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# Ethno-Botanical Study of Anti-Diabetic Medicinal Plants used by the Local People of Kokrajhar District of Bodoland Territorial Council, India

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Traditionally used medicinal plants have been a source of relief in controlling different types of diseases throughout the globe. People living in rural areas of developing countries including India rely mainly on indigenous medicinal practice to get rid of various diseases. In our present study we have conducted an ethnobotanical survey to collect information about the use of traditional medicinal plants for diabetes treatment by the tribes of Bodoland Territorial Council of North-eastern state of India. Our survey has reported as many as 23 numbers of medicinal plants belonging to 19 families. Family Cucubritaceae was found to be of high frequency in terms of its use with a maximum of 3 species. Therefore, it is suggestive that our survey report on antidiabetic medicinal plants could be helpful and useful in finding newer antidiabetic drugs.

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*Keyword:* Traditional Medicinal Plant, Anti-Diabetic, Bodoland Territorial Council.

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### 1. Introduction

Bodoland Territorial Council (BTC) consisting of areas located extreme north of north bank of river Brahmaputra in the state of Assam, at the foothills of Bhutan and Arunachal Pradesh. It is the gateway to the north eastern region of India, which was created in February, 2003 by curving eight districts out of Assam namely Kokrajhar, Dhubri, Bongaigaon, Barpeta, Nalbari, Kamrup, Darang and Sonitpur within the state of Assam. Geographically, it covers an area of 8,795 sq. km (provisional) that includes Bodoland Territorial Area Districts administered by the BTC, an autonomous administrative unit constituted under the Sixth Schedule of the Constitution<sup>[1]</sup>. The geographical boundary of BTC lies between 260 7'12" N to 260 47' 50" N Latitude and 890 47' 40" E to 920 18' 30" E Longitude. With more than 29 lakh of population (2001 census), the area is

inhabited by different tribal groups constituting around 52% of the total population<sup>[2]</sup>.

Interests in ethnobotanical explorations have been increased recently at the national and international level. A perusal of the literature reveals that there is still a huge gap in knowledge of ethno-medicine and its scientific validation in this part of the world. Traditional use of plants and plant-parts has been a deep rooted practical knowledge in the culture and livelihood of the people living in the remote parts of the world and has been using different medicinal plants in their daily health care practices. According to the World Health Organization (WHO) about 65-80% of the world's population in developing countries depends essentially on plants and plant-derived compounds for their primary healthcare<sup>[3]</sup>. According to the National Medicinal Plants Board, Govt. of India, a number of 17,000 to

18,000 species of flowering plants are estimated of which 6,000 to 7,000 species are found to have medicinal usage in folk and documented systems of medicine like Ayurveda, Unani, Siddha and Homoeopathy. Various important and popular medicinal plants like Neem, Oroxyllum, Murraya, Calamus etc. are endemic in this part of the world.

Diabetes mellitus is one of the most common metabolic disorder that arises from malfunctioning of body's mechanism to produce a hormone "insulin", a reduction of the response of peripheral organs to the same hormone, or both [4,5] and has a significant impact on the health, quality of life, and life expectancy of patients as well as on the health care system [6]. According to WHO report, globally, approximately 347 million people or 5-8% of the global population is estimated to be affected by this disease [7]. Diabetes now is becoming the third "killer" of mankind along with cancer, cardiovascular and cerebrovascular disease [8]. It has also been predicted that by the year 2025, more than 75% of people with diabetes will reside in developing countries, as compared with 62% in 1995 [9]. A good number of synthetic commercial anti-diabetic drugs/agents like sulfonylureas, biguanides, glucosidase inhibitors and thiazolidiones are well known today which are not only expensive but also produces serious side effects [10]. Therefore, there has been a growing interest in the ethnobotanical approach to examine the anti-diabetic properties of plants

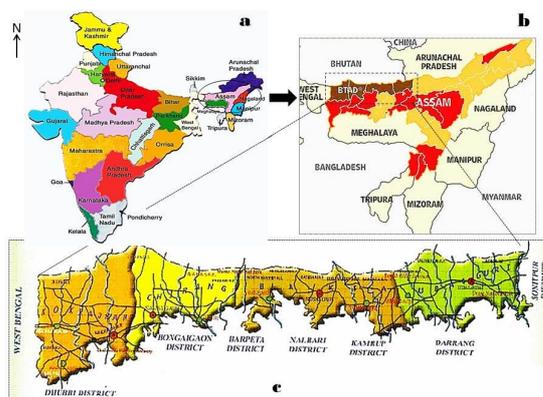
traditionally used by the ethnic groups in different parts of the world. A large number of plants and plant-parts have been investigated for their beneficial role and anti-diabetic properties [11,12]. In view of its medical importance, the present study was focused to know the traditional medicinal plants wealth that is being used by the tribal people of BTC area against diabetes.

## 2. Materials and Methods

### Geographical Position of the study area

Kokrajhar is the biggest district by area under the administration of BTC and is the Head Quarter of BTC that lies roughly between 26° 25' N Longitude and 99° 16' 38" E Latitude, respectively. It covers an area of 3,169.2 sq. km with a population of 8,86,999 that constitute about 30% of the total population of Bodoland Territorial Council [2].

A systematic ethnobotanical survey was carried out in different villages of Kokrajhar district namely Garigaon, Kosugaon, Serfangguri, Dotma, Gossaigaon, Parbatjara etc. during the year 2011-2012 for collection of information on medicinally significant plants being used by the rural population of the area and the plants were collected for identification. The information as well as plants was collected from the local elderly people, Kuberaj and Ojha from the survey areas. The collected plant samples were identified and described. The voucher specimens were deposited in the same herbarium for record.



**Fig 1:** Showing the maps of a) India, b) NE region including the state of Assam and c) Bodoland Territorial Area Districts.

### 3. Results and Discussion

A total of 23 medicinal plant species belonging to 19 families were found to be used by the local people of the area surveyed under study for treatment of diabetes. It was observed that the plant parts used for the treatment included leaves, stems, barks, fruits and seeds, as well as whole plants. Almost all the plant/plant-extracts were found to be prepared in aqueous solution and were consumed during the early hours of the day in empty stomach. Plant parts used more frequently were in form of bark, leaf, tuber, fruits, roots etc.

The botanical names, family, local name, parts used, mode of traditional formulation, compound(s) isolated and the bioactive principle if any are briefly described below.

1. *Annona squamosa* (L), Family: Annonaceae, Local name: aithaphol.

Traditional formulation: Raw bark or/and leaf were grinded and the extracts were obtained by squishing. The extract is then filtered and used 2 to 3 tea spoon full of extract every morning.

Bioactive compounds: The various chemical constituents reported to be isolated from leaves, stems and roots of the plant includes anonaine, aporphine, norcorydine, glaucine, benzyltetrahydroisoquinoline, borneol, camphene,  $\beta$ -caryphyllene, eugenol, farnesol, geraniol, etc <sup>[13]</sup>. The biological activity of the plant is found to be having anti-diabetic <sup>[14]</sup>, antimicrobial and pesticidal activity <sup>[15]</sup>.

2. *Azadirachta indica* (A.juss), Family: Meliaceae, Local name: neem.

Traditional formulations: Raw leaf extracts mixed with little water is taken at a dose of 2-3 tea spoons daily in empty stomach.

Bioactive compounds: A large number of compounds were found to be isolated from different parts of the plant. However, biologically the most active principles isolated from the plant include- azadirachtin, meliacin, salanin, nimbin and valassin etc <sup>[16]</sup>. The various biological and pharmacological activity of the plant includes-anthelmintic, antibacterial, antiulcer, antifertility, anti-diabetic, anti-inflammatory, antiviral, antimalarial, diuretic, insecticidal,

antispermatogenic, antitumor, hypoglycaemic, etc <sup>[17, 18]</sup>.

3. *Cateranthus roseus* (L.) G.Don, Family: Apocynaceae; Local name: daodwi bibar.

Traditional formulation: Fresh leaf extracts or fresh leaf may be chewed in empty stomach.

Bioactive compounds: A large number of alkaloids have been isolated from the plant namely-  $\beta$ -carboline, ammocalline, coronaridine etc. Recently, detailed phytochemical studies using the latest analytical techniques have helped understand the complex phenolic profile of this species. Several highly glycosylated flavonoids have been isolated by Pereira et al.<sup>[19]</sup> mainly of quercetin, kaempferol and isorhamnetin derivatives. Biologically, *C. roseus* is found to possess antispermatogenic, antitumor, anti-diuretic, anti-malarial, anti-diabetic, antibacterial, antiviral, cytotoxicity, anti-inflammatory activities <sup>[20]</sup>.

4. *Centella asiatica* (L. urban); Family: Mackinlayaceae; Local name: manimooni.

Traditional formulations: Fresh leaf extracts 2-3 teaspoon in empty stomach nearly 21 days in the early diabetic conditions.

Bioactive compounds: *C. asiatica* is an important natural source of medicine. The main active constituents of plant are triterpeneslike asiatic acid, madecassic acid, asiaticoside, and madecassoside, etc <sup>[21]</sup>. Two new pentacyclitriterpenoids, namelycentelloside D and centelloside E have also been isolated recently by Weng et al <sup>[22]</sup>. *C. asiatica* exerts diverse pharmacological activities such as antibacterial, antidepresent, antiemetic, antineoplastic, antioxidant, antithrombotic, anxiolytic, gastroprotective, etc <sup>[23]</sup>.

5. *Citrullus colocynthis* (L.) Schrad, Family: Cucurbitaceae, Local name: khuwa bhaturi

Traditional formulation: The bark of the red ripens fruit is dried and powdered. Powder being taken 5-10 gm with water in empty stomach.

Bioactive compounds: Literature has shown that a large number of bioactive compounds were isolated from seeds, aerial part and the fruits of *C. colocynth*. Quercetin, iso-vitexin, colocynthoside A & B, cucurbitacin E 2-O-beta-D-glucoside etc. were reported from the plant. Different parts of

the plant are believed to have antidiabetic, antihyperlipidemic, laxative, anti-inflammatory, analgesic, vermifuge, hair-growth-promoting, antibacterial, antifungal and antioxidant properties<sup>[24]</sup>.

6. ***Kalanchoe pinnata*** (Lam.) Pers.; Family: Crassulaceae, Local name: patgaza.

Traditional Formulation: 1 g of raw leaves grinded with 100 ml of water. Leaf extract, 2-3 tea spoon early in the morning.

Bioactive compounds: *K. pinnata*, commonly known as "air plant" is a globally well-known medicinal plant with diverse medicinal properties. Compounds like astragalin, 3,8-dimethoxy-4,5,7-trihydroxyflavone, rutin, keampferol-3-glucoside, bryophyllin A & C etc. were isolated<sup>[25]</sup>. They have a biological property like antimicrobial, anti-inflammatory, anti-allergic, antianaphylactic, antileishmanial, immunosuppressive, insecticidal etc<sup>[26]</sup>.

7. ***Momordica charantia***, Family: Cucurbitaceae; Local Name: tita kerela

Traditional Formulation: Fresh extracts of fruit juice one ounce to be taken in empty stomach.

Bioactive compounds: *M. charantia* is an important medicinal plant as well as vegetable. Due to its medicinal properties, a large number of biologically active components were isolated. Charantin, polypeptide-p, vicine, 5 $\beta$ ,19-epoxy-3 $\beta$ ,25-dihydroxycucurbita-6, 23(E)-diene, and 3 $\beta$ ,7 $\beta$ ,25-trihydroxycucurbita-5,23(E)-dien-19-al etc. were shown to have anti-diabetic activity properties<sup>[27]</sup>.

8. ***Solanum xanthocarpum***, Family: Solanaceae, Local name: ambu fanthao.

Traditional formulation: The juice extract of the fresh fruits (1-3 no.) is taken as a remedy to the high blood glucose in the body.

Bioactive compounds: Chemical examinations of berries of *S. xanthocarpum* showed many chemical compounds like campesterol, daucosterol and triterpenes like cycloartanol and cycloartenol<sup>[28]</sup> (Parmar et al., 2010). The fruits are known for several medicinal uses like anthelmintic, antipyretic, laxative, anti-inflammatory, antiasthmatic and aphrodisiac activities<sup>[29]</sup>. Recent studies by Poongothai et al.<sup>[30]</sup> showed its anti-hyperglycemic property.

9. ***Stellaria media*** (L.) Vill, Family: Caryophyllaceae, Local name: morolya.

Traditional formulation: Aqueous extracts of the whole plant at a dose of 2-3 tea spoon in empty stomach is believe to help reduce the glucose concentration in blood.

Bioactive compounds: Five chemical constituents were isolated and elucidated as apigenin, 6,8-di-C-glucopyranosyl apigenin, quercetin 3-O- $\alpha$ -L-rhamnoside, quercetin and daucosterol, respectively. As far as the biological activity of the plant is concerned, *S. media* is claimed to be used as astringent, expectorant, galactagogue, useful in kidney complications, rheumatic joints, wounds, and ulcers. Reports have also been founds about its use as medicine in various kinds of skin diseases, for bronchitis, rheumatic pains and dysmenorrhea<sup>[31]</sup>.

10. ***Murraya koenigii*** (L. spreng), Family: Rutaceae, Local name: nwrshing

Traditional formulation: Leaf extract, 2-3 tea spoon early in the morning.

Bioactive compounds: *M. koenigii*, commonly known as 'curry leaf tree', is a popular spice and condiment of India. Verma et al.<sup>[32]</sup> recently isolated some essential oils namely  $\alpha$ -pinene, sabinene, (E)-caryophyllene,  $\beta$ -pinene, terpinen-4-ol etc. from the plant. The plant is reported to have anthelmintic, anti-inflammatory, anticancer, antidiabetic, antibacterial, hepatoprotective property<sup>[33]</sup>.

11. ***Phlogocanthus thyrsoiflorus*** (Nees), Family: Acanthaceae, Local name: titaphool.

Traditional formulations: Fresh extract of the leaf, 2-3 tea spoons early in the morning.

Bioactive compounds: Very few literatures are available about the isolation and purification of compounds from *P. thyrsoiflorus*. Biologically, the plant is used as a medicine for fever, whooping cough, liver and spleen disease, analgesic activity and microbial activity<sup>[34]</sup>.

12. ***Hodgsonia heteroclita*** (Roxb.), Family: Cucurbitacea, Local name: hagrani jwgnar.

Traditional formulation: Fresh or dry extracts of the fruit juice is taken 2-3 tea spoon in empty stomach.

Bioactive compounds: *H. heteroclita* is a large climber traditionally used by the local people as a

medicinal plant against diabetes. As far as bioactive compounds and biological activity of the plant is concerned, no such literature is available till today.

13. ***Spinacia oleracea***, Family: Amaranthaceae, Local name: palang.

Traditional Formulations: About 200 g of *S. oleracea* mixed with a most equal amount of fresh carrot and grounded to obtain juice which is taken every day in empty stomach.

Bioactive compounds: Spinach contains phenolic acids, ascorbic acid, carotenoid like violaxanthin, lutein, 9'-(Z)-neoxanthin 2 and  $\beta$ -carotene, flavonoids like apigenin, jaceidin, luteolin, myricetin, 4'-glu-curonide, 3,5,7,3',4'-pentahydroxi-6-methoxyflavone etc. Biologically, *S. oleracea* is found to have many activities. Besides its good antioxidant property, it has also the efficacies like, anticancer, hepatoprotective activity, anti-hyperglycemic, DNA polymerase inhibitory activity etc [35].

14. ***Erythrina variegata*** L., Family: Fabaceae, Local name: mandar.

Traditional formulations: Fresh roots were grounded for obtaining juice. 25 ml of juice were taken for 1 week without water.

Bioactive compounds: *E. variegata*, commonly known as Tiger's Claw is rich in bioactive constituents such as sigmoidin K, orientanol B, cristacarpin, erycristagallin, 2-( $\gamma,\gamma$ -dimethylallyl)-6a-hydroxyphaseollidin, erycristagallin flavones glycosides etc. Different parts of the plant have been used in traditional medicine as nervine sedative, collyrium in ophthalmia, antiasthmatic, antiepileptic, antiseptic, and as an astringent. *E. variegata* are also known to have antidiabetic and antimalarial activity [36, 37].

15. ***Phyllanthus emblica***, Family: Phyllanthaceae, Local name: amlaki.

Traditional formulation: About 10 numbers of fruits were grounded and juice were mixed with honey and taken every day.

Bioactive compounds: A number of compounds like isostrictiniin, quercetin, gallic acid, 3,6-di-O-galloyl-D-glucose, corilagin etc. has been isolated from the plant [38, 39]. All these compounds are proved to have pharmacological properties such

as anti-bacterial, antimutagenic, and anti-allergic activities [40].

16. ***Rubus fruticosus*** (L), Family: Rosaceae, Local name: gswm bwigri

Traditional formulation: Dried barks of the plant is soaked into water for 12 hours and filtered. The filtrate (approximately 30 ml) is taken every day in empty stomach for 1 month.

Bioactive compounds: The phytochemical analysis of *R. fruticosus* shows the presence of protein, sugars, carbohydrate, calcium, phosphorus and phenolic compounds in high concentration. No major compounds were found to have isolated from the plant till today. Leaves, root and stem are believed to possess antimicrobial, diuretic, antidiabetic and carminative properties and often used to cure health related diseases and ailments [41].

17. ***Vigna mungo*** L., Family: Fabaceae, Local name: Raw matimah.

Traditional formulation: About 50 g of raw seeds grounded and soaked in 1 cup of milk overnight and taken for 20 days.

Bioactive compounds: Seeds of *V. mungo* contains isoflavones such as genistein, 2-hydroxydaidzein, 2-hydroxygenistein, 2-hydroxydihydrodaidzein, kievitone, cyclokievitone, 5-deoxykievitone, kievitonehydrate, 4-O-methykievitone, 5-deoxykievitonehydrate. Experiment proved that the plant has the capacity to lower lipid level and profound hypocholesterolemic effect in animals. Isoflavones plays a significant role in hypolipidemic action [42].

18. ***Curcuma longa*** (L.), Family: Zingiberaceae, Local name: haldi

Traditional formulations: About 8g of raw turmeric were grinded, mixed with water and 1/2 spoon of honey and taken for 1 month after meal.

Bioactive compounds: A large number of compounds have been isolated from *C. longa*. Curcumin, bisdemethoxycurcumin, desmethoxycurcumin, etc. are some of the important compounds isolated [43]. Turmeric has been reported to possess anti-bacterial, anti-inflammatory, antioxidant, anti-HIV, anti-tumor and arthritis. It has also the ability to reduce

fasting blood glucose level and can be used to treat diabetes patients<sup>[44]</sup>.

19. *Phycus hispida* (L.f), Family: Moraceae, Local name: adumbra.

Traditional formulations: Ripe fruits are eaten as a remedy for diabetes. It is used as a supportive medicine for the diabetes treatment.

Bioactive compounds: A large number of bioactive compounds have been isolated from the plant.  $\beta$ -amyrine acetate,  $\beta$ -sitosterol, 6-O-methyltylophorinidine, bergaptine,  $\beta$ -amyrine etc. are some of the examples. Similarly, literature survey revealed that various important pharmacological activities like antioxidant, cardioprotective, hepatoprotective, anticancer, anti-inflammatory, etc. are associated with different parts of *P. hispida*<sup>[45]</sup>.

20. *Leucas aspera*, Family: Lamiaceae, Local name: Khangsisa.

Traditional formulation: The plant is believed to be a liver corrective herb. It is used as a potheb during diabetic treatment.

Bioactive compounds: Chemical components like diterpenes, tannins, saponins, sterols, oleic, linoleic, palmitic, stearic, oleanolic and alkaloids have been isolated from this plant. Large numbers of *in vitro* studies have revealed the antifungal, antimicrobial, antipyretic and insecticide, antinociceptive, antioxidant properties of the plant<sup>[46]</sup>.

21. *Andrographis paniculata* (Burm.f) wall, Family: Acanthaceae, Local name: chirota.

Traditional formulation: Whole plant extract is used for diabetic cure. The crude extract is taken at a dose of 1 tea spoonful in empty stomach in the morning hours before meal.

Bioactive compounds: Several bioactive compounds have been reported from *A. paniculata*. Reddy *et al.*<sup>[47]</sup> isolated six compounds namely andrographolide, 14-deoxy-11,12-didehydroandrographolide, andrograpanin, 14-deoxyandrographolide, (+/-)-5-hydroxy-7,8-dimethoxyflavone and 5-hydroxy-7,8-dimethoxyflavone. The plant has been reported to have antibacterial, antifungal, antiviral, choleric, hypoglycemic, hypocholesterolemic, astringent, diuretic, emmenagogue, gastric and

liver tonic, carminative, antihelminthic, and antipyretic and adaptogenic effects<sup>[48]</sup>.

22. *Syzygium cumini* (L.) Skeels, Family: Myrtaceae, Local name: gswm jamu.

Traditional formulation: Seed powder about 1 teaspoonful is taken with water in the morning in empty stomach and also in the evening before meals.

Bioactive compounds: The plant is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaemferol and myrecetin<sup>[49]</sup>. Various traditional practitioners in India use the plant in the treatment of diabetes, blisters in mouth, cancer, colic, diarrhea, digestive complaints, dysentery, piles, pimples and stomachache<sup>[50]</sup>.

23. *Scoparia dulcis* (L.), Family: Plantaginaceae, Local name: bonsini.

Traditional formulation: Fresh leaves 5-6 in number are eaten or chewed for three times a day before meals.

Bioactive compounds: Scientific literature reveals the presence of numerous chemical constituents from the plant like coumarins, phenols, saponins, tannins, amino acids, flavonoids, terpenoids and catecholamines. Its biological properties like antidiabetic, anti-inflammatory, antiviral, antimalarial, neurotropic as well as anticancer activity have been studied and confirmed by different researchers<sup>[51]</sup>.

#### 4. Conclusion

The healthcare system of rural India mostly depends on the knowledge of local medicines, mainly derived from plant. Exploring this knowledge will always be beneficial to human kind as this knowledge may lead to effective drug discovery. Our survey reports of antidiabetic medicinal plants used by the local people of Kokrajhar district coincide with the scientific studies where most of those plants have been proved to have antidiabetic property by different researchers. However, bioassay guided active compound isolation from those plants and its molecular interactions are the need of hour.

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