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SURVEY AND SCIENTIFIC EVALUATION OF WOUND HEALING, HEMOSTATIC AND ANTI-INFLAMMATORY ACTIVITY OF SOME SELECTED MEDICINAL PLANTS

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Abstract :

In most recent couple of a few years, there has been a unprecedented advancement in understanding the biochemical and cell occasions of typical injury recuperating. Healing is survival mechanism and represents a trial to take care of normal complex body part and performance. All the Traditional systems of medicine, Ayurveda, Siddha and Unani describe applications of medication of plant, mineral and animal origin to treat and heal wounds. Herbal drugs induce healing and regeneration of lost tissue by number of mechanisms, starting with hemostasis, Inflammation, Tissue growth to Tissue remodelling. The present article is a trial to focus on some selected Indian ethno-medicinal plants having wound healing properties. After collecting information, further data processing and analysing of data on the different species of plant was done. Beside this review also emphasis on role of plants in antioxidant, anti-inflammatory and hemostatic activities of selected plant species.

Keywords : Wound healing, Haemostatic, Inflammation, antioxidant.

Introduction :

Wound and its healing process:

Wound healing refers to a living organism's replacement of destroyed or damaged tissue by newly produced tissue. This process is divided into predictable phases: blood clotting (hemostasis), inflammation, tissue growth (cell proliferation), and tissue remodeling (maturation and cell differentiation). Blood clotting may be considered to be part of the inflammation stage instead of a separate stage⁽¹⁾. The 4 phases of wound healing are as follows-

Hemostasis Phase

Hemostasis is the natural process that stops blood loss when an injury occurs. It involves three steps: vascular spasm (vasoconstriction); platelet plug formation; and coagulation⁽¹⁾.

- Vasoconstriction is a reflex in which blood vessels narrow to increase blood pressure.
- Next, platelet plug formation involves the activation, aggregation, and adherence of platelets into a plug that serves as a barrier against blood flow.
- Coagulation involves a complex cascade in which a fibrin mesh is cleaved from fibrinogen.
- Fibrin acts as “molecular glue” during clot formation, holding the platelet plug together.

Inflammatory Phase

Phase 1 is primarily about coagulation, the second phase, called the Defensive/Inflammatory Phase, focuses on destroying bacteria and removing debris—essentially preparing the wound bed for the growth of new tissue⁽¹⁾. During Phase 2, a type of white blood cells called neutrophils enter the wound to destroy bacteria and remove debris. These cells often reach their peak population between 24 and 48 hours after injury, reducing greatly in number after three days. As the white blood cells leave, specialized cells called macrophages arrive to continue clearing debris. These cells also secrete growth factors and proteins that attract immune system cells to the wound to facilitate tissue repair. This phase often lasts four to six days and is often associated with edema, erythema (reddening of the skin), heat and pain⁽¹⁾.

Proliferative Phase

Once the wound is cleaned out, the wound enters Phase 3, the Proliferative Phase, where the focus is to fill and cover the wound. The Proliferative phase often lasts from 2 days to 3 weeks. Macrophages recruit fibroblasts. These cells create a network of collagen fibers. When adequate oxygen and vitamin C are present, granulation of tissue forms. During granulation, fibroblasts create a collagen bed to fill the defect and grow new capillaries. During contraction, myofibroblasts pull the wound edges closer together to decrease the size of the wound. During epithelization, new epithelium migrates from the intact epidermis around the wound and can grow up to 3 cm over the granulation tissue. This process requires a moist surface⁽¹⁾.

Maturation Phase

During the Maturation phase, the new tissue slowly gains strength and flexibility. Here, collagen fibers reorganize, the tissue remodels and matures and there is an overall increase in tensile strength (though maximum strength is limited to 80% of the pre-injured strength). The Maturation phase varies greatly from wound to wound, often lasting anywhere from 21 days to two years. The healing process is remarkable and complex, and it is also susceptible to interruption due to local and systemic factors, including moisture,

infection, and maceration (local); and age, nutritional status, body type (systemic). When the right healing environment is established, the body works in wondrous ways to heal and replace devitalized tissue⁽¹⁾.

The stages of wound healing are a complex and fragile process. Failure to progress in the stages of wound healing can lead to chronic wounds. Factors that lead up to chronic wounds are venous disease, infection, diabetes and metabolic deficiencies of the elderly. Careful wound care can speed up the stages of wound healing by keeping wounds moist, clean and protected from reinjury and infection⁽¹⁾.

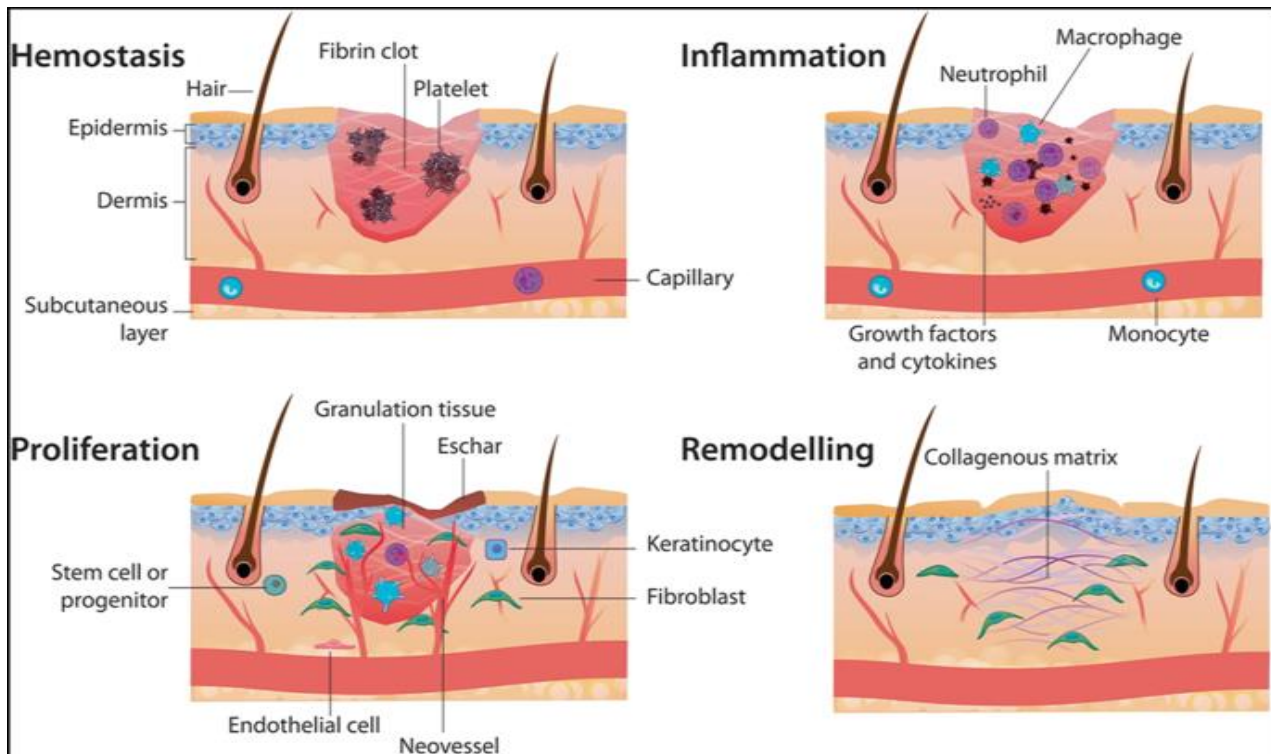


Fig. 1: Diagram of wound healing processes

Some medicinal plants of Northeast India:

Importance of medicinal plants :

Plants are the premise of life on earth and are central to people's livelihoods. Tribal people are the ecosystem folks that board harmony with the character and maintain a detailed link between man and environment. Indian subcontinent is being inhabited by over 53.8 million tribal people in 5000 forest dominated villages of tribal community and comprising 15% of the full geographic region of Indian landmasses, representing one among the best emporia of ethno-botanical wealth⁽²⁾. The Northeastern states of India that comprises of eight sister states viz. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura harbors over 130 major tribal communities of the overall 427 tribal communities found in India (2001 census). In general, the tribes of North East India are categorized into two broad ethnic communities-Khasi and also the Jaintia tribes of Meghalaya, who belong to 'Monkhemar' culture of Austric dialect and also the remainder of the tribal groups are basically Mongoloid, who belongs to Tibeto Burman subfamily of Tibeto Chinese group⁽³⁻⁵⁾.

The Gateway of North East India, Assam with its stunning scenic grandeur entices the adventurer and tourist alike with its verdant valleys, rolling tracts of paddy and tea, misty mountain peaks, swift rivers comprises 12.8% of the whole tribal population of India (2001 census). The Census enumerates 14 hill tribes; 12 of those are tribes whose settlements return to the times of undivided Assam and include pockets of Khasi, Jaintia, and related tribes, Garo, Naga and a clutch of Kuki and related tribes – the foremost numerous and significant factor outside the eight plains tribes and two hill tribes. Karbis (63.8%) and Dimasas (14.4%) form the key hill tribal population of Assam (1991 census). An extensive diversity of both of population and flora within the state has provided an initial advantage to its inhabitants since times immemorial for observing, and scrutinizing the rich flora and fauna for developing their own content. The history reveals that the majority of the tribal economies are engaged in subsistence agriculture or hunting and gathering. With the passage of your time, they need developed a good deal of data on the employment of plants and plant products in curing various ailments. They need a deep belief in their native folklore medicine for remedies and that they rely exclusively on their own herbal cure.



Fig 2. Map of North-East India

Dymaria cordata

D. cordata is an aggressive, shade tolerant, weed of gardens, agriculture, pasture and disturbed land in moist tropical and subtropical areas. It can also be found growing along roadsides and in seminatural areas such as riverbanks, ditches, secondary forests, and forest edges^(6,7,8). It tolerates light to medium shade and germinates quickly after cultivation and other soil disturbance.

The use of the plant for agriculture and traditional medicine has been reported in Africa, Asia and the Americas⁽⁹⁾. In tropical Africa, *D. cordata* preparations are used for the treatment of diverse ailments

including cold, headache, coryza, bronchitis, as poultice on sore (to treat aching, inflamed or painful parts), leprosy, tumors, as fumigant for eye troubles, as cerebral stimulant and antifebrile agent ⁽⁹⁾. Extracts of *D. cordata* have previously been reported to possess antitussive ⁽¹⁰⁾ anti-inflammatory ⁽¹¹⁾, anxiolytic ⁽¹²⁾ and cytotoxic ⁽¹³⁾ activities.

In Nigeria, *D. cordata* (chick weed; “Calabar woman's eye”) is used in folk medicine to treat sleeping disorders, convulsions, and febrile conditions in children⁽¹¹⁾.

Plant profile:

Family : Caryophyllaceae

Genus : Drymaria

Order : Caryophyllales

Clades : Angiosperms

Kingdom : Plantae ⁽¹⁴⁾



Fig 3.: (*Dymaria cordata*)

***Aerides multiflora*:**

Aerides multiflora was first described by William Roxburgh in 1820. This multi-flowered *Aerides*, grown as a tree trunk in dense forest, bank of streams. It is a small to medium sized, hot to cool growing, monopodial orchid with a stout, many leafed stem, carrying ligulate, distichous, curved, bilobed apically leaves that is deeply channeled and keeled. The Plants are around 25-35 cm tall. It blooms from spring to summer with flowers on a rarely branched, 12” (30 cm) long, pendulous, many (to 50) flowered inflorescence with waxy, fragrant flowers. Flowers are white with freely marked and flushed with pink or purple and are about 2-2.8 cm. Leaves about eight inches long, dark green, and covered with small spots

Leaves are 1.5-3 cm and are oblong to linear oblong. Flowers and fruits comes under March to August . They grows as epiphyte in humid places in dense forest, banks of stream ⁽¹⁵⁾.

It is native to North west Himalayan, Nepal, India, Bangladesh, Myanmar, Laos, Thailand, Cambodia and Vietnam. In Assam it is distributed at Tinsukia, Sibsagar, Lakhimpur, Karbi-Anglong, Barpeta, Nalbari, Bongaigaon, Kokrajhar, Baksa, Chirang and Southern Assam ⁽¹⁵⁾.

It is uses to treat wounds in India ⁽¹⁶⁾ and leaf paste is also applied to cuts and wound in Nepal ⁽¹⁷⁻¹⁸⁾ whereas powdered leaf constitutes as tonic ⁽¹⁹⁾ . Epiphytic pseudobulb paste is used to treat fractured and dislocated bones ⁽¹⁷⁾ and tubers exhibit an antibacterial effect *in-vitro*⁽²⁰⁻²¹⁾.

Plant profile:

Species: *A. multiflora*

Family: Orchidaceae

Synonyms: *Aerides affinis*, *Aerides lobbii*, *Aerides veitchii*.

Kingdom: Plantae.

Clade: Tracheophytes. .

Order: Asparagales.

Subfamily: Epidendroideae.

Genus: *Aerides*⁽²²⁾



Fig.4: (*Aerides multiflora*)

METHODS

Survey of Medicinal Plants : The survey was made between September 04 to September 30, 2020 conducted to find out the different plants used in the management of wound, blood loss and inflammation from the survey of existing literature.

Data Collection, Data Processing and Analysing, Reporting of Data : The data was collected from the State of Assam, Tinsukia. Total information of 111 different plant species were collected given below in table no. 4. Various information regarding the use of medicinal plants, parts use and other details were collected from different literature which content the information of various medicinal plants used by the people of Northeast India by using various sources of Scientific literatures like Scifinder, Google Scholar, Pubmed, etc. The data reported that peoples are using the traditional medicinal plants and their parts in different areas of Northeast of Assam from several years in treating wounds, blood loss and inflammatory diseases.

Selection of Plant : Based upon the survey two plants named, *Areides multiflora* and *Dymaria cordata* from NorthEast India were selected. Both the species are facing the danger of extinction, in several regions, due to deforestation, irrational collection and inadequate germination rates in nature. However, as compared to the other orchid, little attention is given towards their conservation in nature.

Selection and Authentication : The selected plants were collected from Tinsukia district of Assam and herbariums were prepared following standard methods and submit to BSI, Guwahati University for authentication.

Processing of Plant : Fresh leaves of *Aerides multiflora* and *Dymaria cordata* are then washed, dried in the shade for 3-4 days, then cut into small pieces in a grinder and grounded into coarse powder using mortar and pestle.

Extraction of Plant Part : The leaves of *Aerides multiflora* and *Dymaria cordata* are grounded into coarse powder using mortar and pestle. Then the coarse powder is subjected to crude extraction by cold maceration protocol. Briefly, 150 g of powdered material was weighed and soaked in a flask containing 500 ml of 80% ethanol in water (with a total of 1500 g powder in 5 L solvent) for a period of 3 days with occasional shaking using a shaker at room temperature. After keeping for 72 hrs, filtered using Soxhlet Apparatus using Whatman No. 1 filter paper⁽⁴³⁾. The filtrate are collected and then concentrated using an Rotary evaporator at 40° C. Resultant extract was preserved in refrigerator for further study.



Fig 5. : Soxhlet Apparatus



Fig.6.: Rotary Evaporator

Preliminary Phytochemical Analysis :

The extract were test for the presence of bioactive compounds by using following standard methods ⁽⁴⁴⁾:

Table 1 : Preliminary Phytochemical analysis

Sl.no.	Methods	Inference of the result
1	Dragandroff's test : A few drops of Dragandroff's test(potassium bismuth iodide solution) was added to 2-3 ml of filtrate.	An orange color precipitate shows the presence of alkaloid.
2	Mayer's test : A few drops of Mayer's test(potassium mercuric iodide solution) was added to 2-3 ml of filtrate.	Formation of cream colored precipitate gives an indication of the presence of alkaloids.
3	Keller killiani test : Glacial acetic acid was added to 2ml extract, followed by the addition of trace quantity of ferric chloride and 2 to 3 drops of sulphuric acid.	A brown ring formed bwteen the layers which showed the presence of Cardiac steroidal glycosides.
4	Salkowski reaction : 2ml of extract was mixed with 2ml chloroform and 2ml concentrated sulphuric acid.	A reddish brown coloration indicates the presence of terpinoid.
5	Ferric chloride test :1ml of the solution was added to 2ml of distilled water followed by few drops of 10% ferric chloride.	A dark green color/blish black color indicates the presence of phenolic compound.

6	Lead acetate test : Diluted 1ml of alcoholic solution of extract with 5ml distilled water and to this added few drops of 1% aqueous solution of lead acetate.	A white precipitate indicates the presence of phenol.
7	Foam test : 1ml of test sample was added to diluted with 20ml of distilled water and shaken it in a graduated cylinder for 3minutes.	A presence of foam layer of 2cm for atleast 30 mins confirms the presence of saponin.
8	Alkaline reagent test : A few drops of NaOH solution was added to the extract.	An intense yellow color indicate the presence of flavanoid which becomes colourless on addition of diluted acid.
9	Lead acetate test : A few drops of lead acetate was added to 5ml of aqueous extract.	A yellow precipitate indicates the presence of flavanoid.
10	Crude extract was shaken in 10 ml benzene and was filtered, 10% ammonia solution was added and the mixture was shaken well.	A pink/violet or red colour indicates the presence of anthraquinone.
11.	1ml of the extract was treated with 0.5 ml of acetic anhydride and cooled in ice. This was mixed chloroform and 1ml of concentrated H ₂ SO ₄	A reddish brown ring shows the presence of steroids.
12.	0.5g of the crude powder was stirred in 10 ml of distilled water and was filtered. This was filtered and FeCl ₃ reagent was added to the filtrate.	The appearance of intense green, purple, blue or black indicates the presence of tannins.
13.	1ml of Barfoed's reagent was added in extract and heated for 2 mins.	A red color precipitate indicates the presence of Carbohydrates.

Antioxidant Study (DPPH Free Radical Scavenging Assay): α, α -diphenyl- β -picrylhydrazyl (DPPH) free radical scavenging method is used to evaluate the antioxidant potential of a compound, an extract or other biological sources. This is the simplest method, wherein the prospective compound or

extract is mixed with DPPH solution and absorbance is recorded after a defined period. The free radical scavenging activity of all the extracts was evaluated by 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) according to the previously reported method by ⁽⁴⁵⁾. Briefly, an 0.1mM solution of DPPH in methanol was prepared and 1mL of this solution was added to 3 ml of the solution of all extracts in methanol at different concentration (50,100,200,400 & 800µg/mL).The mixtures were shaken vigorously and allowed to stand at room temperature for 30 minutes. Then the absorbance was measured at 517 nm using a UV-VIS spectrophotometer. Ascorbic acid was used as the reference. Lower absorbance values of reaction mixture indicate higher free radical scavenging activity. The capability of scavenging the DPPH radical was calculated by using the following formula.

$$\text{DPPH scavenging effect (\% inhibition)} = \frac{(A_0 - A_1)}{A_0} * 100$$

Where, A₀ is the absorbance of the control reaction, and A₁ is the absorbance in presence of all of the extract samples and reference. All the tests were performed in triplicates and the results were averaged.

Nitric Oxide Radical Scavenging Assay

The assay is the nitric oxide radical scavenging assay⁽⁴⁶⁾. The extracts were prepared from a 10 mg/mL ethanol crude extract. These were then serially diluted with distilled water to make concentrations from 100–1000 µg/mL of the three plants and the standard Ascorbic acid. These were stored at 4°C for later use. Griess reagent was prepared by mixing equal amounts of 1% sulphanilamide in 2.5% phosphoric acid and 0.1% naphthylethylene diamine dihydrochloride in 2.5% phosphoric acid immediately before use. A volume of 0.5 mL of 10 mM sodium nitroprusside in phosphate buffered saline was mixed with 1 mL of the different concentrations of the ethanol extracts (100–1000 µg/mL) and incubated at 25°C for 180 mins. The extract was mixed with an equal volume of freshly prepared Griess reagent. Control samples without the extracts but with an equal volume of buffer were prepared in a similar manner as was done for the test samples. The colour tubes contained ethanol extracts at the same concentrations with no sodium nitroprusside. A volume of 150 µL of the reaction mixture was transferred to a 96-well plate. The absorbance was measured at 546 nm using a SpectraMax Plus UV-Vis microplate reader (Molecular Devices, GA, USA). Ascorbic acid was used as the positive control. The percentage inhibition of the extract and standard was calculated and recorded. The percentage nitrite radical scavenging activity of the ethanol extracts and Ascorbic acid were calculated using the following formula:

Percentage nitrite radical scavenging activity:

$$\text{Nitric oxide scavenged (\%)} = \frac{A_{\text{control}} - A_{\text{test}}}{A_{\text{control}}} * 100$$

where A_{control} = absorbance of control sample and A_{test} = absorbance in the presence of the samples of extracts or standards.

In-Vitro Haemostatic Evaluation:

i. BCI Measurement: Different formulations will kept in beaker and pre warmed to 37°C. 25 ml fresh ACD blood dropped on to the formulation followed by addition of calcium chloride 0.02 ml (0.2 mol/l). The formulation will be incubated at 37 °C and shaken at 30 rpm. After 5 min, 10 min, 20 min, 30 min, 50 min, red blood cells (RBCs) that are no trapped in the clot were haemolyzed with 50 ml of water and the absorbance of the resulting hemoglobin solution was measured at 540 nm. The blood clotting index (BCI) of biomaterials can be evaluated by of following equation:

$$\text{BCI} = \frac{\text{Absorbance of blood which had been in contact with sample} \times 100}{\text{Absorbance of solution of distilled water and ACD blood}}$$

ii. Haemolysis activity: Hemolytic assay was carried out by collecting fresh human red blood cells were taken and washed three times by 150 mM NaCl (2500 rpm for 10 minutes). The serum was removed and the cells were suspended in 100 mM sodium phosphate buffer. Four different concentrations (50 µg, 100 µg, 150 µg and 200 µg) of extracts were mixed with 200 mL of RBC solutions and the final reaction mixture volume was made up to 1 ml by adding sodium phosphate buffer. The reaction mixture was then placed in water bath for 1 hour at 37°C. After the incubation time the reaction mixture was centrifuged again at 2500 rpm for 15 minutes. The supernatant was collected and the optical density was measured at 541 nm keeping sodium phosphate buffer as blank. Deionised water was used as a positive control⁽⁴⁷⁾. The experiment was done in triplicate and mean ± S.D. was calculated.

$$\text{Percentage hemolysis} = \frac{(\text{Absorbance of sample} - \text{Absorbance of blank}) \times 100}{\text{Absorbance of positive control}}$$

In-vitro Antiinflammatory Activity:

i. Inhibition of Albumin Denaturation: The assay was carried out by adopting the methods described by Kumari *et al.* with some modifications in which the volume of each component in the reaction mixtures was reduced by half. The plant extracts and positive standards (ibuprofen and diclofenac) were prepared at a concentration of 0.1% each (1.0 mg/ml). A reaction vessel for each mixture was prepared consisted of 200 µl of egg albumin, 1400 µl of phosphate buffered saline, and 1000 µl of the test extract. Distilled water

instead of extracts was used as a negative control. Afterward, the mixtures were incubated at 37°C for 15 min and then heated at 70°C for 5 min. After cooling, their absorbances were measured at 660 nm (Jasco V-630 Spectrophotometer, Japan) and the data were processed by Spectra Manager system⁽⁴⁸⁾. The inhibition percentage of protein denaturation was calculated using the following formula:

$$\% \text{ Denaturation inhibition} = (1 - D/C) \times 100\%$$

Where D is the absorbance reading of the test sample, and C is the absorbance reading without test sample (negative control).

ii. Membrane Stabilization: HRBC method was used for the estimation of anti-inflammatory activity *in vitro*⁽⁴⁹⁾. Blood was collected from healthy volunteers and was mixed with equal volume of sterilized Alsevers solution. This blood solution was centrifuged at 3 000 rpm and the packed cells were separated. The packed cells were washed with isosaline solution and a 10% v/v suspension was made with isosaline. This HRBC suspension was used for the estimation of anti-inflammatory property. Different concentrations of extract, reference sample and control were separately mixed with 1mL of phosphate buffer, 2 mL of hyposaline and 0.5 mL of HRBC suspension. All the assay mixtures were incubated at 37 °C for 30 minutes and centrifuged at 3 000 rpm. The supernatant liquid was decanted and the hemoglobin content was estimated by a spectrophotometer at 560 nm. The percentage hemolysis was estimated by assuming the hemolysis produced in the control as 100%.

$$\text{Percentage protection} = 100 - (\text{OD sample} / \text{OD control}) \times 100$$

RESULT :

From the survey of medicinal plant we have found 111 medicinal plant used in wound healing activity.

Table 2 : Traditional medicinal plants of north east having wound healing activity :

Sl No	Name of Plant	Family	Common Name	Parts Used	Uses	Traditional mode of use	Area	Reference
1.	<i>Euphorbia hirta L</i>	Euphorbiaceae	Paal chedi	Whole plant	Used for respiratory ailments, worm infection in children, dysentery, jaundice, digestive problems and tumors.	Plant is first grind into paste and then the paste is slightly heated and applied on the wounds.	Kampur district (assam)	50

2.	<i>Amaranthus tricolor L.</i>	Amara nthace ae	Bishaly a karani	leaves	Used for ulcers,diuret ic,high cholesterol, diarrhea.	Leaf paste is mixed with spit and applied to cuts and wounds for quick heal.	Dhek orgora h, Jorhat .	50
3.	<i>Eupatorium odoratum L</i>	Astrac eae	Jarmani bon	Leaves, young shoots	Used to treat peptic ulcer, burns, skin infections and wounds.	Leaf paste is mixed with spit and applied to wounds for quick heal.	Silcha r(<i>Assa m</i>)	50
4.	<i>Hydrocotyle sibthorpioides Lamk.</i>	Apiac eae	Khoru manim uni	leaves	Used to treat boils,sore throat,hepat oma,influen za,itch,jaun dice,sinusiti s.	Leaves are grind into paste and mixed with coconut oil and applied to wounds before going to bed at night.	Sikki m,Tri pura,	50
5.	<i>Centella asiatica L.</i>	Apiac eae	Bor manim uni	Leaves	Used for diabetes,wo und healing,me mory enhancing,s kin nourishment .	Leaf paste is applied to wounds.	Guwa hati	50
6.	<i>Drymaria cordata L.</i>	Caryo phylla ceae	Lai Jabor	Leaves	Used for cold,headac he,poultice on sore,bronchi tis,coryza,le prosy,tumor s.	Leaves are crushed with spit and applied on the wounds.	Nagao n (Assa m)	50
7.	<i>Eclipta prostrate L</i>	Astera ceae	Keheraj	Roots	Used to treat diabetes,fev er,GI Disorder,R T disorder,hai r loss and greying of hair.	Roots are grind into paste and mixed with coconut oil and applied in wounds.	Cacha r, dibrug arh	50
8.	<i>Oroxylum indicum L</i>	Bigno niacea e	Bhatghi la	Root and bark	Used as Astringent,a phrodisiac,e xpectorant,a nthementic and tonic.	Dry the seeds in the shade powder it and powder is applied in wounds.	Karbi - Anglo ng	50
9.	<i>Ageratum conyzoides L</i>	Astera ceae	Ghondv a Bon	Leaf, young shoot	Used to treat pneumonia, dysentery,di arrhea,cure wounds and burns	Paste and juice is applied in injured portion of cut and wounds.	Jorhat	50

10.	<i>Curcuma longa L</i>	Zingiberaceae	Haladhi	Rhizome	Used to treat joint pains, diarrheal condition, fever, skin inflammation.	Rhizome is grind into paste and mixed with mustard oil and applied on the wounds.	Dibrugarh	50
11.	<i>Aegle marmelos</i>	Rutaceae	Bel	Leaves and Fruit palm	Used for cancer, ulcer, diuretic, diarrhea, malaria, skin infections.	Leaves are grind into paste along with black pepper, slightly heated and applied on the wounds.	Kokrajhar	50
12.	<i>Delonix regia</i>	Fabaceae	Krishnachura	Leaves	Used to treat diarrhea, diabetes, hepatoprotective, wound healing and gastroprotective.	Leaves are crushed and applied on the wounds.	Darikaal Gaon (Tezpur)	50
13.	<i>Dillenia indica L.</i>	Dilleniaceae	Otenga	Barks	Used for malarial, cancer, dysentery, jaundice, rheumatic pain, asthma, influenza,.	Barks are dipped in water for overnight and then grind into paste and applied on the wounds.	Dibrugarh	50
14.	<i>Azadirachta indica</i>	Meliaceae	Neem pat	Leaves	Used for skin disorders, intestinal worms, eye disorder, bloody nose, heart disease, stomach upset, leprosy, diabetes, gum disease, liver problems.	Boiled leaves water are used for washing the wounds and leaves paste mixed with mustard oil is also used for wound healing.	Assam	50
15.	<i>Clitonia ternatea</i>	Papilionaceae	Aparajita	Roots.	It supports digestive, circulatory and central nervous system also used as aphrodisiac, pain relief, diuretic etc, reduces wrinkles, greying of	Roots paste is applied on the wounds	Dibrugarh	50

					hair,blurred vision.			
16.	<i>Mimosa pudica</i>	Mimosaceae	Nilaj bon	Leaves	Used to treat microbial infection,diarrhea,ulcer, mood disorder,head wound,gastric disorder.	Leaves are crushed along Eupatorium odoratum and applied on the wounds.	Dibrugarh	50
17.	<i>Argemone maxicana</i>	Papaveraceae	Siyalkata	Roots	Used in tumors, warts, skin diseases, inflammations, microbial infection.	Roots paste is applied on the wounds.	Jorhat	50
18.	<i>Alocasia indica</i>	Araceae	Kochu	Stems	Useful in treating pneumonia, asthma, rheumatism and several other skin ailments.	Stems are cut and its juice is applied on the wounds.	Karbiangling	50
19.	<i>Blechnum orientae L.</i>	Blechnaceae	Bonoria dhekia	Fronds	Used in diabetes, Skin problems.	Fronds are crushed and is applied on the wounds.	Meghalaya	50
20.	<i>Bryophyllum pinnatum Lam.</i>	Crassulaceae	Dupor Tenga	Leaves	It is used in skin infection,inflammation, insect-bite, burns and wounds.	Shade dried leaves are very good for application to wound and leaves reduced to paste when applied to wounds encourage papillations.	Bongaigaon, Assam	51,52
21.	<i>Aloe vera</i>	Asphodelaceae	Ghritkumara	leaves	Used in Ulcer,diabetes, cancer, diarrhoea.	Leaf paste is topically applied on the wound.	Guwahati	53,54,55
22.	<i>Arctium lappa</i>	Asteraceae	Janglikuth	Roots, seed, leaf	Used Skin problems, diabetes, Ulcer cancer,digestive problems	Root paste is topically applied on the wound.	Barpeta	56
22.	<i>Targetes erecta L</i>	Compositae	Narjiphul	leaf	Used in ulcer, digestive problems.	Leaf paste is topically applied to wound.	Magaldai(Assam)	57
23	<i>Tridax procumbens</i>	Compositae	Tridax daisy or	Leaf	Used in inflammatory	Leaf paste is applied on the wound.	Jorhat	58

			belama ku		disorders,di abetes,skin disease.			
24	<i>Angelica sinesis</i>	Apiac eae	Women 's ginseng	Roots	Used in inflammator y problems, analgesic problems,H aemorrhage	Root paste is applied on the wound	Tripur a	59,6 0
25	<i>Blumea balsamifera</i>	Astera ceae	Langthr ei (Manip ur)	Leaves, roots	Used against skin injury, tumour,der matitis.	Oil extract is applied on the wound.	Manip ur	61
26	<i>Caesalpinia sappan</i>	Fabac eae	Baghas ora	Leaves, bark,root s	Used in inflammator y problems, allergic,ode ma and pain	Leaf paste is topically applied on the surface of wound.	Tinsu kia,As sam	62
27	<i>Calendula officinalis</i>	Astera les	Pot marigol d, Narji	Whole plant	Used in cuts, rashes, swelling.	Plant extract ia applied on the wound.	Moir bari,A ssam	63
28	<i>Camellia sinensis</i>	Theac eae	Cha	Leaf	It is used in skin infection,inf lammation and diabetes.	Leaf paste is applied on the wound.	Chabu a,Assa m	64
29	<i>Panax ginseng</i>	Aralia ceae	Asian ginseng	Rhizome	It is used in skin infection,inf lammation.	Applied as paste on the wound.	Aruna chal	65
30	<i>Ocimum gratissimum L.</i>	Astera ceae	Ram tulsi	Leaf	It is used in skin infection,inf lammation.	Leaf paste is applied on the wound.	Silcha r	66,6 7
31	<i>Acalypha Indica</i>	Eupho rbiace ae	Muktoj huri	leaves	It is used in treating pneumonia, asthma, rheumatism, several other skin ailments	Leaf paste is applied on the wound.	Kamr up	68,6 9,70
32	<i>Aerides multiflora</i>	Orchid aceae	Ronga kopou ful	Leaves	Used in treating cuts and wound, fractures and dislocated bones	Leaf paste are prepared to apply on the wound.	Tinsu kia, Sibsa gar, Lakhi mpur, Karbi- Anglo ng	71
33	<i>Zantedeschi a aethiopica</i>	Arace ae	Arum lily or calla lily	Root, stem, leaves	Used boils,wound s,minor burns,insect	Root or leaf paste is applied on the wound.	Shillo ng	72

					bites, gout or rheumatis.			
34	<i>Verbascum fruticosum</i>	Srophulariaceae	Mullein	Aerial part	It is used in skin infection, inflammation, cancer and ulcer	Plant extract is applied on the wound.		73
35	<i>Vitis vinifera</i>	Vitaceae	Common grape or wine grape	seed	Used against inflammation, allergic reaction, pain to promote wound healing	Seed oil is applied on the wound.	Goraimari (Assam)	74
36	<i>Typha capensis</i>	Typhaheophytes	Bulrush	Root, stem, leave	It is used in skin infection, inflammation	Applied on the wound topically as paste.	Sonitpur (Assam)	75
37	<i>Solanum panduriforme</i>	Solanaceae	Poison apple	Fruit	Used against Edema, inflammation, other, skin infections.	Fruit paste is applied on the wound.	Kamrup	76
38	<i>Panax bipinnatifidus</i>	Araliaceae	Feather-leaf bamboo ginseng	Root	Used in haemostatic bruising, bleeding and muscle pain	Root paste is applied on the wound.	Arunchal Pradesh	77
39	<i>Calamintha officinalis</i>	Lamiaceae	Mill mountain	Aerial part	Used in Cuts, rashes, swelling and burns.	Plant extract is applied on the wound.	Jorhat, Sivasagar	78,79
40	<i>Allium sativum</i>	Liliaceae	Garlic	Bulb	Used in inflammatory problems, skin infection.	Topically applied as creams on the wound.	Sonitpur	80
41	<i>Taraxacum officinale</i>	Asteraceae	Dandelion	Root, Leaves, Petals	Used in inflammatory problems, skin infection.	Leaf paste is topically applied on the wound.	Digboi	81
42	<i>Lumnitzera racemosa</i>	Combr etaceae	Black mangrove	Leaves	Used in inflammatory problems, Skin disease, diabetes, ulcer.	Leave paste is applied as cream, ointment and lotion	Barpeta	82
43	<i>Arnica viscosa</i>	Asteraceae	Mountain arnica	Flowers	Used in inflammatory problems,	Flower paste is applied as cream, ointment and lotion	Assam	83

					,heal,pain, injuries, such as sprain and bruises.			
44	<i>Thymbra spicata</i>	Lamiaceae	Mediterranean thyme	Aerial part	Used in hyperlipidemia, hyperglycemia, hepatic steatosis, wound healing.	Applied on the wound topically	Golaghat	84
45	<i>Syzygium aromaticum</i>	Myrtaceae	Clove	Flower bud	Used in tumor, skin infection, scabies, cholera, malaria, and tuberculosis	The clove flower buds are crushed using mortar and pestle and applied on wounds.	Raha(Assam)	85,86
46	<i>Teucrium creticum</i>	Labiaceae	Cretan German	Aerial part	Used in digestive diseases, diabetes, rheumatism, scars, blood pressure lowering, antispastic, anorexia.	Plant extract is applied on the wound.	Golaghat(Assam)	87,88
47	<i>Ruta chalepensis</i>	Rutaceae	Fringed rue	Aerial part	It is used in arthritis, eczema, ulcers, arthritis, fibromyalgia, antidote for venoms.	Plant extract is applied on the wound.	Kashihills(Assam)	89
48	<i>Parinari curatellifolia</i>	Chrysobalanaceae	Mobolaplum	Bark	Used to treat toothache, pneumonia, fever.	Bark extract is applied as paste on the wound.		90,91
49	<i>Jatropha curcas Linn</i>	Euphorbiaceae	Bongalibotora	Bark	Used in the treatment of allergies, burns, cuts, wound inflammation, leprosy, leucoderma, smallpox, respiratory infection, cancer, indigestion, infectious disease.	Bark excude was applied on the wound.	Hengrabari, Guwahati	92,93,94

50	<i>Jatropha gossypifolia</i>	Euphorbiaceae	Bellyache bush	Bark	Used in hemorrhage, cancer, constipation stomachache, coagulant.	Resin of the plant is used as Paste on the wound.	Rani, Guwahati	95,96
51	<i>Chromolaena odorata</i>	Asteraceae	Communist patche	Leaves	Used in the treatment of leech bites, swelling, rashes, burns, diabetes, periodontitis and as an insect repellent.	Leaf paste is applied on the wound.	Bhutan	97,98
52	<i>Solanum aculeastrum</i>	Solanaceae	Soda apple or bitter apple	Fruit	Used for jigger infestations, cuts, burns, swollen joints in fingers, gangrene, toothaches, 223iscose 223to, bronchitis, rheumatism and in ringworm.	Flower paste is applied on the wound	Arunachal Pradesh	99
53	<i>Ficus religiosa</i>	Moraceae	Bodhi tree, peepal tree	Leaves, bark	Used in the treatment of ulcer, diabetes, gonorrhoea and skin diseases.	Oil extract of bark is applied on the wound.	Tinsukia	100, 101, 102
54	<i>Nigella sativa</i>	Ranunculaceae	Black seed or kola jira	Seed (oil)	Used for diuretic, hypertensive, diabetes, cancer asthma, various skin conditions, lowering blood sugar and cholesterol levels, aiding in weight loss and protecting brain health.	Oil extract of seed is applied on the wounds	Malegaon, Assam	103

55	<i>Anethum graveolens.</i> L	Apiaceae	Dill	Seeds, leaves	Used for ulcers, abdominal pains, eye diseases and uterine pains.	Leave paste is topically applied on the wound.	Meghalaya	104
56	<i>Eucalyptus</i>	Myrtaceae	Ghost gum	Aerial part	Used in asthma, bronchitis, plaque and gingivitis, head lice, toe nail fungus.	Plant extract is applied as paste on the wound.	Golaghat	105
57	<i>Trigonella foenum</i>	Fabaceae	Fenugreek	Seeds	Use for gastric stimulant, diabetes, and a galactagogue, as well being used to combat anorexia.	Seed oil is applied on the wound.	Assam	106
58	<i>Nelumbo nucifera</i>	Nymphaeaceae	Komol	Flower, rhizome	Used in hematemesis, epistaxis, hematuria, lowering blood sugar levels, diarrhea, cholera, fever, and hyperdipsia.	Flower paste is applied on wounds.	India	107
59	<i>Morinda cotrifolia</i> Linn	Rubiaceae	Bartundi (hindi)	Leaves	Used in headache, fever, arthritis, gingivitis, respiratory disorders, infections, tuberculosis, and diabetes	Leave paste is applied on the wound.	Assam	108
60	<i>Astragalus membranaceus</i>	Leguminosae	Mongolian milkvetch	Roots	Used to treat the common cold, upper respiratory infections, fibromyalgia, and diabetes.	Paste is applied on the wound	Rajbari (Assam)	109

61	<i>Pistacia atlantica</i>	Anacardiaceae	Ethiopia or Mt. Atlas mastic tree	Aerial parts	Used for stomach diseases, renal disorders, wounds and coughs, gastrointestinal disease.	Plant paste is applied on the wound.	Guwahati	110
62	<i>Rosemary officinalis</i>	Lamiaceae/Labiatae	Rosemary	Leaves	Used for improving memory, indigestion (dyspepsia), arthritis-related joint pain, hair loss.	Leaf paste is applied on the wound.	Bamora, Assam	111
63	<i>Ribwort plantain</i>	Plantaginaceae	Bartang	Leaf	Used for toothaches, prevent infections, poison ivy, cuts, insect bites and, rashes.	Both externally as paste and internally as juice can be applied	Assam	112
64	<i>Aegle marmelos</i>	Rutaceae	Bael	Leave, fruit.	Used in the treatment of chronic diarrhea, dysentery, and peptic ulcers, as a laxative and to recuperate from respiratory affections in various folk medicines.	Leave paste is externally applied on wound	Bongaigaon	113
65	<i>Linum usitatissimum</i>	Linaceae	Flaxseed	Seeds	Used for constipation, for controlling levels of <u>cholesterol</u> and <u>blood sugar</u> in the body.	Externally used as ointment on the wound.	Assam	114
66	<i>Curcuma longa</i>	Zingiberaceae	Haladhi	Rhizome, Tuber	Used in 225iscose 225tory disease, hemorrhage, high cholesterol,	The tuber is mashed and is applied on wounds.	Mangaldoi	115, 116, 117

					Skin infections.			
69	<i>Acorus calamus</i>	Acoraceae	Bach	Green leaves	Used for gastrointestinal (GI) problems, ulcers, <u>rheumatoid arthritis</u> , <u>stroke</u> and skin diseases.	Green leaf paste is topically applied on the wound.	Jorhat	118
70	<i>Adhatoda vasica</i>	Liliaceae	Adulasa, Vasaka	Leaves	Used in bronchitis, leprosy, blood disorders, heart troubles, thirst, asthma, fever, vomiting, loss of memory, leucoderma, jaundice, tumors, mouth troubles, sore-eye, fever, and gonorrhoea.	Green leaf paste is topically applied on the wound.	Cachar, Assam	119
71	<i>Alternanthera brasilliana</i>	Amaranthaceae	Matikaduri	Leaves	Used in elimination of kidney stone, tumor, infections of the liver and bladder.	Leaf paste is topically applied on the wound.	Langting, Assam	120
72	<i>Cissampelos pareira L.</i>	Menispermaceae	Tubukilota	Leaf	Used in ulcer, chronic skin disease, poisonous bites, has Anti-inflammatory activity, ,	Juice of leaf is applied to wounds.	Sivsagar.	121
73	<i>Cleome viscosa L.</i>	Cleomaceae	Hurduriya	Leaf	Used in hypertension, malaria, rheumatic arthritis and wound healing.	Paste of leaf is applied topically to heal wounds.	Arunachal Pradesh	121

74	<i>Combretum flagrocarpum</i>	Combr etaceae	Madha vi lata	Leaf	Used in anaplastic thyroid cancer, wound healing	The leaf juice is applied to wounds and cuts.	Guwa hati	122
75	<i>Commiphora mukul Engl.</i>	Burser acae	Guggul	Bark	Used in rheumatoid Arthritis, osteoarthritis, high cholesterol.	Bark exudates was applied on the wound.	Jorhat	123
76	<i>Commelina benghalensis</i>	Comm elinac eae	Kona-simalu	stem	Uses to reduce high blood pressure, treat burns, sore throat, dysentery, leprosy, rashes, cuts and burns.	Juice of the stem is applied to heal wounds.	Golag hat	121
77	<i>Sida acute</i>	Malva ceae	Boriala, janghali methi	Leaf	Used in diuretic, sedative, blood disorder, astringent.	Leaf paste with albumin applied on wounds.	Kanch anjuri, kajiranga Assam	124
78	<i>Calotropis procera Br</i>	Asclepi adaceae	Akan	Stem latex	Used in skin disease, arthritis, cramp and joint pain.	Drops of the stem latex are used to treat wounds	Guwa hati	123
79	<i>Calotropis gigantea L.</i>	Asclepi adaceae	Akon	Latex and leaves	Used in toothache, cramps, joint pain, parasitic infection.	Latex and leaves was applied on the wounds.	Guwa hati.	121
80	<i>Cassia alata L.</i>	Caesal pinae	Khor goss	leaves	Used in malaria, asthma, diabetes typhoid, tinea infections, scabies, eczema.	Leaves of the plant applied on the wounds.	Jorhat	123
81	<i>Cassia auriculata L.</i>	Carsal pinae	Soru-medelua	Leaves, bark	Used in muscle pain, constipation, jaundice, liver disease, UIT.	Leaves and bark usually applied on the wounds.	Assam	123
82	<i>Chenopodium album Linn.</i>	Cheno podiac eae	Jilmil sak	Leaves	Used in rheumatoid, skin	Crushed leaves are applied locally.	Bongaigaon, Assam.	125

					problem, UIT.			
83	<i>Cirsium verutum Spreng.</i>	Asteraceae	Thakal	Roots	Used in stomach disorder, relieve fever, sore throat,	The root is crushed and tied on the wound.	Assam	125
84	<i>Datura stramonium L.</i>	Solanaceae	Kola-Datura	leave	Used in intestinal infection, inflammatory disorders, intestinal pain, toothache, fever.	Latex of the leaves was applied on the wound.	Chamoria, Kamrup	123
85	<i>Daucus carota L.</i>	Apiaceae	Wild carrot		Used in inflammatory disorder, diuretics, intestinal and skin infection.	Juice of the root applied on the wound	Bongaigaon, Assam	123
86	<i>Dendrophthoe falcata L.f.</i>	Loranthaceae	Raghumala	Leaves and stem	Used in ulcer, menstrual disorder, swelling, wounds, renal, asthma.	Paste of leaf and stem is applied to heal wounds.	Sapekhati, Assam.	121
87	<i>Dodonaea viscosa Linn.</i>	Sapindaceae	Sand olive	Leaf	Used in malaria, fever, ulcer, diarrhoea, rheumatism.	Leaf paste with albumin applied as paster.	Bhangagarh, Guwahati.	124
88	<i>Dumasia villosa DC.</i>	Fabaceae	Black bean	Whole plant	Used in healing wounds, sore throat, skin rashes, burns and cuts.	Whole plant parts are used to wash wounds.	Bhangagarh, Guwahati.	121
89	<i>Euphorbia antiquorum L.</i>	Euphorbiaceae	Bajbaran	Stem	Used in Inflammation, arthritis, wounds, stomach ache, Diabetes	Latex from the stem is applied topically to heal wounds.	Mangaldoi, Assam.	121
90	<i>Euphorbia pilosa</i>	Euphorbiaceae	Siju	Latex	Used in respiratory disorders, skin infection, inflammation,	Latex of plant applied applied locally.	Dibrugarh.	125

					gonorrhoea, migraine.			
91	<i>Ficus bengalensis</i> L.	Moraceae	Borogoss	Leaf	Used in ulcer, fever, inflammation, leprosy, syphilis, dysentery.	Leaf powder is applied topically to treat wounds.	Tinsukia	121
92	<i>Gelsemium elegans</i>	Loganiaceae	N	Leaf	Used in migraine, cancer, sores,	The leaf juice is applied to wounds and cuts.	Mizoram	122
93	<i>Ixora coccinia</i> L.	Rubiaceae	Rogiyal-phul	Flower	Used in dysentery, tuberculosis, antiseptic, astringent, analgesic, sedative, stomachic.	Flower's decoction is applied to heal wounds.	Assam	121
94	<i>Melastoma malabathricum</i>	Malastomaceae	Phutuka, phutukala (assam)	Bark	Used in diarrhoea, dysentery, haemorrhoids, cuts and wounds, stomachache.	Paste of bark and juice is applied to the wounds.	Kokrajhar.	122
95	<i>Mentha viridis</i> L.	Lamiaceae	Peppermint	Leaves	Used in indigestion, diarrhoea, nausea, upper gastrointestinal tract spasms,	Leaves paste was applied on the wounds.	Assam	123
96	<i>Mikania micrantha</i> HRK	Asteraceae	Japanilota	Leave	Used in skin itches, rashes, wound healing, stomach aches, headaches, cold.	The leaf juice is applied to wounds and cuts.	Tezpur.	122
97	<i>Morinda pubescens</i>	Rubiaceae	Bartundi	Leaf	Eczema, fever, ulcer, digestive disorder, glandular swellings, dysentery, rheumatic disease.	Leaf paste was applied topically to heal wounds.	Karbi Anglong	121
98	<i>Murraya paniculata</i> Mill	Rutaceae	Kaminikanchan	Leaf	Used in dysentery, diarrhoea, analgesic, antinociceptive	Leaf paste with albumin applied on the wound.	Assam	124

					e activity,anti cancer.			
99	<i>Nerium indicum Mill</i>	Apocyanaceae	Raktakarabi	Leave	Used in malaria,leprosy,asthma, mensutrial periods,venereal disease,epilepsy.	Juice of the leaves was applied on the wound.	Panik haiti, Guwahati	123
100	<i>Aerides multiflora</i>	Orchidaceae	Rongakopouful	Leaves	Used in treating cuts and wound, fractures and dislocated bones	Leaf paste are prepared to apply on the wound.	Tinsukia, Sibsagar, Lakhimpur, Karbi-Anglong	121
101	<i>Pedlanthus tithymaloideus</i>	Euphorbiaceae		Whole plant	Used in inflammatory disease, tumor, hemorrhage, skin infections.	Latex of the plant applied on the wound.	Bangghar.	123
102	<i>Pinus roxburghii</i>	Pinaceae	Chir	Bark	Used in intestinal disease,diuretic, hemorrhage,diaphoretic.	Bark paste is applied locally.	Arunachal pradesh	125
103	<i>Pongamia pinnata L.</i>	Fabaceae	Karchaw	Seed	Used in skin infection,ulcer,gonorrhoea,piles,tumor.	Seeds oil is applied topically on the wounds.	North Guwahati.	121
104	<i>Pothos scandens L.</i>	Araceae	Hathidhekiya	Leave	Used in epilepsy, convulsion, wound healing, rheumatic arthralgia.	Paste of leaf is applied topically on the wounds.	Golaghat	121
105	<i>Rubia cordifolia L.</i>	Rubiaceae	Majathi	Bark, Root	Used in diabetes, inflammatory disease.	Bark and root mostly applied on the wound.	Nagaoan	121
106	<i>Rungia repens L.</i>	Acantaceae		Whole plant	Used in diuretic,vermifugal,antimicrobial.	Paste of whole plant is applied on the wound.	Bangghar, Guwahati	121
107	<i>Scoparia dulcis L.</i>	Srophulariaceae	Liqcorice	Leaf	Used in hypertension, skin disorder,ane	Paste of leaf applied topically to treat wounds.	Tezpur	121

					mia, dysentery, hemorrhoids, diarrhea.			
108	<i>Terminalia chebula</i>	Combr etaceae	Haritaki	Whole plant	Used in respiratory tract infection, cough,cold, Skin infection, hemorrhage .	Plant paste is applied on the wound.	Kamrup, Assam	123
109	<i>Jasminum auriculatum</i>	Oleaceae	Juhi	Juice of leaves	Used in headaches, diseases of oral cavity, skin infections, treatment of wounds.	Leaf paste is applied as ointment on the wound.	Kamrup, Assam	126
110	<i>Glycyrrhiza glabra</i>	Fabaceae	Jesthmodhu	Roots	Used in respiratory disorder, hyperdipsia, epilepsy, skin disease, jaundice, rheumatism, paralysis, stomach ulcer.	Root paste is applied on the wounds.	Titabor, Assam	127
111	<i>Areca catechu</i>	Areaceae	Betelnuts	Fruit	Used in hemorrhage, abdominal discomfort, kill intestinal parasite and other pathogens.	Area catechu oil is applied topically for burn wound healing.	Nagaoan (Assam)	123

Other than wound healing activity these plants also used for different other disorders. The information on scientific names, local names of the plant species, its parts used for cure and methods of dosage has been provided.

The medicinal plant species were found to be distributed across 64 families and 47 genera. Different parts of medicinal plant species were used as medicine. For curing ailments, the use of aboveground plant parts was higher (76.59%) than the underground plant parts (23.41%). Of the above ground plant parts, leaves were used of the cases (63 species). Different pseudo-bulb have also been found to be in used as a source for curing ailments.

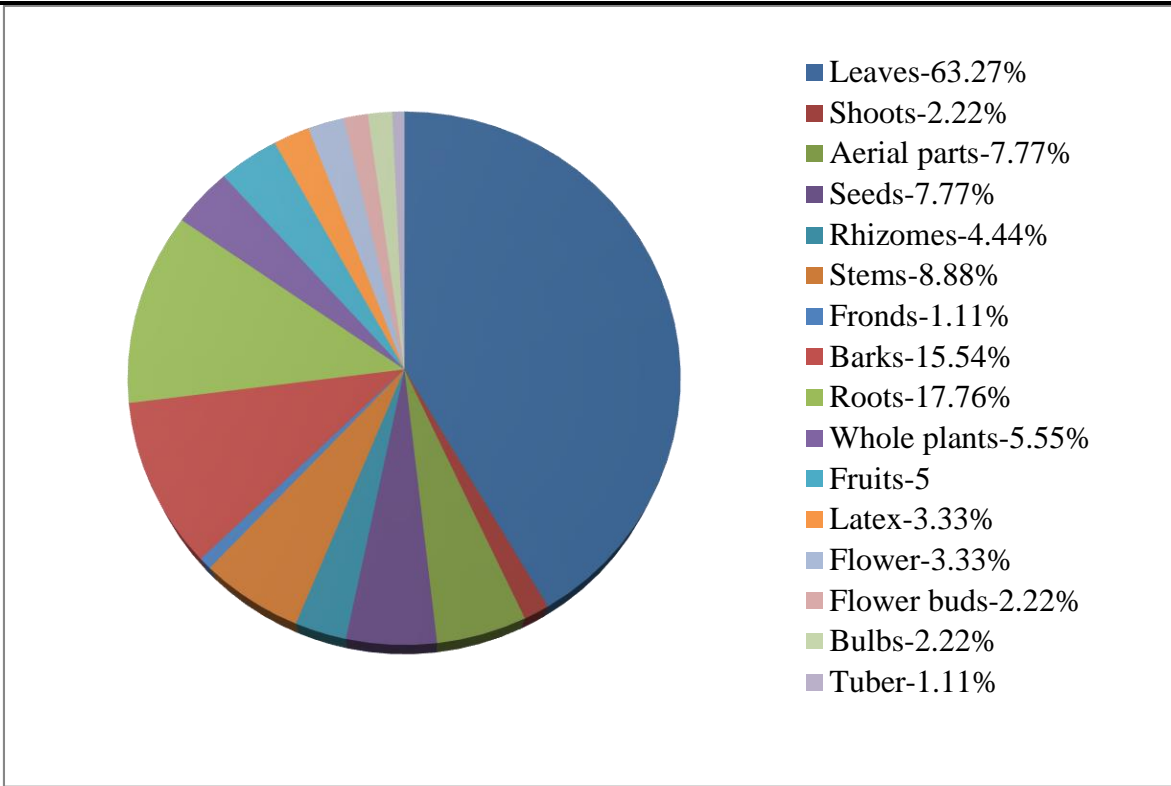


Fig.7 : Plant parts used in wound healing and related activity

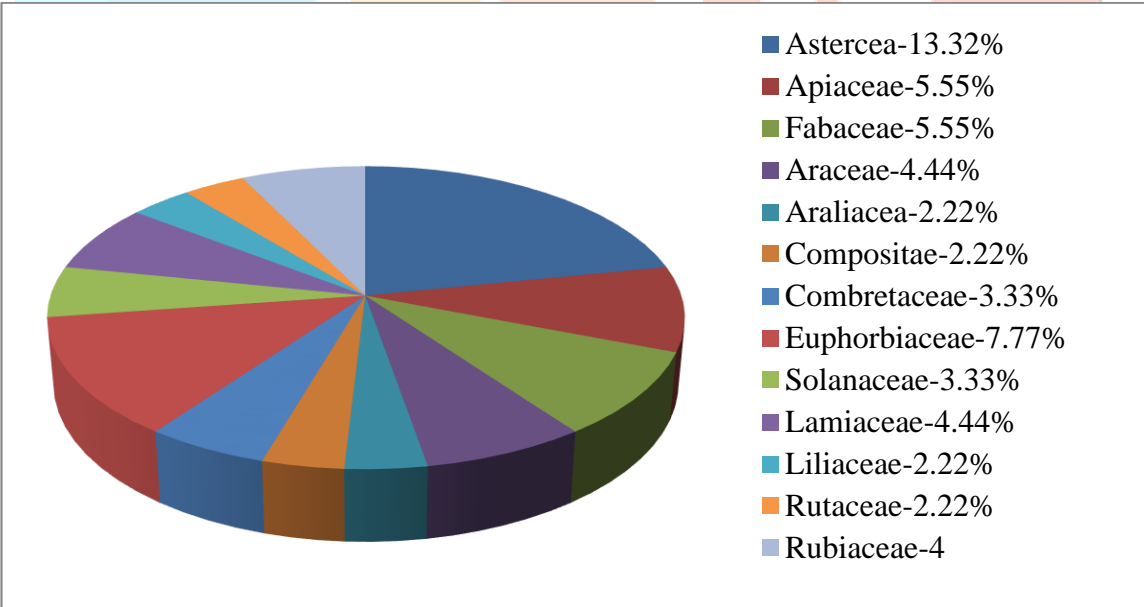


Fig.8: Schematic chart of families of different plant species

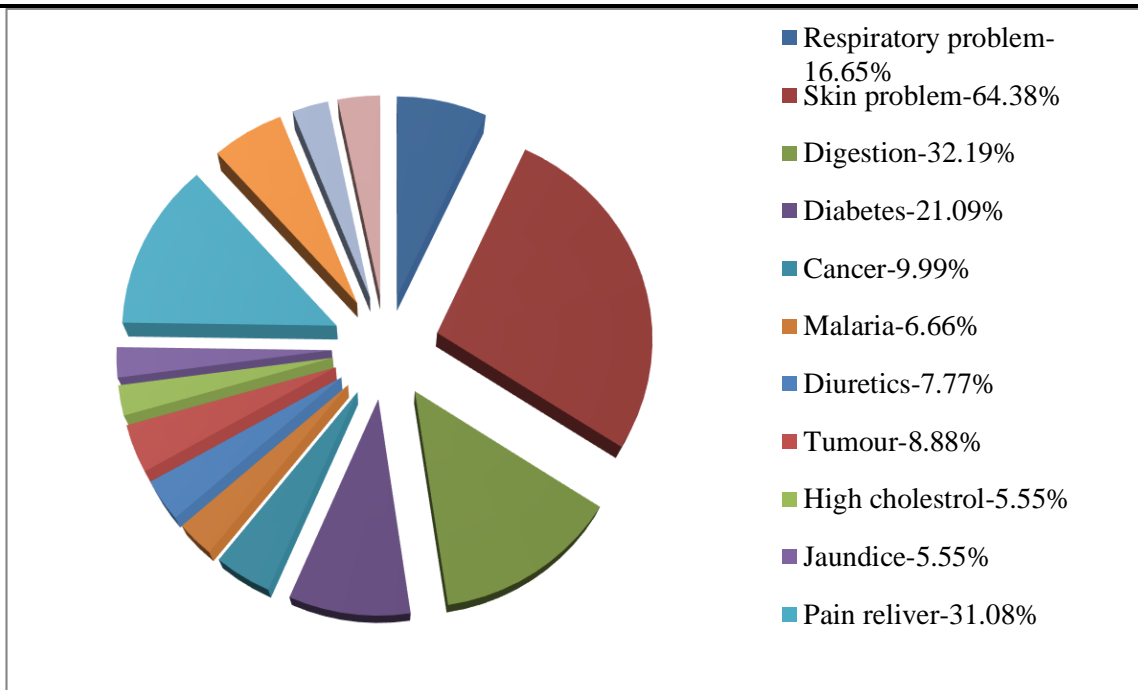


Fig 9 Schematic chart of traditional uses of plant species

Qualitative Phytochemical Analysis :

The phytochemical analysis of various extracts of *Aerides multiflora* is shown in the Table 3. From the qualitative findings presented in Table 3, it is observed that the *Aerides multiflora* of different extracts confirmed the presence of alkaloids, flavonoid, phenols, proteins, tannins, terpenoids and glycosides. Surprisingly, anthraquinone and steroids was not observed in the extract. However, alkaloids, flavonoids, tannin, phenols, carbohydrates and terpenoids components are present in three extracts of ethanol.

While, carbohydrates, saponins, tannins and glycosides was only found in two extracts namely ethanol and aqueous extract. Proteins are found in all three extracts. The study revealed that ethanolic fruit extract was found to have more constituents when compared with other extracts.

TABLE 3 : Qualitative Phytochemical Analysis of the Ethanolic Extract of *Aerides multiflora* (EAM) and Ethanol *Dymaria cordata* (EDC)

Sl. no.	Phytochemical Constituent	EAM	EDC
1.	Alkaloids	+	+
2.	Carbohydrates	+	+
3.	Flavanoids	+	+
4.	Phenols	+	+
5.	Saponins	-	-
6.	Tannins	+	+
7.	Steroids	-	-
8.	Terpenoids	+	+
9.	Anthraquinone	-	-
10.	Glycosides	+	+

Note: + present, - Absent.

The presence of phytochemicals in EAM and EDC possesses varying degrees of disease preventive anti-inflammatory, hemostatic and antioxidant molecules.

Antioxidant Activity :

DPPH Free Radical Scavenging Assay:

TABLE 4 : DPPH free radical scavenging activity :

Sample	Concentration ($\mu\text{g/ml}$)	%inhibition
EDC	50	7 ± 0.006
	100	14 ± 0.026
	200	44 ± 0.013
	400	45 ± 0.013
EAM	50	13 ± 0.013
	100	16 ± 0.005
	200	34 ± 0.010
	400	49 ± 0.007

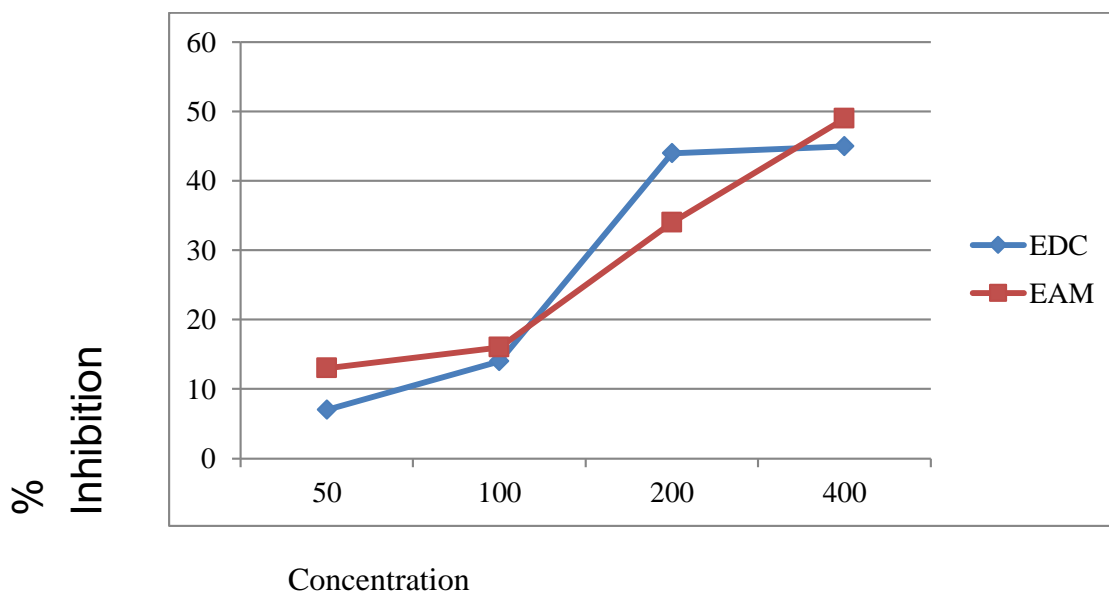


Fig 10 : DPPH free radical scavenging of EDC and EAM

Nitric Oxide Free Radical Scavenging Assay:

TABLE 5 : Nitric oxide free radical scavenging of EDC and EAM

Concentration	EAM	EDC	Ascorbic acid
10	20.294	11.316	49.528
20	26.896	12.448	69.974
40	30.215	21.275	77.857
80	50.942	27.575	93.361
100	53.942	33.233	96.266

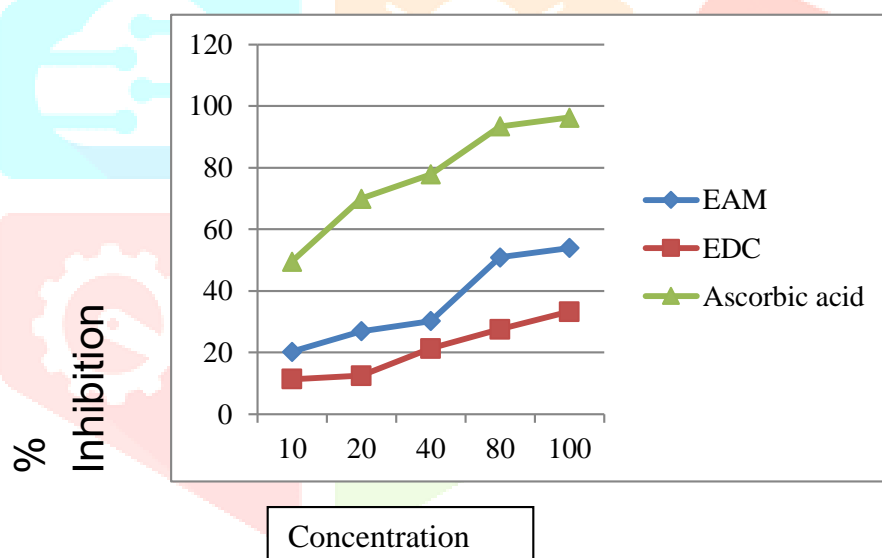
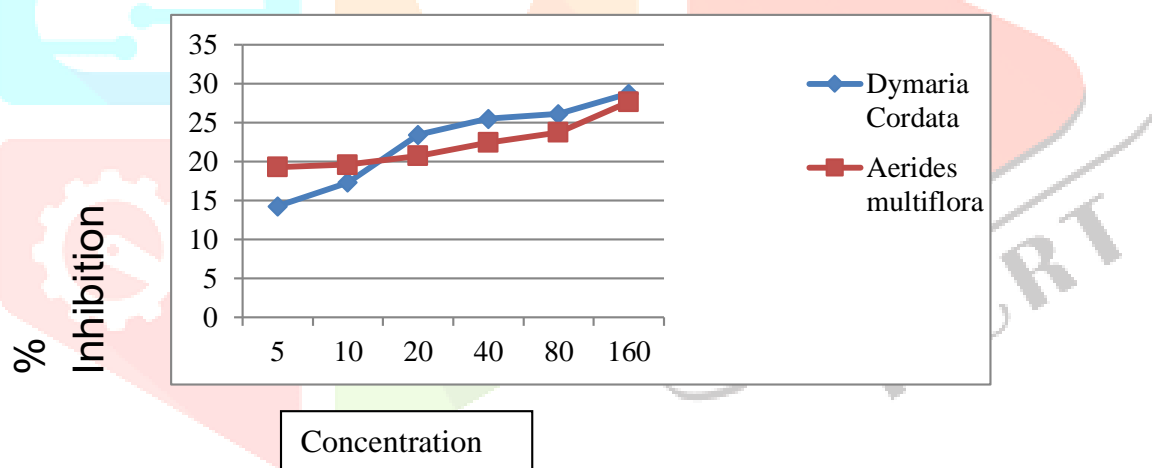


Fig 11. Nitric oxide free radical scavenging of EDC and EAM

Antiinflammatory Activity :**Inhibition of Protein Denaturation :****TABLE 6 :** Inhibition of protein denaturation of EAM and EDC

Concentration	EDC	EAM
5	14.26	19.29
10	17.3	19.58
20	23.43	20.71
40	25.47	22.43
80	26.09	23.73
160	28.71	27.65

**Fig 12 :** Inhibition of protein denaturation of EAM and EDC**Hemostatic Activity :*****In Vitro* Blood clotting Assay (Blood clotting Index)**

The blood clotting index expresses antithrombogenic activity of a material and is considered an effective marker of *In vitro* blood clotting efficacy. Generally the lower the BCI index higher is the blood clotting efficacy.

TABLE 7: *In-vitro* Blood clotting Index of EAM and EDC :

	EDC	EAM	Control
BCI in %	69.24±1.23	65.67±1.73	88.45±2.12

n=3, Result were expressed as mean ± SEM

Statistical Analysis :

Results were expressed as mean ± Standard deviation (SD). Statistical analysis was performed using student's t-test. P<0.05 was considered statistically significant. All the statistical analysis was carried out through Microsoft Excel 2007.

DISCUSSION :

From the survey we found 111 different species of medicinal plant used in **wound healing activity**. Other than wound healing activity these plants also used for different other disorders. It is mostly used in curing Skin Diseases (64.38%), which includes rashes, swelling, cuts, burns etc., other than that also found to used against Digestion (32.19%), Diabetes (21.09%), Pain reliver (31.08%), Respiratory problems (16.65%), Cancer (9.99%), Tumour (8.88%), Diuretic (7.77%), Malaria (6.66%), Jaundice and High Cholestrol (5.55%). The information on scientific names, local names of the plant speieces, its parts used for cure and methods of dosage has been provided. The medicinal plant species were found to be distributed across 64 families and 47 genera. The most frequently studied families are Asteracea (13.32%), Euphorbiaceae (7.77%), Apiaceae (5.55%) and Fabaceae (5.55%) Different parts of medicinal plant species were used as medicine. For curing aliments, the use of aboveground plants parts was higher (76.59%) than the underground plant parts (23.41%). Of the above ground plant parts, leaves were used of the cases (63 species). The mostly used plants part are leaves (63.27%), roots (17.76%), barks (15.54%), stems (8.88%), aerial parts and seeds (7.77%), whole plant and fruits (5.55%), flowers and latex (3.33%), shoots (2.22%) and other parts like fronds, tuber, bulbs were used very less.

Phytochemical analysis of the extract *Aerides multiflora* and *Dymaria cordata* revealed the presence of alkaloids, carbohydrates, terpenoids, tannin, glycosides, tannins, and flavonoids. These metabolites are usually responsible for the pharmacological activities of medicinal plants. These secondary metabolites contribute significantly towards the biological activities of medicinal plants such as hypoglycemic, antidiabetic, antioxidant, antimicrobial, anti-inflammatory, anticarcinogenic, antimalarial, anticholinergic, antileprosy activities.

Tannins have been reported for its wound healing properties, anti-inflammatory, analgesic and antioxidant. The antioxidant activity are measured by atleast two methods. Among them DPPH and Nitric Oxide free radical scavenging activity were used to measure the antioxidant activity. In the present study, DPPH and Nitric Oxide free radical scavenging activity of *Aerides multiflora* was found highest in ethanolic extract

as compared to *Dymaria cordata*. Phenolics and flavonoids are two naturally occurring phenolic compounds, which are particularly beneficial, acting as antioxidants and their polyphenolic nature enables them to scavenge injurious free radicals such as super oxide and hydroxyl radicals.

The presence of flavonoids can explain the anti-inflammatory activity of these plants. Inflammation induced by heat promotes a biphasic acute inflammatory response. Denaturation of protein molecules is well documented in the literature, and it is due to an inflammation process in conditions like arthritis. One of the main mechanisms of action of NSAIDs is the protection against protein denaturation. Therefore, inhibition of protein denaturation may play an important role in the antirheumatic activity of NSAIDs. The ability of studied leaf extracts to prevent thermal and hypotonic protein denaturation may be responsible for their anti-inflammatory properties. It has been also proposed that the extract inhibits the release of the lysosomal constituents of neutrophils at the site of inflammation. Lysosomal constituents are bactericidal enzymes and proteinases which, upon extracellular release, cause further tissue inflammation and damage. Hence, maintaining the stability of RBC membrane is important in limiting inflammatory response.

The extract of *Aerides multiflora* and *Dymaria cordata* confirms the hemostatic mechanism in Blood clotting index and hemocompatibility *invitro* tests. The astringency of tannins prompts the platelet interaction and their precipitation and thromboxane A₂ generation, which induces vasoconstriction, facilitates platelet aggregation and results in activation of primary hemostasis and bleeding control. It was observed that both the extracts showed less percentage of Blood Clotting Index than control, hence higher is its blood clotting efficacy.

CONCLUSION :

This investigation enlightens the uses and effectiveness of the traditional medicinal plants in the treatment of haemorrhage and inflammation which are also associated to wound healing. Our data base related to the wound healing activity is useful for the researcher for further research works. Therefore this study generates scientific knowledge and output for finding a natural means of such treatment. This will also help to explore the medicinal values of selected plants which are available in our region.

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