts applied as a paste, juice extracted from the fresh parts of the plant, and plants used to prepare decoction in combination with water and powder made from fresh or dried material.

## 2.4. Discussion

Almost in every corner of the Jalpaiguri and Alipurduar districts, plants were found to be used as medicines. The study reveals unquestionable dependency of tribals of Jalpaiguri and Alipurduar districts on medicine-men called as gunin. They are integral part of the medication process and provide treatment to the members of the tribe in their home setting depending primarily on medicinal plants. There is a conscious effort to preserve this traditional knowledge exclusively within their own community. The herbal preparations made from the traditional medicinal plants were mostly used to treat common ailments prevalent in this region like cuts and wounds, cough and cold, skin diseases, pain and inflammation, bone fracture and stomach ache and abdominal disorder, for treatment of jaundice and liver problems, and fever. Some frequently used plant species used by local tribal population of the studied area were found to be in common with those used by the tribal population of Tripura (Debbarma et al., 2017), Nagaland (Bhuyan et al., 2014),

Assam (Bora et al., 2012), Rajasthan (Choudhary et al., 2008) and Bangladesh (Khatun and Rahman, 2019). In the present study, 50 plant species of 30 families were listed, which the tribal population use in their regular health care in different forms such as raw extract of the whole plant, part of plant or in dried form. It was found that leaves are the most frequently used plant parts, followed by roots. This finding is in agreement with previous studies in different parts of India and Bangladesh (Debbarma et al., 2017; Bhuyan et al., 2014; Bora et al., 2012; Khatun and Rahman, 2019).

Use of medicinal plants among the tribals of Jalpaiguri and Alipurduar districts in treatment of various diseases has definitely been outnumbered today by the allopathic treatment. But still their dependence on plants of their surroundings to get relieved from day-to-day ailments is unquestionable. However, all persons who are using plants as medicine, complain about the gradual fading out of many of the medicinal plants from their surroundings. It is presumable that availability of such plants in the vicinity may increase the use of plants as medicine. So, possibilities of propagation, preservation and cultivation of these plants in this area should be explored to achieve the goal of sustainable development. Further research on the medicinal plants mentioned in this study might provide some potential leads to fulfil the needs of search for bioactive compounds and the discovery of new drugs to fight diseases. Four very common and well-known medicinal plants, *R. serpentina* (sarpagandha), *M. oleifera* (drumstick), *N. arbor-tristis* (seuli or night jasmine) and *C. excavata* (agnijol), whose utilizations were found to be vast and versatile among the above said population, were selected for further study both in laboratory set up and on animal models.