

Ethnomedicinal heritage and significance of indigenous plants of North East India - A review

Mamoni Das*, Jwngsar Baro, Deeptimayee Mahapatra & Manisha Sharma

Department of Food and Nutrition, College of Community Science, Assam Agricultural University, Jorhat 785 013, Assam

*E-mail: mamoni.das@aau.ac.in

Received 17 April 2025; revised 29 September 2025; accepted 04 November 2025

India has a long history of traditional medicinal systems such as Ayurveda, Siddha and Unani which are in coexistence with the various systems of ethnomedicine practiced in the region. Of these, the North Eastern part of India is extremely rich in terms of indigenous knowledge, due to its ecological diversity and cultural traditions of the many tribal groupings that comprise the region. The North East Indian is a land of extraordinary biological cultural diversity that is replete with the traditional ethnomedicinal information that is entrenched in the operations of the indigenous people in that region. This review examines how indigenous plants are used in the alternative health care system that is in existence among the tribes in the region where more than 200 tribes and subtribes have continued to use indigenous plant in the prevention and healing of various ailments over the years. The area, which is believed to be part of the Indo-Burmese hotspot of biodiversity, hosts a huge reservoir of endemic and useful as therapeutic plants. They are applied in the therapy of a broad range of disorders like common infections and gastrointestinal disorders to chronic diseases like diabetes, hypertension, and inflammation. The review is a synthesis of ethnobotanical information of published and field literature to bring out the main medicinal plants, their therapeutic uses, preparation modes, and phytochemical compounds. The particular focus is placed on the socio-cultural and ecological environment where this knowledge is perpetuated and issues of modernization, loss of habitats, and erosion of knowledge. This paper has put forward a strong argument on the importance of the ethnomedicinal heritage of North East India in community health care, and also highlighted the potential untapped by it in the discovery of drugs through natural products. The scientific justification and the records of these traditional practices are not only necessary to preserve cultural heritage but also the promotion of integrative and sustainable health care systems in India.

Keywords: Chronic diseases, Ethnomedicinal, Indigenous plants, Local healer, North-East, Traditional medicine

IPC Code: Int Cl.²⁵: A61K 36/00

India is known for its rich biodiversity and long-standing traditional knowledge systems. The northeastern part of Indian subcontinent is a major source of ethnomedicinal knowledge. It lies in the Indo-Burmese biosphere hot spot, which is a rich ecosystem of endemic plants. There are over 200 different ethnic groups which live in the region and each of them has its own language, cultural practices, and medical traditions. In the past, these communities have relied on a rich collection of medicinal herbs to treat various health problems, including metabolic, infectious and chronic diseases. Recent ethnobotanical examinations have recorded the therapeutic uses of many plant species in this area¹. In developing nations, it is estimated that about eighty percent of the population mostly rely on folk medicinal practices to meet essential healthcare needs, and the formulations made of plants form the foundation of

these systems². This dependence is not purely cultural but also a factor that is determined by limited access to formal health care provision, financial constraints and the long-term effectiveness of the most common ethnomedicinal treatments. India, and more specifically the North East part of it is characterized by strong ethnopharmacological tradition, where the indigenous population of the country and its subgroups, have vast knowledge regarding the medical usage of the local plants. Traditional treatment of non-communicable diseases (NCDs) which includes cardiovascular disease (CVDs), therapeutic management of non-communicable diseases (NCDs), including cardiovascular diseases (CVDs), type 2 diabetes, and dyslipidaemia, predominantly relies on synthetic pharmacological agents such as fibrates, resins, statins, and nicotinic acid derivatives, which exert their effects mainly by inhibiting endogenous cholesterol biosynthesis and/or reducing its intestinal absorption^{3,4}.

*Corresponding author

Such pharmacological agents are often linked to side effects, such as hepatotoxicity, myopathy, and gastrointestinal issues, which lead to increased patient non-adherence and the search of more reliable options.

The most common synthetic pharmacotherapies that have been utilized in curing of NCDs like antihypertensives, statins, antidiabetics, and corticosteroids are clinically effective but are often characterized by adverse drug reactions, high-cost burden, and inadequate patient adherence especially in rural and underserved populations⁵. This therapeutic quandary has been a catalyst to the increasing world attention to plant-derived therapeutics as complementary or alternative therapies. The traditional medicinal systems, in particular, those developed by the indigenous communities, residing in the biodiversity-rich areas, such as the Northeastern India, are a good source of botanical remedies, which had been historically used in the prevention and treatment of chronic diseases⁶. Ethnomedical repositories of this area record a wide range of plant species that were used as remedies in symptoms and pathologies related to non-communicable diseases, such as fatigue, hyperglycaemia, inflammation, circulatory insufficiency, and digestive dysfunction. Several species of this pharmacopeia have been identified to have relevant pharmacological attributes to NCD

management including: antioxidant, anti-inflammatory, hypoglycaemic, lipid-lowering, and hepatoprotective properties. Yet, a significant part of this ethnobotanical information is not recorded or has not been adequately investigated in terms of strict scientific validation^{7,8}.

In this regard, this review is aimed at thoroughly synthesizing the ethnomedicinal flora that is used by local communities of North East India. It will look at the therapeutic uses of the species, methods of their preparations, and how they relate to the culture and evaluate at the same time the available scientific data regarding the pharmacological properties of these species. Combining the ancient wisdom with the current scientific views, the given paper will claim the importance of ethnomedicinal heritage preservation and assist it in its adoption into the modern healthcare system.

Material and Methods

Comprehensive literature research was performed PubMed, Scopus, Scientific Information Database (SID), and Iranian Medical Matabase (IranMedex) databases and includes the research published since 2004 up to 2023. The keywords used were ethnomedicine, traditional medicine, northeast India, medicinal plants and tribal medicine in order to get relevant researches. As shown in (Fig. 1) a total of 16,120 records were first identified.

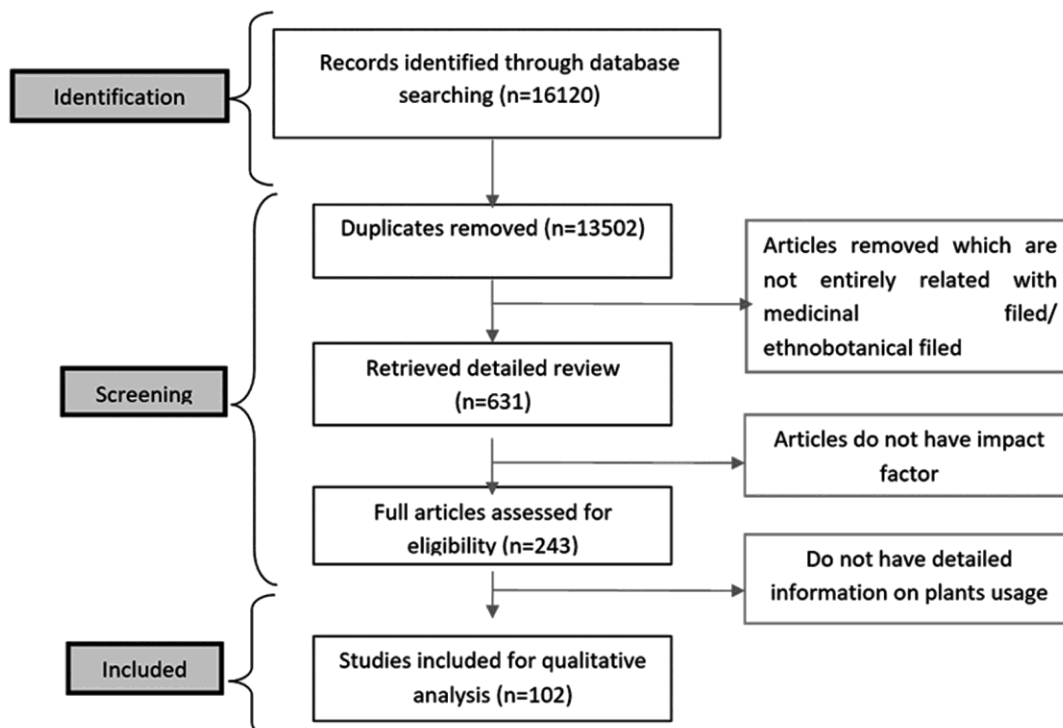


Fig. 1 — Flow chart on screening and selection of articles of traditional healing plants

After the removal of 2,618 duplicate records, 631 records remained to be screened on title and abstract. After that, the eligibility of 243 full-text articles was considered in detail. In the end, 102 articles were chosen that met the inclusion criteria, with the first consideration being relevance to the Northeastern region, followed by a focus on traditional plant-based practices and the last consideration as peer-reviewed publications. Peer-reviewed articles, which were included, were limited to databases that are reputable, including ISI, PubMed, Scopus, SID, or IranMedex. Selected articles had to contain clear ethnobotanical data, *i.e.*, scientific and local names of plants, plant parts used, medicinal use, preparation, and cultural or tribal value. Priority was given to publications that contained original field observations or exhaustive reviews of the literature that made a substantial contribution to the knowledge of indigenous practices of healing in Northeast India. The synthesis of findings took the form of narrative analysis and descriptive statistics, thus putting into focus some salient trends and insights.

Results

The relevant literature states that medicinal plants in North East India comprises of over a hundred plant species that have been used as herbal medicine to treat symptoms and diseases such as hyperglycaemia, hypertension, inflammation, liver problems, and metabolic syndromes. The most common families of plants in this region include; Asteraceae, Zingiberaceae, Rutaceae, Lamiaceae, and Fabaceae. Some of the indigenous communities like Bodo, Mizo, Khasi, Naga, Mishng, and Mishmi have advanced usage of local flora and it is important to note that the indigenous communities have rich traditional knowledge systems. As an example, the Bodo people use a shrub named *Clerodendrum colebrookianum*, not only as a food source but as a medicine to treat hypertension and the Mishmi tribe uses *Coptisteeta* to treat both diabetes and liver diseases^{9,10}. A few of such species have been scientifically examined and confirmed to be pharmacologically relevant in terms of NCD management. *Clerodendrum colebrookianum* has proven to have great antihypertensive and lipid-lowering effects in preclinical experiments. *Coptisteeta* which is also abundant in berberine has a strong hypoglycaemic effect and is hepatoprotective. Similarly, *Houttuynia cordata* or Masundari as it is commonly known by the locals has demonstrated

strong antioxidant and antidiabetic properties, and *Phyllanthus emplicis* (Amla), is widely known due to its antioxidant, hypolipidaemic and anti-aging properties^{11,12}. The conventionally known uses of these botanicals are supported by pharmacological validation studies. The *Phyllanthus emblica*, *Centella asiatica* and *Houttuynia cordata* have been reported to have antioxidant activity and this has supported their use in diseases where the oxidative stress is the main characteristic. *Clerodendrum colebrookianum* has vasodilatory effects that help in reduction of blood-pressure. *Coptisteeta* and *Andrographis paniculata* have shown antidiabetic action, which is mediated by insulin sensitisation and insulin secretion protection of pancreatic beta-cells. Additionally, taxa like *Tinospora cordifolia* and *Aegle marmelos* have presented hepatoprotective effect that is beneficial in metabolic and hepatic disease^{13,14}.

Some of the important medicinal plants in North East India are as follows Fig. 2(a-i):

Alstonia scholaris (L.) R.Br.

A. scholaris is an Indian native and belongs to Apocynaceae. It grows wild all over, plains, evergreen and in deciduous forests. Its pharmacological activity is broadly spread and is used to treat GI disorders, dyspepsia, malaria, acute fever, skin diseases, asthma, heart diseases and bronchitis because of its several therapeutic properties. Milky leaf juice can be used for healing wounds, ulcers and rheumatic pain according to the folklore practice to apply it to the wounds, ulcers, and rheumatic pain. It may also be used with oil and applied to the ear to relieve earaches. *A. scholaris* extract has been reported to have many pharmacological activities such as hepatoprotective, antimutagenic, antiplasmodial and immunostimulatory (Table 1). It has been discovered by scientists that echitamine, one of the indole alkaloids extracted off the bark, is anticancerous. Verma *et al.*¹⁵ have shown that the administration of aqueous leaf extracts of *A. scholaris* lowered the glycemic index, lipid profile, renal indices and hepatic transaminases, phosphatases, dehydrogenases.

Arulmozhi *et al.*¹⁶ reported that, glibenclamide and the ethanolic extract of *A. scholaris* exhibit significant ($p < 0.001$) and positive effects on reduction of blood sugar, HbA1c and reduced lipid peroxidation activities and lowering weight of body, increase liver and muscle glycogen contents and various antioxidant



Fig. 2 — (a-i) Some of the important medicinal plants in North East India

activities. Moreover, administration of *A. scholaris* oral extract of the leaves, which contained ethanol, also decreased MBG, HbA1c and TC in diabetic rats¹⁷. A study by Bello *et al.*¹⁸ examined the effect of the *A. scholaris* bark ethanolic extract on the antihypertensive effect and it was observed that the ethanolic extract can produce vasodilation through the blockage of calcium channels, soluble guanylate cyclase stimulation, and possible mechanism linked to prevention of inositol 1, 4, 5-triphosphate formation (Table 2).

***Terminalia chebula* Retz.**

Terminalia chebula is one of three plants constituting the traditional remedy of the ancient

Indian Ayurvedic system called Triphala which belongs to the family of Combretaceae. The Ayurvedic approach of medicine traditional system refers to the usage of *T. chebula* for prevention of type 2 diabetes mellitus. As it has been shown, *T. chebula* possesses several chemical compounds, such as luteolin, tannic acid, ellagic acid, chebulinic acid, luteolin, gallic acid and 2,4-chebulyl-b-D-glucopyranose. Research indicates that *T. chebula* has antifungal, antiviral, antimicrobial, inflammatory, anticancer antioxidant properties. According to the studies carried out by our research group, aqueous extract of *T. chebula* dried fruit has a short-term antidiabetic effect. Some other researchers have

indicated that the *T. chebula* extract of chloroform and methanolic possess renoprotective and anti-diabetic effects. Reddy *et al.*¹⁹ also reported that the *T. chebula* bark methanolic extract at the dosage of 200, 400 and 600 mg/kg had significant effect on the reduction of serum total cholesterol and serum triglyceride levels. Murali *et al.*²⁰ noted that the high levels of blood glucose were decreased by 43.2% ($p < 0.01$) and the rise in HbA1c was significantly reduced after oral administration of *T. chebula* aqueous extract of daily doses once for every two months ($p < 0.01$). The same dose was also successful in reducing the high cholesterol levels as well as controlling insulin levels in serum as compared to the untreated diabetic animals. Besides this, after eight weeks of treatment of HFD rabbits with the powder of *T. chebula* fruit (540 mg /Kg bw), TC, LDL, Triglycerides and atherogenic index were decreased

significantly and raised ($p < 0.05$) the serum HDL level²¹ (Table 2).

Syzygium cumini (L.) Skeels

Syzygium cumini (L.) Skeels, often called black plum or jamun. It includes nutrients that have been utilized both medicinally and as an edible. The fleshy jamun fruits have a reasonable shape and a single dark brown seed that contains a large amount of medicinal compounds^{22,23}. It originated in India, Myanmar, and Sri Lanka before spreading to the Himalayas, China, Eastern Australia, and Southeast Asian islands²⁴. Plants include a collection of chemical substances known as phytochemicals, which have been shown to play a significant role in disease prevention that goes beyond nutrition. Terpenoids, alkaloids, and phenolics are the three main types of phytoconstituents found in jamun plants of various regions²⁵.

Table 1 — *In vivo* Investigations of ethnomedicinal plants used in Northeast India

| Sl. no. | Plant name | Family | Part used | Extract | Dose | Animal / cell model | Activity | References |
|---------|---------------------------------------|--------------|-----------|--------------------------|-----------------------------------|--------------------------|---|--------------------------------------|
| 1 | <i>Alstonia scholaris</i> (L.) R. Br. | Apocynaceae | Leaf | Ethanollic leaf extracts | 300 mg/kg bw | Wistar rats | ↓TC, ↓TG, ↓LDL, ↑HDL, ↑glutathione, and ↑catalase | Verma <i>et al.</i> , 2019, (15) |
| | | | Leaf | Ethanollic extract | 100, 200 & 300 mg/kg bw | Albino Wistar rats | ↓blood glucose level, glycosylated hemoglobin and lipid peroxidation | Arulmozhi <i>et al.</i> , 2010, (16) |
| | | | Bark | Ethanollic extract | 12.5, 25, 50, 100 mg/kg bw | Sprague Dawley (SD) rats | Exerts vasodilation via calcium channels blockade, direct activation of soluble guanylate cyclase and possibly by also inhibiting the formation of inositol 1, 4, 5-triphosphate. | Bello <i>et al.</i> , 2015 (18) |
| 2. | <i>Terminalia chebula</i> Retz. | Combretaceae | Bark | Methanollic extract | 200, 400, and 600 mg/kg bw | Wistar rats | ↓TC, ↓TG, ↓LDL, ↑HDL | Reddy <i>et al.</i> , 2015 (19) |
| | | | Fruit | Aqueous extract | 100, 200, 300, and 400 mg / kg bw | Wistar rats | ↓Insulin, ↓Glucose, ↓HbA1c, ↓TC, ↓TG, ↑HDL | Murali <i>et al.</i> , 2007 (20) |
| | | | Fruit | Fruit powder | 540 mg /Kg bw | Rabbits | ↓TC, ↓TG, ↑HDL, ↓Atherogenic index | Anjum <i>et al.</i> , 2014 (21) |

... Contd.

Table 1 — *In vivo* Investigations of ethnomedicinal plants used in Northeast India (Contd.)

| Sl. no. | Plant name | Family | Part used | Extract | Dose | Animal / cell model | Activity | References |
|---------|------------------------------------|---------------|--------------|---------------------|---|-------------------------------------|---|--|
| 3. | <i>Syzygium cumini</i> (L.) Skeels | Myrtaceae | Leaves | Ethanol extract | 125, 250 and 500 mg/kg bw | Wistar rats | ↓blood glucose, ↓TC, ↓TG, ↓VLDL | Jain, <i>et al.</i> , 2010 (22) |
| | | | Fruits | Ethanol extract | 200 mg/kg/day | Wistar rats | ↓TC, ↓TG, ↓LDL, ↓VLDL, ↑HDL | Pereira <i>et al.</i> , 2021 (23) |
| | | | Seed | Jamun seed powder | 5% of meal | Albino rats (Sprague Dawely strain) | ↓TC, ↓TG, ↑HDL, ↓Atherogenic index, ↓GPT, ↓GOT, ↓ALP | Hammam <i>et al.</i> , 2019 (24) |
| | | | Leaves | Jamun leave powder | 5% of meal | Albino rats (Sprague Dawely strain) | ↓TC, ↓TG, ↑HDL, ↓Atherogenic index, ↓GPT, ↓GOT, ↓ALP | |
| | | | Seed | Methanol extract | 200 and 400 mg/kg bw | Zebrafish | ↓blood glucose | Prema <i>et al.</i> , 2023 (25) |
| | | | Seed | Seed powder | 2.5% of food, w/w | Wistar rats | ↓body weight, ↓white adipose tissue (WAT) weights, ↓blood glucose, ↓insulin, ↓TC, ↓TG, ↑HDL | Ulla <i>et al.</i> , 2017 (26) |
| | | | Seed | Methanolic extracts | 100 and 200 mg/kg b.w. | Wistar albino rats | ↓body weight, ↓TC, ↓TG, ↑HDL, ↓AST, ↓ALT, ↓Food intake, ↓body weight, ↓TC, ↓TG, ↑HDL | Nahid, <i>et al.</i> , 2017 (27) |
| 4. | <i>Oroxylum indicum</i> (L.) Kurz | Bignoniaceae | Fruit | fruit extract | 100, 200, 300 mg/kg bw/day | Albino mice | ↓PPARc2 and SREBP-1c, ↓GLUT4, ↓FAS, ↓leptin | Hengpratom <i>et al.</i> , 2022 (28) |
| | | | Fruit | Ethanol extract | 50 to 200 µg mL | 3T3-L1 adipocyte | ↓lipid accumulation & lipase activity | Hengpratom <i>et al.</i> , 2020 (29) |
| | | | fruit pods | Ethanol extract | 200, 150 µg/mL | 3T3-L1 adipocyte | ↓lipid accumulation & lipase activity | Hengpratom, <i>et al.</i> , 2018 (30) |
| 5. | <i>Nyctanthes arbor-tristis</i> L. | Oleaceae | Leaf | Ethanol extract | 200, 400 mg/kg bw | Sprague–Dawley (SD) rats | ↓TC, ↓TG, ↑HDL, ↓insulin | Mousum <i>et al.</i> , 2018 (31) |
| | | | Flower | Aqueous extract | 250, 500 & 750 mg/kg b.w. | Mice | ↓TC, ↓TG, ↑HDL, ↓α-amylase | Rangika <i>et al.</i> , 2015 (41) |
| | | | Seed | Ethanol extract | 1.25 g/kg b.w. | Long Evans rats | ↓blood glucose | Rahman <i>et al.</i> , 2013 (33) |
| 6. | <i>Momordica charantia</i> L. | Cucurbitaceae | Fruit | Fruit powder | 500 mg/kg | C57BL/6 J mice | Modulating gut microbes and increasing SCFAs production. | Zhang <i>et al.</i> , 2020 (36) |
| | | | Leaves | Aqueous extract | 25, 50 & 100 mg/kg b.w. | Wistar rats | ↓Glucose, ↓TC, ↓TG, ↑HDL | Parra <i>et al.</i> , 2021 (38) |
| | | | Unripe fruit | Fruit extract | 4 and 8% of the average daily food intake | Wistar rats | ↓TC, ↓TG, ↑HDL | Doosti-Moghaddam <i>et al.</i> , 2022 (39) |

... Contd.

Table 1 — *In vivo* Investigations of ethnomedicinal plants used in Northeast India (Contd.)

| Sl. no. | Plant name | Family | Part used | Extract | Dose | Animal / cell model | Activity | References |
|---------|-------------------------------------|-----------|-----------|---|--|---------------------|--|------------------------------------|
| 7. | <i>Clerodendrum infortunatum</i> L. | Lamiaceae | Leaves | Aqueous extract | 312.5, 625, 1250 mg/kg b.w. | Wistar rats | ↓TG, ↑HDL, ↓LDL, ↓organ weight-liver, kidney & heart | Martial, <i>et al.</i> , 2020 (42) |
| | | | Leaves | Ethylacetate extract & Methanolic extract | (40 mg/kg/b.w.) & (40 mg/kg/b.w.) | Sprague–Dawley rats | ↓TC, ↓TG, ↑HDL, ↓LDL, | Devi & Sharma, 2004 (43) |
| | | | Leaves | Methanol extract | 31.25, 62.5, 125, 250 and 500 mg/kg b.w. | Swiss albino mice | ↓TC, ↓TG, ↓AST, ↑HDL, ↓LDL, ↓Atherogenic index | Zailani <i>et al.</i> , 2023 (45) |

Abbreviations: ALP, Alkaline Phosphatase; ALT, Alanine Aminotransferase; AST, Aspartate Aminotransferase; bw, body weight; FAS, Fatty Acid Synthase; GLUT4, Glucose Transporter Type 4; GOT, Glutamate Oxaloacetate Transaminase (also known as AST); GPT, Glutamate Pyruvate Transaminase (also known as ALT); HDL, High-Density Lipoprotein; LDL, Low-Density Lipoprotein; PPAR γ 2, Peroxisome Proliferator-Activated Receptor Gamma 2; SCFAs, Short Chain Fatty Acids; SREBP-1c, Sterol Regulatory Element-Binding Protein 1c; TC, Total Cholesterol; TG, Triglycerides; VLDL, Very Low-Density Lipoprotein; WAT, White Adipose Tissue

Quantitative phytochemical studies of jamun pulp powder showed that this compound contained about 0.54% anthocyanins, 0.17% ellagitannins, which were significantly related to its antioxidant and anti-proliferative properties in cell and *in vivo* cancer models. In line with these results, the extracts of pulp and seeds contained strong antioxidant capacity. Antioxidant properties of the jamun pulp extract was justified by the anthocyanin content in it, but the seed extract, though it did not contain any anthocyanins, was active it is rich in the level of ellagitannins and gallic acid. Moreover, the two extracts produced significant anti-proliferative actions of various cancer cell lines as demonstrated in lung, breast, and leukemia models. Interestingly, the seed extract caused significant growth inhibition even in the absence of anthocyanins, which is indicative of the involvement of ellagitannins and ellagic acid and their close polyphenols as the main contributors of its anticancer activity²⁶. The pharmacological investigations have revealed that in addition to cardioprotective and gastroprotective effects, seeds possess anti-inflammatory, antimicrobial, antioxidant, antidiarrheal and anticancer effects. The increase in lifestyle disorders due to stress and sedentary lifestyles coupled with high consumption of highly processed foods makes these JSs rich in phytochemicals and antioxidants useful as therapy agents^{27,28}.

According to Jain *et al.*²⁹ *S. cumini* leaves have the potential to be utilized as the preferred alternative and/or complementary therapy for the treatment of hyperlipidemia and diabetes. In this study, it was

observed that the acute treatment of the *S. cumini* ethanolic extract with doses of 125 and 500 mg/kg b.w. led to a marked reduction in blood glucose levels of the hyperglycemic rats, triglyceride and cholesterol levels of the diabetic rats. Pereira *et al.*³⁰ also found that administration of 200 mg/kg/day of the ethanolic extract of *S. cumini* fruit is efficient in lowering LDL, TG, VLDL and TC (Table 2).

According to Hammam *et al.*³¹ jamun seeds and leaves were found to be the most effective at lowering TC, TG, and LDL levels. Furthermore, liver functions have improved, with a substantial reduction in GOT, GPT, and ALP activity when compared to the positive control group. Another study by Prema *et al.*³² found that jamun seed methanolic extract effectively reduced blood sugar levels in a zebrafish model³². Furthermore, obese wistar rats administered jamun seed powder (2.5% w/w) showed significant reductions in body weight and white adipose tissue³³. Furthermore, wistar albino rats were given dosages of 100 and 200 mg/kg b.w., and it was revealed that the seed methanolic extract considerably reduced body weight, total cholesterol, triglycerides, AST, and ALT³⁴ (Table 2).

Oroxylum indicum (L.) kurz

Oroxylum indicum belongs to the Bignoniaceae family of plants. The tree is also known as *Hippoxylum indica* (L.) Raf., *Oroxylum flavum* Rehder, *Calosanthos indica* (L.) Blume, *Bignonia reticulatum* Blume ex Miq., and *Bignonia tuberculata* Roxb. *Oroxylum indicum* is also known as Sonapatha

Table 2 — Plant Species, Preparation Modes for Traditional Management of NCDs

| Scientific name | Family | Accession number | Local name | Parts used | Preparation | Dosage | Habit |
|---------------------------------------|---------------|--|----------------|------------------|-------------|---------------------|---------|
| <i>Alstonia scholaris</i> (L.) R.Br. | Apocynaceae | AAU WEED HERBARIUM Acc. No. 5468 | Sithona | Bark | Decoction | 1-2tsp daily | Tree |
| <i>Oroxylum indicum</i> (L.) kurz | Bignoniaceae | AAU WEED HERBARIUM Acc. No. 5463 | Kharongkhandai | Leaves/ fruit | Fresh Juice | 1 cup twice daily | Tree |
| <i>Syzygium cumini</i> (L.) Skeels | Myrtaceae | AAU WEED HERBARIUM Acc. No. 5464 | Gswmjamboo | Seed | Powder | 1-2 tsp twice daily | Tree |
| <i>Terminalia chebula</i> Retz. | Combretaceae | AAU WEED HERBARIUM Acc. No. 5475 | Selekha | Fruit | Fresh juice | 1 cup twice daily | Tree |
| <i>Nyctanthes arbor-tristis</i> (L.) | Oleaceae | AAU WEED HERBARIUM Acc. No. 5474 | Sewali | Flower | Decoction | 2-3 tsp daily | Shrub |
| <i>Momordica charantia</i> (L.) | Cucurbitaceae | AAU WEED HERBARIUM Acc. No. 5473 | Udasi | Seed | Decoction | 1-2tsp twice daily | climber |
| <i>Clerodendrum infortunatum</i> (L.) | Lamiaceae | AAU WEED HERBARIUM Acc. No. 5471 | Mwkhwna | Leaves | Decoction | 1 cup once daily | Shrub |

or Shyonak in Hindi and the Tree of Damocles in English. The Sonapatha tree is semi-deciduous, reaching a height of 18 to 20 meters and having few branches³⁵. The *O. indicum*, popularly known as the beko plant, is a common medicinal herb in Asia. This is a diverse plant, and practically all of its parts are claimed to have various pharmacological properties. Baicalein, the plant's most frequent bioactive ingredient, has been linked to a number of essential medicinal properties. According to Hengpratom *et al.*³⁶ the fruit extract of *O. indicum* has a lipid-lowering impact on hyperlipidemic mice. When hyperlipidemic rats were treated with different doses of 100-300 mg/kg body weight/day showed a substantial reduction in body weight, food intake, total cholesterol, and triglyceride levels³⁶. In contrast, the hyperlipidemic mice treated with the extract showed a considerable improvement in HDL levels. Some studies on 3T3-L1 adipocyte have showed that the ethanolic extract of *O. indicum* could inhibit the synthesis of fatty acid, leptin and lipase activity significantly^{37,38} (Table 2).

Nyctanthes arbor-tristis L.

The native habitat of *Nyctanthes arbor-tristis* (NAT) is South Asia. It is located in North India, Southeast Thailand, and Northern Pakistan and Nepal. Today the tropics and subtropics are occupied by huge cultivation of this plant. *Nyctanthes aculeata* and NAT are the two types of species that constitute

the genus *Nyctanthes*. It is a native Indian plant that is worshipped in religious activities. *N. arbor-tristis* L. (Oleaceae) is a very important plant as it has been used to have a myriad of medicinal uses throughout history. Traditional and native cultures have been using much of the plant parts medically. As a laxative, diuretic, expectorant, digestive and mildly bitter tonic, *N. arbor-tristis* is used in Ayurveda, Siddha-Ayurveda, and Unani medicine³⁹.

Mousum *et al.*⁴⁰ noted that in hyperlipidemic rats fed on ethanolic extract of *N. arbor-tristis* leaf, serum HDL level significantly increased and total cholesterol, triglycerides and insulin level significantly decreased. It was also observed that the aqueous extract of the flower had good influence on lipid profile and other parameters like alpha-amylase activity, when the hyperlipidemic mice were treated with 250, 500 & 750 mg/kg b.w.⁴¹. In a different study by Rahman *et al.*⁴² it was observed that ethanolic extract of seed treated with 1.25 g/kg of its b.w. there was a remarkable decrease in the level of glucose in the blood.

Momordica charantia L.

Momordica charantia L. belongs to the Cucurbitaceae family, which includes 12 Asian species and 47 African species. All Asian species are dioecious, but all African species are unisexual^{43,44}. This plant's English names include bitter melon, bitter apple, African cucumber,

wild cucumber, and bitter cucumber. Although it originated in Asia, it is now grown all over the world, particularly in Africa, Central and South America⁴⁵. Over the last five years, researchers have identified and reported a substantial variety of bioactive chemicals found in *M. charantia*. The phytochemical studies revealed the presence of flavonoids, phenols, glycosides, alkaloid and saponins^{46,47}. A variety of plant components, including fruits, seeds, and leaves, have been found to contain bioactive compounds⁴⁸. Doosti-Moghaddam *et al.*⁴⁹ discovered that consuming 4 and 8% of the average fruit extract diet daily was capable of dramatically lowering total cholesterol, triglycerides, and elevating HDL levels in hyperlipidemic wistar rats (Table 2). According to Zhang *et al.*⁵⁰, *M. charantia* fruit powder can regulate intestinal bacteria and increase short chain fatty acid synthesis. The outcomes of this study revealed that C57BL/6 J mice were given 500 mg/kg of *M. charantia* fruit powder, which was proven to be capable of regulating gut bacteria and, as a result, lowers fat accumulation in our organism. In fact, aqueous extracts of the leaf were shown to have a significant cholesterol-lowering effect in hyperlipidemic wistar rats⁵¹ (Table 2).

Clerodendrum infortunatum L.

The *Clerodendrum* genus (Lamiaceae) includes over 580 species of tiny trees, shrubs, and herbs that are primarily found in tropical and subtropical regions of the world. The Bhat *Clerodendrum infortunatum* is an example of a terrestrial shrub that grows in Bangladesh's mixed deciduous and evergreen to semi-evergreen woods, as well as in West Bengal, India. It has a terrible odor. The plant and its components, notably the leaves and roots, are popular in Indian and Bangladeshi traditional medicine for the treatment of a variety of common disorders due to its availability of access and observed therapeutic properties^{52,53}. Folk medicine uses the leaves and roots to cure skin disorders, tumors, snakebites, and scorpion bites. Furthermore, the leaf infusions are used to treat malaria as both an antiperiodic and bitter tonic. Leaf juice extracted fresh is thought to be a useful cholagogue and laxative. To back up the traditional assertions, experimental research has shown a variety of biological properties, including anti-snake venom action, analgesic and anticonvulsant action, nootropic action, antibacterial activity, antioxidation potential, and hepatoprotection. Previous phytochemical studies of *C. infortunatum* leaf have revealed the presence of

phenolic, steroid, terpenoid, flavonoid, and phenylpropanoid compounds⁵⁴⁻⁵⁶.

Clerodendron thomsoniae has traditionally been used in the treatment of obesity through its leaves. The lipid-lowering and antioxidant properties of *C. thomsoniae* leaf were compared to the effects of aqueous extract dosages (312.5, 625, and 1250 mg/kg). The highest dose (1250 mg/kg) showed the greatest percentage change (33%, 51%, 37%, 43%, and 62%). Similarly, dose-dependent increases in the amounts of belly fat and blood glucose were impressive. Furthermore, the extract significantly reduced catalase in a dose-dependent manner⁵⁷. Devi & Sharma⁵⁸ discovered that the serum lipid levels such as including TC, TG, LDL, significantly decreased ($p < 0.001$) in rats treated with methanol extract (ME) after administration of both crude and organic extracts. Even after administering crude extract against a high-fat meal, TC and TG levels decreased significantly ($p < 0.001$). This trial revealed that administering EE (46%) and ME (38%) could result in cardioprotective lipid, or high density lipoprotein (HDL) improvements⁵⁸. Furthermore, they discovered that the control group that received 250 and 500 mg/kg body weight of *Clerodendrum* methanol leaf extract experienced a significant improvement in lipid and liver profiles. On high doses, serum concentrations of LDL-c, triglycerides, and total cholesterol with the index of atherogenicity were significantly reduced ($p < 0.05$) compared to the control. On day 14 and 28, the concentration of HDL-c in serum lipoprotein (a) increased significantly ($p < 0.05$) compared to the control⁵⁹ (Table 2).

Centella asiatica (L.) Urb.

Centella asiatica or Indian Pennywort or Gotu Kala is a small herbaceous plant, which is a perennial plant and is widespread in tropical and subtropical areas, especially in South and Southeast Asia. It is called Manimuni in Assam in North-East India, where it is traditionally eaten as a food and as a medication. *C. asiatica* is revered in Ayurveda, Traditional Chinese Medicine and other indigenous healing systems and is recognized worldwide due to its diverse pharmacological and therapeutic effects. Among the best-reported positive effects of *C. asiatica* is its usefulness in improving cognitive performance. The herb is also well-known because of its healing and regenerating effect on wounds.

C. asiatica extracts have been shown to enhance collagen synthesis, antioxidant activity on the skin,

and microcirculation and all of this has led to enhanced wound healing and tissue repair⁶⁰. Due to these reasons, it is usually a topical cream ingredient to treat burns, scars, stretch marks, and other minor skin injuries. Moreover, *C. asiatica* has also been found to have anti-inflammatory effects and antioxidant effects, and thus is helpful in the treatment of chronic inflammatory diseases. The active components of the plant aid at the elimination of the free radicals, decrease of the oxidative stress, and also inhibition of the behavior of the pro-inflammatory cytokines⁶¹. *C. asiatica* is commonly consumed in the North-East of India, either as salads or chutney, or as a flavouring in herbal tea. The fact that it is integrated in the diet and the traditional medicine is a manifestation of the holistic nature of the community in regards to wellness⁶¹ (Table 2).

Zanthoxylum armatum DC

Zanthoxylum armatum or toothache tree, commonly abbreviated as Timur or Prickly Ash, is a thorny aromatic shrub or small tree native to the Himalayan and sub-Himalayan areas, and includes the North-Eastern states of India including Arunachal Pradesh, Sikkim, Manipur, and Assam. Native to Assam and Mizoram, it is known locally as Tez-moori in Assam and Thingthupui in Mizoram and it is an important ingredient in indigenous medicine and local food. The ground fruit is used to rub down the gums or chewing to alleviate dental pain and oral hygiene. The plant is also said to have digestive as well as carminative effects. Common stomach disorders that are treated using it include indigestion, flatulence, and diarrhea. The fruits will trigger the release of digestive enzymes and will help in peristaltic motion, which promotes the health of the gut and increases nutrient absorption⁶².

These antimicrobial properties underpin the use as a traditional medicine to treat skin infections, wounds and respiratory conditions including coughs and colds. One more important advantage is its antioxidant effect, it combats oxidative stress and inflammation on the organism. The plant contains a lot of flavonoids, tannins and phenolic compounds, which are natural antioxidants, preventing cell destruction, and which could lower the risk of chronic diseases, such as cancer and cardiovascular disorders⁶³. In addition, plant has demonstrated antispasmodic and anti-ulcer effects in animal chronic studies and this means that the plant can be used to treat ailments such as muscle cramps and peptic

ulcers. In traditional medicine, the essential oils and extracts are also used to stimulate the blood circulation and remove rheumatic pain and fever. *Z. armatum* is also used as a spice and as a flavoring ingredient in the culinary process, because it has a tangy and peppery flavor. It is also added to pickles, chutneys as well as meat dishes, not only because of its flavor but also due to its digestive and preservative properties⁶³.

Conclusion

Northeast India's medicinal plant heritage stands out for its remarkable breadth and depth, reflecting the region's extraordinary biocultural diversity and long-standing traditions. Among the more than 200 ethnic communities inhabiting this Indo-Burmese biodiversity hotspot, hundreds of native plant species have been used over generations to treat illnesses ranging from common infections to chronic conditions like diabetes and hypertension. The rich cultural ethnomedicinal knowledge has a vast connection with cultural praxis and remains a very crucial aspect in the healthcare provision in many remote societies. One of the most striking discoveries of this survey is the fact that most of the species reported have high therapeutic relevance, which can be supported by the current literature that is gradually validating this assumption. As an example, the folk antihypertensive extract of the plant, named *C. infortunatum*, has been shown to have strong blood-pressure-lowering and lipid-lowering effects in preclinical models, but the plant, *Coptisteeta*, already used in treating diabetes, has been shown to have strong hypoglycemic and hepatoprotective effects. Equally, typical botanicals like and *H. cordata* and *P. emblica* reflect strong antioxidant and metabolic activities that reflect their traditional medicine applications. This alignment of empirical evidence and ethnobotanical support is testimony to the great biomedical promise of the flora of Northeast India to suggest that it is a region worth pursuing as a source of new therapeutic agents and drug leads.

However, the research highlights that there is an immediate requirement of enhanced scientific interaction. A large part of native pharmacopoeia is either not documented or has been proved only partially based on scientific study. Furthermore, both species of medicine and the oral culture that perpetuate their usage are endangered by the pace of

modernization, destruction of the habitat, and the loss of cultural values. As a result, the primary goal should be the strengthening of conservation efforts, *i.e.*, the biodiversity, which is strategically preserved with the assistance of sustainable control of the medicinal plants and the protection of indigenous knowledge by means of systematic documentation and the involvement of community members. These steps will guarantee that the ethnomedicinal wealth of Northeast India will be kept and may be properly incorporated into modern healthcare frameworks. The combination of ancient knowledge and scientific validation will help to reach the full therapeutic potential of these medicinal plants and not only the local people will benefit, but the whole society.

Future prospects

The neglected but valuable indigenous botanical resources of Northeast India are an asset, which can further better health and well-being. Future research directions must focus on the scientific testing of therapeutic claims by pharmacological experimentation and clinical trials, and harmonize the bioactive constituents. Novel drug discovery may be expedited by advanced phytochemical analysis and molecular analysis (metabolomics and drug-target interaction analysis). The accessibility and cultural relevance can be improved through incorporating these established conventional practices in contemporary healthcare, especially in rural and tribal areas. Moreover, sustainable harvesting, cultivation and conservation of biodiversity are needed to guard medicinal flora and the related knowledge systems. Exploring ethnopharmacogenomics might provide a clue to the unique reaction of every population to plant-based treatment, which will simplify the process of personalized treatment. Strong policy frameworks and intellectual property protection should be established to facilitate fair distribution of benefits with the communities of the area and to control the exploitation of the traditional knowledge. The multidisciplinary or multidisciplinary approach is essential in the full utilization of the potential of these medicinal plants to advance the best health and well-being.

Acknowledgements

The authors sincerely acknowledge the valuable contributions of local healers and indigenous communities of North East India for preserving traditional knowledge and sharing insights that

formed the basis of this review. We are also grateful to the institutional library and research facilities that provided access to scientific databases and ethnobotanical records. The support received from Department of Food and Nutrition, College of Community Science, Assam Agricultural University is gratefully acknowledged.

Conflict of Interest

Authors declare no conflict of interest

Author Contributions

The review article was conceptualized by MD and written by JB, DM, and MS under the supervision of MD, with final editing carried out jointly by JB and MS.

Data Availability

This review article does not involve the collection of primary data. All data supporting the finding of the study are derived from published sources which have been appropriately cited within the manuscript.

References

- 1 Dutta M, Deb P & Das A K, Factors shaping plant diversity in traditional agroforestry system of dominant ethnic communities of upper Brahmaputra valley regions of Northeast India, *Agrofor Syst*, 97 (7) (2023) 727-738.
- 2 Khan M S A & Ahmad I, Herbal medicine: current trends and future prospects. In: *New Look to Phytomedicine*; Ahmad I, Aqil F, Owais M, Eds.; Academic Press: Cambridge, MA, USA, (2019) 3-13.
- 3 Jian-Jun L I, Shui-Ping Z H A O, Dong Z H A O, Guo-Ping L U, Dao-Quan P E N G, *et al.*, China Guidelines for Lipid Management, *J Geriatr Cardiol*, 20 (9) (2023) 621-621.
- 4 Islam M S, Sharif A, Kwan N & Tam K C, Bile acid sequestrants for hypercholesterolemia treatment using sustainable biopolymers: recent advances and future perspectives, *Mol Pharm*, 19 (5) (2022) 1248-1272.
- 5 Chauke G D, Nakwafila O, Chibi B, Sartorius B & Mashamba-Thompson T, Factors influencing poor medication adherence amongst patients with chronic disease in low-and-middle-income countries: a systematic scoping review, *Heliyon*, 8 (6) (2022). DOI:10.1016/j.heliyon.2022.e09716.
- 6 Wirtz V J & Moucheraud C, Beyond availability and affordability: how access to medicines affects non-communicable disease outcomes, *Lancet Public Health*, 2 (9) (2017) e390-e391.
- 7 Lamo J M, John L & Rao S R, Medicinal plants of North-East India: biodiversity and their ethnomedicinal values. In: *Medicinal Plants: Biodiversity, Biotechnology and Conservation*; Reddy P S, Ed.; Springer Nature: Singapore, (2023) 219-247.
- 8 Baro J, Das M, Mahapatra D, Choudhury M & Goswami S, *et al.*, Documentation of antiobesogenic plants used by Bodo

- community of Assam, India, *J Pharm Res*, 15 (11) (2023) 416-428.
- 9 Das R J, Pathak K, Bordoloi S, Saikia R, Alqahtani S A, *et al.*, *Clerodendrum colebrookianum* Walp: an insight into its pharmacology, expository traditional uses and extensive phytochemistry, *Curr Tradit Med*, 9 (2) (2023) 56-63.
 - 10 Gray N E, Alcazar Magana A, Lak P, Wright K M & Quinn J, *et al.*, *Centella asiatica*: phytochemistry and mechanisms of neuroprotection and cognitive enhancement, *Phytochem Rev*, 17 (1) (2018) 161-194.
 - 11 Wang S, Li L, Chen Y, Liu Q, Zhou S, *et al.*, *Houttuynia cordata* Thunb. alleviates inflammatory bowel disease by modulating intestinal microenvironment: a research review, *Front Immunol*, 14 (2023) 1306375, DOI: 10.3389/fimmu.2023.1306375.
 - 12 Kiewhuo K, Gogoi D, Mahanta H J, Rawal R K, Das D, *et al.*, North East India medicinal plants database (NEI-MPDB), *Comput Biol Chem*, 100 (2022) 107728.
 - 13 Soliman M M, El-Mohamady R S, Hegazy A M & Ahmed S A, The antioxidant and hepatoprotective activities of the ethanolic extract of *Tinospora cordifolia* leaves: in vitro and in vivo studies, *Egypt J Zool*, 79 (2023) 262157.
 - 14 Kumar P, Kale R K & Baquer N Z, Augmentation of hepatoprotective potential of *Aegle marmelos* in combination with piperine in carbon tetrachloride model in Wistar rats, *J Ayurveda Integr Med*, 9 (3) (2018) 204-211.
 - 15 Verma P K, Raina R, Sharma P, Sood S & Bhat M A, Attenuating potential of leaf extracts of *Alstonia scholaris* on altered glycemic index, lipid, hepatic and renal parameters in streptozotocin induced diabetic rats, *J Vet Pharmacol Toxicol*, 18 (2) (2019) 39-48.
 - 16 Arulmozhi S, Mazumder P M, Lohidasan S & Thakurdesai P, Antidiabetic and antihyperlipidemic activity of leaves of *Alstonia scholaris* Linn. R. Br., *Eur J Integr Med*, 2 (1) (2010) 23-32.
 - 17 Baro J, Das M, Goswami S, Choudhury M & Shom A, *et al.*, Evaluation of antiobesity potential of methanolic bark extract of *Alstonia scholaris* (L.) R.Br. in high fat diet induced obese rats: *in vitro* and *in vivo* studies, *Ann Phytomed*, 13 (1) (2024) 635-645.
 - 18 Bello I, Usman N S, Mahmud R & Asmawi M Z, Mechanisms underlying the antihypertensive effect of *Alstonia scholaris*, *J Ethnopharmacol*, 175 (2015) 422-431.
 - 19 Reddy M M, Dhas Devavaram J, Dhas J, Adeghate E & Starling Emerald B, Anti-hyperlipidemic effect of methanol bark extract of *Terminalia chebula* in male albino Wistar rats, *Pharm Biol*, 53 (8) (2015) 1133-1140.
 - 20 Murali Y K, Anand P, Tandon V, Singh R & Chandra R, *et al.*, Long-term effects of *Terminalia chebula* Retz. on hyperglycemia and associated hyperlipidemia, tissue glycogen content and in vitro release of insulin in streptozotocin induced diabetic rats, *Exp Clin Endocrinol Diabetes*, 115 (10) (2007) 641-646.
 - 21 Anjum K M, Sayyed U, Ullah A, Mughal M S & Yaqub A, *et al.*, Anti-hypercholesterolemic and anti-atherogenic activity of *Terminalia chebula* fruit in normal and cholesterol fed rabbits, *J Anim Plant Sci*, 24 (2014) 1618-1622.
 - 22 Kumar M, Hasan M, Lorenzo J M, Dhupal S & Nishad J, *et al.*, *Syzygium cumini* (L.) Skeels seed bioactives and its biological activities: a review, *Food Biosci*, 46 (2022). DOI:10.1016/j.fbio.2022.102109.
 - 23 Hameed F, Gupta N, Rahman R, Anjum N & Nayik G A, Jamun, In: *Antioxidants in Fruits: Properties and Health Benefits*; Nayik G A, Ed.; Springer: Cham, Switzerland, (2020) 615-637.
 - 24 Nair K N (Ed.), *The Genus Syzygium: Syzygium cumini and Other Underutilized Species*, 1st ed., Singapore: CRC Press, (2017).
 - 25 Parate M A, Bajpai N D & Walke D D, Role of *Syzygium cumini* (Jamun) in cosmetic, *Int J Sci Dev Res*, 4 (6) (2019) 193-201.
 - 26 Kannan A & Puraikalan Y D, Development and effects of jamun seed powder incorporated cookies, *Int J Sci Res*, 46 (1) (2015) 59-65.
 - 27 El-Shenawy S M A, Biological activities of *Eugenia jambolana* (family Myrtaceae) seeds. In: *Nuts and Seeds in Health and Disease Prevention*; Preedy V R, Watson R R & Patel V B, Eds.; Academic Press: London, UK, (2011) 685-690.
 - 28 Kasthuri S, Mandal P K, Pal U K, Elanchezhian N & Perumal S V, Effect of incorporation of drumstick leaf and jamun seed powder on sensory quality of functional chicken chips, *J Meat Sci*, 12 (2) (2017) 14-18.
 - 29 Jain A, Sharma S, Goyal M, Dubey S & Jain S, *et al.*, Anti-inflammatory activity of *Syzygium cumini* leaves, *Int J Phytomedicine*, 2 (2) (2010) 124-126.
 - 30 Pereira R J, das Graças Cardoso M, Andrade M A & Pereira R J, Hypoglycemic and antihyperlipidemic effects of *Syzygium cumini* (Lamarck) Skeels and *Syzygium paniculatum* (Gaertn.), *Rev Colomb Cienc Quím Farm*, 50 (3) (2021) 121-134.
 - 31 Hammam M A, El-Kadousy S A, El-Sayed S M & Rashed R M, Hypolipidemic effect of jamun *Syzygium cumini*, *Menoufia J Agric Biotechnol*, 4 (5) (2019) 61-72.
 - 32 Prema S, Sharma S, Kondrapu P, Kumre Y M & Salim M R, *et al.*, Evaluation of antioxidant, antidiabetic and antihyperlipidemic activity of *Syzygium cumini* seeds in diabetic zebrafish model, *Eur Chem Bull*, 12 (6) (2023) 2833-2839.
 - 33 Ulla A, Alam M A, Sikder B, Sumi F A & Rahman M M, *et al.*, Supplementation of *Syzygium cumini* seed powder prevented obesity, glucose intolerance, hyperlipidemia and oxidative stress in high carbohydrate high fat diet induced obese rats, *BMC Complement Altern Med*, 17 (2) (2017) 1-13.
 - 34 Nahid S, Mazumder K, Rahman Z, Islam S & Rashid M H, *et al.*, Cardio- and hepato-protective potential of methanolic extract of *Syzygium cumini* (L.) Skeels seeds: a diabetic rat model study, *Asian Pac J Trop Biomed*, 7 (2) (2017) 126-133.
 - 35 Jagetia G C, A review on the medicinal and pharmacological properties of traditional ethnomedicinal plant Sonapatha, *Oroxylum indicum*, *Sinusitis*, 5 (1) (2021) 71-89.
 - 36 Hengpratom T, Kupittayanant S, Churproong S & Eumkeb G, Lipid-lowering effect of *Oroxylum indicum* (L.) Kurz extract in hyperlipidemic mice, *Asian Pac J Trop Biomed*, 12 (4) (2022) 148-155.
 - 37 Hengpratom T, Ngernsoungnern A, Ngernsoungnern P, Lowe G M & Eumkeb G, Antiadipogenesis of *Oroxylum indicum* (L.) Kurz extract via PPAR γ 2 in 3T3-L1 adipocytes, *Evid Based Complement Altern Med*, (2020). DOI: 10.1155/2020/6720205.

- 38 Hengpratom T, Lowe G M, Thumanu K, Suknasang S, Tiomyom K, *et al.*, *Oroxylum indicum* (L.) Kurz extract inhibits adipogenesis and lipase activity in vitro, *BMC Complement Altern Med*, 18 (2018) 1-14.
- 39 Singh J, Singh A P & Singh A P, *Nyctanthes arbor-tristis*: A comprehensive review, *World J Curr Med Pharm Res*, (2021) 74-78.
- 40 Mousum S A, Ahmed S, Gawali B, Kwatra M & Ahmed, *et al.*, *Nyctanthes arbor-tristis* leaf extract ameliorates hyperlipidemia- and hyperglycemia-associated nephrotoxicity by improving antioxidant and anti-inflammatory status in high-fat diet-streptozotocin-induced diabetic rats, *Inflammopharmacology*, 26 (2018) 1415-1428.
- 41 Rangika B S, Dayananda P D & Peiris D C, Hypoglycemic and hypolipidemic activities of aqueous extract of flowers from *Nyctanthes arbor-tristis* L. in male mice, *BMC Complement Altern Med*, 15 (2015) 1-9.
- 42 Rahman M M, Rokeya B, Shahjahan M, Ahmed T & Roy S K, *et al.*, Hypoglycemic effect of *Nyctanthes arbor-tristis* Linn extracts in normal and streptozotocin-induced diabetic rats, *Malays J Pharm Sci*, 11 (1) (2013) 21-30.
- 43 Dalamu, Behera T K, Gaikwad A B, Saxena S & Bharadwaj C, *et al.*, Morphological and molecular analyses define the genetic diversity of Asian bitter gourd (*Momordica charantia* L.), *Aust J Crop Sci*, 6 (2) (2012) 261-267.
- 44 Schaefer H & Renner S S, A three-genome phylogeny of *Momordica* (Cucurbitaceae) suggests seven returns from dioecy to monoecy and recent long-distance dispersal to Asia, *Mol Phylogenet Evol*, 54 (2) (2010) 553-560.
- 45 de Oliveira M S, da Costa W A, Bezerra F W F, Araújo M E & Ferreira G C, *et al.*, Phytochemical profile and biological activities of *Momordica charantia* L. (Cucurbitaceae): a review, *Afr J Biotechnol*, 17 (27) (2018) 829-846.
- 46 Mada S B, Garba A, Mohammed H A, Muhammad A & Olagunju A, Antimicrobial activity and phytochemical screening of aqueous and ethanol extracts of *Momordica charantia* L. leaves, *J Med Plants Res*, 7 (10) (2013) 579-586.
- 47 Oragwa L N & Okwute S K, Phytochemicals, antimicrobial and free radical scavenging activities of *Momordica charantia* Linn (PalisotaReichb) seeds, *Afr J Pure Appl Chem*, 7 (12) (2013) 405-409.
- 48 Choi J S, Kim H Y, Seo W T, Lee J H & Cho K M, Roasting enhances antioxidant effect of bitter melon (*Momordica charantia* L.) increasing flavan-3-ol and phenolic acid contents, *Food Sci Biotechnol*, 21 (1) (2012) 19-26.
- 49 Doosti-Moghaddam M, Miri H R, Ghahghaei A, Hajinezhad M R & Saboori H, Effect of unripe fruit extract of *Momordica charantia* on total cholesterol, total triglyceride and blood lipoproteins in rats with hyperlipidemia, *Cell Mol Biomed Rep*, 2 (2) (2022) 74-86.
- 50 Zhang F, Zhang X, Yu J, Tan Y, Guo P, *et al.*, The gut microbiota confers the lipid-lowering effect of bitter melon (*Momordica charantia* L.) in high-fat diet induced hyperlipidemic mice, *Biomed Pharmacother*, 131 (2020) 110667.
- 51 Parra A L, Soto-del Valle R M, Ferrer J P, Hang P T N, Thi N, *et al.*, Antidiabetic, hypolipidemic, antioxidant and anti-inflammatory effects of *Momordica charantia* L. foliage extract, *J Pharm Pharmacogn*, 9 (4) (2021) 537-548.
- 52 Nandi S & Lyndem M L, *Clerodendrum viscosum*: traditional uses, pharmacological activities and phytochemical constituents, *Nat Prod Res*, 30 (2016) 497-506.
- 53 Uddin M J, Russo D, Haque M A, Çiçek S S, Sönnichsen F, D *et al.*, Bioactive abietane-type diterpenoid glycosides from leaves of *Clerodendrum infortunatum* (Lamiaceae), *Molecules*, 26 (14) (2021) 4121.
- 54 Swargiary A, Daimari A, Daimari M, Basumatary N & Narzary E, Phytochemicals, antioxidant and anthelmintic activity of selected traditional wild edible plants of lower Assam, *Indian J Pharmacol*, 48 (2016) 418-423.
- 55 Shendge A K, Basu T, Panja S, Chaudhuri D & Mandal N, An ellagic acid isolated from *Clerodendrum viscosum* leaves ameliorates iron-overload induced hepatotoxicity in Swiss albino mice through inhibition of oxidative stress and the apoptotic pathway, *Biomed Pharmacother*, 106 (2018) 454-465.
- 56 Uddin M J, Çiçek S S, Willer J, Shulha O, Abdalla M A, *et al.*, Phenylpropanoid and flavonoid glycosides from the leaves of *Clerodendrum infortunatum* (Lamiaceae), *Biochem Syst Ecol*, 92 (2020) 104131.
- 57 Martial D E, Dimitry M Y, Selestin S D & Nicolas N Y, Hypolipidemic and antioxidant activity of aqueous extract of *Clerodendrum thomsoniae* Linn. (Verbenaceae) leaves in albino rats, *Rattus norvegicus* (Muridae), *J Pharmacogn Phytochem*, 9 (1) (2020) 595-602.
- 58 Devi R & Sharma D, Hypolipidemic effect of different extracts of *Clerodendrum colebrookianum* Walp in normal and high-fat diet fed rats, *J Ethnopharmacol*, 90 (1) (2004) 63-68.
- 59 Zailani A H, Balogun E A & Adebayo J O, Hypolipidemic effect of *Clerodendrum violaceum* methanol leaf extract in mice, *Niger J Biochem Mol Biol*, 38 (1) (2023) 33-42.
- 60 Gohil K J, Patel J A & Gajjar A K, Pharmacological review on *Centella asiatica*: a potential herbal cure-all, *Indian J Pharm Sci*, 72(5) (2010) 546-556.
- 61 James J T & Dubery I A, Pentacyclic triterpenoids from the medicinal herb *Centella asiatica* (L.) Urban, *Molecules*, 14 (10) (2009) 3922-3941.
- 62 Panghal M, Arya V, Yadav S, Kumar S & Yadav J P, Medicinal plants used by Saperas community of Khetawas, Jhajjar District, Haryana, India, *J Ethnobiol Ethnomed*, 6 (1) (2010) 4-5.
- 63 Kumar A, Ilavarasan R, Jayachandran T & Decaraman M, Phytochemical investigation and antioxidant activities of *Zanthoxylum armatum* DC, *Int J Pharm Pharm Sci*, 3 (3) (2011) 277-280.