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Research Article

ANTIDEPRESSANT PLANTS AND THEIR USE BY THE *CHIRU* TRIBES OF MANIPUR, INDIA

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ABSTRACT: Depression is a potentially life-threatening mental disorder with serious socioeconomic consequences. It is very common and affects people of all age groups. Clinically, a class of synthetic drugs called antidepressants is used to treat depression but face limitations due to multiple side effects. Traditional healing practices followed by different communities worldwide use plants as a source of antidepressants. The Chiru tribe is one such community with rich ethnomedicinal knowledge having their unique ways to cure mental ailments. Ten plants [*Canthium parviflorum* Lam., *Centella asiatica* (L.) Urb., *Curcuma longa* L., *Holmskioldia sanguinea* Retz., *Magnolia champaca* (L.) Baill. ex Pierre, *Marsilea minuta* L., *Ocimum tenuiflorum* L., *Phyllanthus emblica* L., *Rotheca serrata* (L.) Steane & Mabb. and *Tagetes lucida* Cav.)] are used by Chiru tribes as potential antidepressants. Out of these, two plants *viz., Canthium parviflorum* Lam. and *Holmskioldia sanguinea* Retz. are recorded as antidepressants for the first time by the *Chiru* tribes. Two antidepressant plants (*Canthium parviflorum* Lam. and *Curcuma longa* L.) are used for treating memory loss. A total of 132 medicinal plants have been recorded in literature to contain phytochemicals with antidepressant activity worldwide. Changes in lifestyle and lack of properly documented data on medicinal plants pose a serious concern. The plant-based alternatives to treat depression will be much safer and cost-effective in the long run. The primitive knowledge could prove useful in developing potent antidepressants shortly. For this, further productive research and appropriate conservation methods for these plant species must be initiated.

Key words: Antidepressant plants, *Chiru* tribe, Ethnomedicinal knowledge, Phytochemicals.

INTRODUCTION

Use of herbs as some medicine was started at very ancient stage of human civilization and validation of documented uses of such plant medicines is a very important area of present-day research performed for their possible effective use in different forms (Pattanayak 2021a, Patel *et al.* 2022, Paul and Sujata 2022). The ethnic communities and the people living in remote places use such plant resources as medicine and the collection of information from them is still very important (Pradhan *et al.* 2021). The present study was conducted on a tribe of Monipur, India to get information related to the use of plants as some medicine for anxiety, mental disorder, and alike problems.

Among mental disorders, depression is one of the most commonly known psychological disorders affecting thoughts, feelings, behavior, and sense of well-being in a person (Pannu *et al.* 2021). With rising cases of mental illness and suicidal tendencies being part of it, it presents a significant socioeconomic burden (Pannu *et al.* 2021, Bondy *et al.* 2002) It is so common that it is expected to be the primitive cause of various other diseases by 2030, as per WHO report (Pannu *et al.* 2021). Clinically, synthetic drugs are used to treat depression but they have several limitations like multiple side effects, slow onset of action, poor remission and response rates, and drug-drug and dietary interactions (Bondy *et al.* 2002, Khushboo *et al.* 2017, Pardhe *et al.* 2020). Several emerging pieces of research have shown an association between dietary measures and the risk of depression pointing to the use of nutraceuticals as antidepressants (Pannu *et al.* 2021, Hritcu *et al.* 2017, Martins 2018).

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Several phytochemicals in plants have been studied for antidepressant properties. The Indian traditional system of medicine AYUSH explores a wide variety of medicinal and aromatic plants to treat various ailments with minimum side effects and low costs. The agroclimatic conditions of Manipur sustain the diversity of medicinal plants in the region. Since time immemorial, different ethnic groups inhabiting different regions of the state have followed traditional healthcare practices with their rich knowledge of medicinal plants. These age-old home remedies and associated medico-religious practices are often cheap, safe, long-time tested, and based on local resources and strength. The *Chiru* tribe of Manipur too has a repository of knowledge on medicinal plants, amongst which is their indigenous knowledge to cure mental illness. The WHO has even started documenting and listing popular tribal remedies used to cure ailments. The primitive knowledge could prove useful to discover chemically useful compounds which could be prototype compounds to treat psychological disorders including several forms of depression. There is a future need for pre-clinical and clinical trials to prove their efficacy as anti-depressants and further development of therapeutically useful drugs.

The *Chiru* tribe is one of the *Kuki* Scheduled tribe groups of Manipur inhabiting 3 districts and 13 villages, *viz.* one in Churachandpur district (Charoi Khullen), two in Tamenglong district (Lamdangmei and Dolang) and ten in Senapati district (Dolang Khunou, Nugsai, Bungte Khullen, Lower Bungte, Sadu *Chiru*, Thangjing *Chiru*, Kangchup *Chiru*, Waithou, Uran *Chiru* and Chawang Chiru), of Manipur in different geographical regions. The traditional knowledge of *Chirus* is not documented properly yet. No proper investigation has been done so far to explore the traditional knowledge of antidepressants of the *Chiru* tribes. Traditional knowledge faces the risk of disappearing before documentation due to changes in livelihood patterns and environmental degradation. Hence, the present study has been carried out.

METHODS

Five villages, *viz.*, Bungte Khullen, Kangchup *Chiru*, Lower Bungte Khullen, Sadu *Chiru*, and Uran *Chiru* in the Senapati district of Manipur were chosen as the study area. A total of 20 field-cum survey tours were conducted throughout the five villages. The *Chiru* tribe is most populated in these villages. Prior Informed Consent (PIC) was taken from the headmen of the villages and the villagers after explaining the purpose of the study. With regards to sharing of information on traditional Health Practices, an agreement was made with due compliance to the norms of the North Eastern Institute of Folk Medicine (NEIFM), Department of AYUSH. The informants were interviewed with queries including the description of the health condition, diagnostic features used by the healer, details of treatment followed, the local name of the plant, the plant part used, preparation of medicine and dosage (in terms of quantity and frequency of intake) recommended to cure the ailment. In this way, proper data was collected using Participatory Rural Appraisal (PRA) and interview-questionnaire methods (Martin 2007). Meetings were held in the presence of headmen and villagers to share the knowledge of the traditional healthcare practitioners.

With the help of the *Chiru* tribe, a direct visit was made to the nearby forest to identify and collect the medicinal plants used as antidepressants. Further, the collected plant species were identified with the help of regional floras in consultation with authentic herbarium at Botanical Survey of India, Kolkata and Botanical Survey of India, Eastern Regional Centre, Shillong, and herbarium at DM College of Science, Imphal, Manipur. Also, herbarium specimens were prepared and deposited in the herbarium at DM College of Science, Dhanamanjuri University Imphal, Manipur, India.

RESULTS AND DISCUSSION

A literature review resulted in the documentation of around 130 antidepressant plants (Table 1). Altogether 10 plant species have been used by *Chiru* tribes for treating mental disorders, out of which two are recorded for the first time (Marked by *).

The uses of the plants with their dosage are described below:

1. **Canthium parviflorum* Lam. (Local name-*Lam-heibi*, Family- Rubiaceae):

When the leaf extract of the plant (dosage- 1 teaspoon) is given daily to the patient for about 2-3 months, it reduces loss of memory.

2. *Centella asiatica* (L.) Urb. (Local name- *Peruk*, Family- Apiaceae):

Consumption of fresh juice of the whole plant (mixed with water) for 2-3 weeks reduces mental disorders.

3. *Curcuma longa* L. (Local name- *Yaingang*, Family- Zingiberaceae):

When aqueous extract of the plant rhizome is administered orally 2 times daily for 2-3 weeks, it increases memory and reduces depression.

4. **Holmskiodia sanguinea* Retz. (Local name- *Kharamleishok*, Family- Verbenaceae):

Boiled extract of the young shoots is used as an antidepressant.

5. *Magnolia champaca* (L.) Baill. ex Pierre (Local name- *Leihao*, Family- Magnoliaceae):

The bark of the tree with ginger rhizome when ground and mixed with water is administered to the patient for reducing mental disorder.

6. *Marsilea minuta* L. (Local name- *Ishing Yenshang*, Family- Marsileaceae):

Decoction of the whole plant mixed with tea is consumed for recovering from mental disorders.

7. *Ocimum tenuiflorum* L. (Local name- *Tulsi*, Family- Lamiaceae):

Boiled extract of the leaves and inflorescence of the plant is given daily for mental disorders until recovery.

8. *Phyllanthus emblica* L. (Local name- *Heigru*, Family- Phyllanthaceae):

Fresh juice of the fruit mixed with water is used to treat psychiatric disorders.

9. *Rotheca serrata* (L.) Steane & Mabb. (Local name- *Moirang Khanamba*, Family-Verbenaceae)

Fresh root and leaf of the plant when crushed with water is used to reduce mental disorder.

10. *Tagetes lucida* Cav. (Local name- *Sanalei thondabi*, Family- Asteraceae):

Aqueous extract of the leaves is used as an antidepressant.

Out of these ten antidepressant plants, two plants (*Canthium parviflorum* Lam. and *Curcuma longa* L.) are used for treating memory loss. Out of the ten species of plants, eight plants, *viz. Centella asiatica* (L.) Urb., *Curcuma longa* L., *Magnolia champaca* (L.) Baill. Ex Pierre., *Marsilea minuta* L., *Ocimum tenuiflorum* L., *Phyllanthus emblica* L., *Rotheca serrata* (L.) Steane & Mabb. and *Tagetes lucida* Cav. are also reported to have antidepressant properties by earlier studies. Antidepressant plants, *Canthium parviflorum* Lam. (Rubiaceae) used to reduce loss of memory, and *Holmskioldia sanguinea* Retz. (Verbenaceae) used to reduce mental disorders are reported for the first time by the *Chiru* tribe.

The plant parts used for treatment included the whole plant, leaves, fruits, roots, rhizome, the bark of the tree, and inflorescence, leaves being mostly used. The *Chiru* tribes collected the medicinal plants from their immediate environment or nearby forests and prepared their traditional medicines afresh as and when required. They do not have any well-recognized mechanism to preserve and store their traditional medicines. They have strong confidence in their traditional medicines though they could not explain how the plants are effective in treating mental ailments. They also ascertain that the plant extracts in the recommended doses pose no established side effects throughout their age-old practice.

It is observed that in most cases, they use the plant parts directly after use, without any processing or modification. It is a very important aspect of the use of plants for medicinal purposes, as validation of reported uses of plant parts is generally not performed at that stage. Different diluent extracts of the dried plant parts are generally evaluated for their reported efficacies, though it has been argued that the succulent plant parts contain the highest number and quantity of phytoconstituents than any other stage (Pattanayak 2016, 2020). Such plant medicines traditionally used in their succulent condition can be used in the bio-encapsulated form directly after proper validation of efficacy and calculation of doses (Pattanayak 2021b, 2022).

The earlier reported antidepressant plants have been found to contain phytochemicals with antidepressant activity which include alkaloids, flavonoids, glycosides, phenolics, steroidal saponins, essential oils, resins, tannins, phenols, triterpenoids, sesquiterpenes. The extract of plant parts like roots, leaves, and whole plants when administered in different doses in mice for behavioral experiments, exhibited antidepressant impact (Rahman *et al.* 2017, Martins 2018, de Souza *et al.* 2022). The mechanism of action of most antidepressant plants involves increasing levels of neurotransmitters like Serotonin, Norepinephrine, or Dopamine in the brain, interaction with their receptor systems and corresponding transporters; or through inhibition of Monoamine oxidase enzymes which break down the neurotransmitters by oxidative deamination thereby increasing the concentration of neurotransmitters in the brain (Bondy 2002, Martins 2018, Khushboo *et al.* 2017).

Table 1. Different antidepressant plants recorded in the literature.

(Abbreviations used are - SERT: Serotonin Transporter; NE: Norepinephrine; NET: Norepinephrine Transporter; DAT: Dopamine Transporter; MAO: Monoamine Oxidase; MAO-A: Monoamine Oxidase A; MAO-B: Monoamine Oxidase B; GABA: Gamma-Aminobutyric Acid; 5-HT: 5-hydroxytryptamine; CNS: Central Nervous System; cAMP: Cyclic Adenosine Monophosphate; PPAR gamma: Peroxysome proliferator-activated receptor gamma).

Scientific name [Family]	Nutraceutical compound reported	Effects on	Reference
Actaea racemosa L. [Ranunculaceae]	--	Partial agonist of serotonin receptor subtypes	Khushboo *et al.* 2017, Burdette *et al.* 2003
Acorus tatarinowii Schott. [Araceae]	--	Antidepressant activity	Li *et al.* 2001, 2004
Aegle marmelos (L.) Correa [Rutaceae]	--	Increase monoamines level at post-synaptic site; anxiolytic and antidepressant activity	Rahman *et al.* 2017
Agapanthus campanulatus F.M. Leight [Agapanthaceae]	Flavonoids	Inhibition of SERT, NET and DAT	Martins 2018, Pederson *et al.* 2008
Akebia quinata (Houtt.) Decne [Lardizabalaceae]	Hederagenin	Inhibition of SERT, NET and DAT	Martins 2018
Alafia multifora (Stapf) Stapf [Apocynaceae]	Flavonoids, tannins, alkaloids, phenols	Antioxidant, effect on CNS, antidepressant activity	Rahman *et al.* 2017
Albizzia julibrissin Durazz [Fabaceae]	Saponins	Activation of the serotonergic system	Martins 2018, Kim *et al.* 2007
Allium cepa L. [Amaryllidaceae]	Quercitin glycosides (Flavonoids)	Inhibitor of Monoamine oxidase (MAO)	Martins 2018, Sakakibara *et al.* 2008
Allium macrostemon Bunge [Amaryllidaceae]	--	Behavioral despair	Khushboo *et al.* 2017
Allium sativum L. [Amaryllidaceae]	--	Behavioral despair	Khushboo *et al.* 2017
Aloysia polystachya (Griseb.) Moldenke [Verbenaceae]	--	Antidepressant activity	Khushboo *et al.* 2017, Martins 2018
Andrographis paniculata (Burm.f.) Nees [Acanthaceae]	--	Antidepressant activity	Rahman *et al.* 2017
Anemarrhena asphodeloides Bunge [Asparagaceae]	Sarsasapogenin	Inhibition of MAO-A and MAO-B activities	Martins 2018 Ren *et al.* 2006
Aniba riparia Nees (Mez) [Lauraceae]	Riparin II, Riparin III	Interaction with serotonergic, noradrenergic and dopaminergic receptor systems	Teixeira *et al.* 2013, Sousa *et al.* 2004
Apocynum venetum Linn. [Apocynaceae]	Hyperoside, Isoquercitrin	Increase in NE and Dopamine levels in the hippocampus	Martins 2018, Khushboo *et al.* 2017
Areca catechu L. [Arecaceae]	Saponins	Increase in 5-HT and NE levels in the hippocampus	Dar *et al.* 1997, 2000
Artemisia absinthium L. [Asteraceae]	--	Antidepressant activity	Ahangar *et al.* 2011, Martins 2018
Asparagus racemosus Willd. [Asparagaceae]	Steroidal saponins, essential oils, resins, tannins, glycosides	Interaction with Serotonergic, Noradrenergic, Dopaminergic, GAB Aergic receptor systems	Dhingra and kumar 2007, Singh *et al.* 2009
Bacopa monnieri (L.) Pennell [Plantaginaceae]	--	Inhibition of MAO-A and MAO-B activities	Girish *et al.* 2016, Martins 2018

Scientific name [Family]	Nutraceutical compound reported	Effects on	Reference
Basella alba L. [Basellaceae]	Flavonoids, saponins, phenolic and tannins	Antidepressant activity	Rahman *et al.* 2017
Berberis aristata DC. [Berberidaceae]	Berberine (Alkaloid)	CNS, Inhibit Monoamine oxidase	Khushboo *et al.* 2017
Benincasa hispida (Thunb.) Cogn. [Cucurbitaceae]	--	Interaction with Serotonergic, Noradrenergic, Dopaminergic and GAB Aergic receptor systems	Dhingra *et al.* 2012a, Martins 2018
Boophone disticha (L.f.) [Amaryllidaceae]	Buphanidrine, Buphanamine (Alkaloids)	Inhibition of SERT, NET and DAT	Martins 2018, Pedersen *et al.* 2008
Bupleurum falcatum L. [Apiaceae]	--	Psycho stimulant effect	Khushboo *et al.* 2017
Camellia sinensis (L.) Kuntze [Theaceae]	Theanine	Antidepressant activity	Marmat *et al.* 2013, Singal *et al.* 2006
Canavalia brasiliensis Benth. [Leguminosae]	Lectins	Interaction with serotonergic, noradrenergic and dopaminergic receptor systems	Martins 2018, Barauna *et al.* 2006
Cannabis sativa L. [Cannabaceae]	Cannabinoids	Enhanced efflux of Noradrenaline, 5- HT and Dopamine levels	de Souza *et al.* 2022
Carthamus tinctorius L. [Asteraceae]	--	Antidepressant activity	Martins 2018, Maleki *et al.* 2013
Casimiroa edulis La Llave [Rutaceae]	Hydroalcoholic extract	Antidepressant activity	Martins 2018, Mora *et al.* 2005
Cayratia japonica (Thunb.) Gagnep. [Vitaceae]	Flavonoids	MAO inhibition	Martins 2018, Han *et al.* 2007
#*Centella asiatica* (L.) [Apiaceae]	Triterpines, saponins, flavonoids, phenolic acids	Increase levels of Monoamine neurotransmitters.	Pardhe *et al.* 2020, Rahman *et al.* 2017
Cissampelos sympodialis Eichl. [Menispermaceae]	Total tertiary alkaloids	Antidepressant activity	Martins 2018, Netto *et al.* 2008
Citrus maxima (Burm.) Merr. [Rutaceae]	--	Antidepressant activity	Rahman *et al.* 2017
Citrus paradisi Macfad. [Rutaceae]	--	Antidepressant activity	Martins 2018, Gupta *et al.* 2010.
Clitoria ternatea Linn. [Fabaceae]	--	Cognitive behaviour, anxiety, depression, stress	Martins 2018, Parvathi *et al.* 2013
Coleus forskohlii Briq. [Lamiaceae]	Forskolin	Increasing brain cAMP availability	Maeda *et al.* 1997, Martins 2018
Convolvulus pluricaulis Choisy. [Convulvulaceae]	--	Restores brain monoamines	Dhingra *et al.* 2007, Martins 2018
Crocus sativus L. [Iridaceae]	Ethanolic extract, Kaempferol, Safranal,	Induces dopamine and glutamate release in the brain	Hosseinzadeh *et al.* 2007, Martins 2018
Cucurbito pepo L. [Cucurbitaceae]	Flavonoids, glycosides	Antioxidant and Antidepressant activity (protects brain feature from CNS disturbance)	Pardhe *et al.* 2020
#*Curcuma longa* L. [Zingiberaceae]	Volatile oils-turmerone, curcuminoids, curcumin, sesquiterpenes	Curcumin inhibits MAO enzymes; expands serotonin, noradrenalin and dopamine level in brain	Pardhe *et al.* 2020, Martins 2018

Scientific name [Family]	Nutraceutical compound reported	Effects on	Reference
Dracocephalum moldavica L. [Lamiaceae]	Triterpenoids, steroids, flavonoids, alkaloids, phenols, coumarins	Antidepressant activity	Pardhe *et al.* 2020
Echium amoenum Fisch. & C.A. Mey [Boraginaceae]	--	Antidepressant activity	Martins 2018, Sayyah *et al.* 2009
Eleutherococcus senticosus (Rupr. & Maxim) Maxim. [Araliaceae]	--	Antidepressant activity	Martins 2018, Kimura *et al.* 2004
Epimedium brevicornum Maxim. [Berberidaceae]	Icariin (Flavonoid)	Antidepressant activity	Martins, 2018, Pan *et al.* 2007
Galphimia glauca Cav. [Malpighiaceae]	--	Antidepressant activity	Martins 2018 Ruiz *et al.* 2006
Gastrodia elata Blume [Orchidaceae]	--	Regulates both serotonergic and dopaminergic systems	Martins 2018, Hong *et al.* 2013
Gentiana kochiana E.P. Perrier & Songeon [Gentianaceae]	Xanthones (Gentiacaulein)	Inhibition of MAO-A activity	Martins 2018, Tomic *et al.* 2005
Ginkgo biloba L. [Ginkgoaceae]	--	Antistress, antidepressant activity	Khushboo *et al.* 2017
Glycyrrhiza glabra L. [Fabaceae]	Triterpenoidal saponins, flavonoids, alkaloids, phenolic acids	Inhibition of MAO-A activity, increase in brain Norepinephrine and Dopamine levels	Pardhe *et al.* 2020, Martins 2018
Glycyrrhiza uralensis Fisch. Ex DC. [Fabaceae]	Liquiritin, Isoliquiritin (Flavonoids)	Increase 5-HT and NE in the hippocampus, hypothalamus and cortex	Fan *et al.* 2012, Zhaoa *et al.* 2008
Gossypium herbaceum L. [Malvaceae]	--	Activates adenyl cyclase-cAMP pathway in signal transduction system	Martins 2018, Khaleequr *et al.* 2012
Hippeastrum vittatum (L' Her) [Amaryllidaceae]	Montanine (Alkaloid)	Neurological disorders and Neurodegenerative disease	Da Silva *et al.* 2006, Martins 2018
Humulus lupulus L. [Cannabaceae]	Alpha-acids	Antidepressant activity	Martins 2018, Zanoli *et al.* 2005
Hypericum canariense L. [Hypericaceae]	Methanolic Extract	Neuro pharmacological effect, Anti-cholinergic and sedative properties	Mateo *et al.* 2005, Khushboo *et al.*2017
Hypericum glandulosum Aiton [Hypericaceae]	Methanolic Extract	Neuro pharmacological effect, Anti-cholinergic and sedative properties	Mateo *et al.* 2005, Khushboo *et al.*2017
Hypericum caprifoliatum Cham. & Schltdl. [Hypericaceae]	Phloroglucinol derivatives	Monoamine uptake inhibition	Viana *et al.* 2005, Martins 2018
Hypericum perforatum L. and *Hypericum maculatum* Crantz. [Hypericaceae]	Hyperforin	Antidepressant activity	Gambarana *et al.* 2001, Rahman *et al.* 2017
Hypericum reflexum L.f. [Hypericaceae]	--	Effect on CNS, Antidepressant activity	Mateo *et al.* 2001
Ilex pubescens Hook. & Arn. [Aquifoliaceae]	--	Antidepressant	Xu *et al.* 2004
Inula japonica Thunb. [Asteraceae]	Japonicins (Flavonol)	Antidepressant activity	Martins 2018, Yu *et al.* 2006

Scientific name [Family]	**Nutraceutical compound reported**	**Effects on**	**Reference**
Kaempferia parviflora Wall. ex Baker [Zingiberaceae]	--	Psychiatric illness	Martins 2018, Hawiset *et al.* 2011
Kielmeyera coriacea Mart. Et Zucc. [Calophyllaceae]	Xanthones	Monoamine uptake inhibition	Martins 2006, Goulart *et al.* 2007
Lafoensia pacari A. St. Hil. [Lythraceae]	--	Effect on CNS, Antidepressant activity	Martins 2018, Galdino *et al.* 2009
Lavandula angustifolia Mill. [Lamiaceae]	Linalool, Linalyl acetate	Antidepressant activity	Kageyama *et al.* 2012, Hritcu *et al.* 2012
Lepidium meyenii Walp. [Brassicaceae]	--	Antidepressant activity	Martins 2018, Rubio *et al.* 2006
#*Magnolia champaca* (L.) Baill. ex Pierre [Magnoliaceae]	Bioactive compounds	Antidepressant, anxiolytic properties	Pushpa *et al.* 2022
Magnolia officinalis Rehder & Wilson [Magnoliaceae]	Magnolol, Honokiol	GABA modulators, agonist to PPAR gamma	Nakazawa *et al.* 2003a, Xu *et al.* 2008
Malus domestica Borkh. [Rosaceae]	Flavonoids, phenolic compounds	Antioxidant rich, involves in growth and production of neurotransmitter Acetylcholine	Pardhe *et al.* 2020
#*Marsilea minuta* Linn. [Marsileaceae]	Ethanolic extract, Marsiline (sedative)	Antidepressant activity	Bhattamisra *et al.* 2008
Melissa officinalis L. [Lamiaceae]	--	Similar activity like antidepressant drug imipramine, strengthens memory, relieves stress-induced headache	Taiwo *et al.* 2012
Mimosa pudica L. [Fabaceae]	--	Act as Tricyclic Antidepressants	Molina *et al.* 1999
Mitragyna speciosa (Korth.) Havil. [Rubiaceae]	Mitragynine	Antidepressant activity	Martins 2018 Idayu *et al.* 2011
Momordica charantia L. [Cucurbitaceae]	Alkaloids, flavonoids, glycosides, steroids, phenols	Dependent on serotonergic, noradrenergic, dopaminergic receptor systems	Ishola *et al.* 2013
Mondia whitei (Hook.f.) Skeels [Apocynaceae]	--	Affinity for SERT	Pedersen *et al.* 2008
Morinda officinalis L. [Rubiaceae]	Succinic acid, Nystose, 1F- fructo-furanosylnystose, Inulin-type hexasaccharide, heptasaccharide	Binds selectively to Serotonin receptor	Zhang *et al.* 2002
Morus alba L. [Moraceae]	--	Antidepressant activity	Sattayasai *et al.* 2008, Anand *et al.* 2011
Myristica fragrans Houtt. [Myristicaceae]	--	Antidepressant activity	Dhingra *et al.* 2006, Moinuddin et al 2012
Nardostachys jatamansi (D. Don) DC. [Caprifoliaceae]	--	Inhibition of MAO activity, Interaction with GABA receptors	Deepa *et al.* 2013, Dhingra and Goyal 2008a
Nelumbo nucifera Gaertn. [Nelumbonaceae]	Neferine (Alkaloid)	Serotonin receptor agonist	Martins 2018, Dhanarasu and Al Hazimi 2013

Scientific name [Family]	Nutraceutical compound reported	Effects on	Reference
#*Ocimum tenuiflorum* L. [Lamiaceae]	Phenolic compounds	Interaction with dopaminergic system	Chatterjee *et al.* 2011, Pemminati *et al.* 2010
Paeonia lactiflora Pall. [Paeoniaceae]	Paeoniflorin, Albiflorin (Glycosides)	Effect on Central Monoaminergic Neurotransmitter system, Inhibition of MAO activity	Mao *et al.* 2008 Rahman *et al.* 2017
Passiflora foetida L. [Passifloraceae]	Flavonoids, hydrocyanic acid and Harman alkaloids	Effect on CNS disorders, Antidepressant activity	
Paullinia cupana Kunth [Sapindaceae]	Methylxanthines and possibly others	Antidepressant activity	Campos *et al.* 2005, Martins 2018
Perilla frutescens (L.) Britt [Lamiaceae]	Apigenin, 2,4,5-trimethoxycinnamic acid, Rosemarinic acid	Via dopaminergic mechanism, Cell proliferation in dentate gyrus	Ito *et al.* 2008, Nakazawa *et al.* 2003b
#*Phyllanthus emblica* L. [Phyllanthaceae]	Tannins, gallic acid, alkaloids, phenols	Inhibition of MAO-A activity	Dhingra *et al.* 2012b, Pemminati *et al.* 2010
Piper laetispicum C. DC [Piperaceae]	Laetispicine, Leatispiamide A (Alkaloids)	Effect on pain and depression, Antinociceptive properties	Xie *et al.* 2011, Pan *et al.* 2005
Piper longum L. [Piperaceae]	Ethanolic extract, Piperine, Methylpiperate	Inhibition of MAO-A and MAO-B activities	Martins 2018, Lee *et al.* 2005
Piper methysiticum Forst. [Piperaceae]	Pyrones, Desmethoxy yangonin	Inhibition of MAO-B activity, via Dopaminergic mechanism	Martins 2018, Baum *et al.* 1998
Piper tuberculatum Jacq. [Piperaceae]	Piplartine (Alkaloid)	Anxiolytic and antidepressant activities	Felipe *et al.* 2007
Plantago asiatica L. [Plantaginaceae]	--	Antidepressant	Xu *et al.* 2004
Polygala sabulosa A.W. Benn. [Polygalaceae]	Scopoletin, A coumarin	Serotonergic, Dopaminergic and Noradrenergic activities	Khushboo *et al.* 2017
Polygala tenuifolia Willd. [Polygalaceae]	Polygalatenosides A and B	Norepinephrine reuptake inhibitors, Inhibition of MAO-A and MAO-B activities	Cheng *et al.* 2006, Hu *et al.* 2011
Pontederia crassipes Mart. [Pontederiaceae]	Flavonoids, alkaloids, tannins, saponins	Nervine tonic, stimulant, antioxidant, antidepressant	Rahman *et al.* 2017
Protium heptaphyllum (Aubl.) Marchand [Burseraceae]	Alpha- and Beta-amyrin (Triterpenes)	Antidepressant activity	Aragao *et al.* 2006, Martins 2018
Psoralea corylifolia L. [Fabaceae]	Psoralen, Psoralidin (Furocoumarins)	Inhibition of MAO-A and MAO-B activities	Martins 2018, Xu *et al.* 2008
Ptychopetalum olacoides Benth. [Olacaceae]	--	Via D1 dopamine and β-noradrenergic receptor systems	Siqueira *et al.* 2004
Pueraria montana (Lour.) Merr. var. lobata (Willd.) [Fabaceae]	--	Antidepressant activity	Yana *et al.* 2004, Martins 2018
Rhazya stricta Decne. [Apocynaceae]	--	Effect on Monoamine Oxidase inhibition	Ali *et al.* 1998, Khushboo *et al.* 2017
Rhodiola rosea L. [Crassulaceae]	Rosaridin	Via Serotonergic system, Inhibition of MAO-A and MAO-B activities	Mannucci *et al.* 2012

Scientific name [Family]	**Nutraceutical compound reported**	**Effects on**	**Reference**
Rosa damascena Herrm. [Rosaceae]	--	Antidepressant activity	Martins 2018, Rahman *et al.* 2017
Rosmarinus officinalis L. [Lamiaceae]	Ursolic acid (Triterpenoid), Carnosol, Betulinic acid	Interacts with Monoaminergic system; improves dopaminergic, serotonergic, noradrenergic and cholinergic features.	Machado *et al.* 2013, Mukhtar *et al.* 2013
#*Rotheca serrata* (L.) Steane & Mabb. [Verbenaceae]	Flavonoids	Increases levels of norepinephrine and 5-hydroxytryptamine.	Vazhayil *et al.* 2017
Roystonea regia (Kunth) O.F.Cook [Arecaceae]	Fatty acids	Antidepressant activity	Carbajal *et al.* 2009, Martins 2018
Salvia divinorum Epling & Jativa [Lamiaceae]	Salvinorin A	Antidepressant activity	Braida *et al.* 2009, Martins 2018
Salvia elegans Vahl. [Lamiaceae]	--	Antidepressant activity	Khushboo *et al.* 2017
Schinus molle L. [Anacardiaceae]	Rutin (Flavonoid)	Dependent on Serotonergic, Noradrenergic and Dopaminergic receptors.	Machado *et al.* 2007, Khushboo *et al.* 2017
Schizandra chinensis (Turcz.) Baill. [Schisandraceae]	Flavonoids	Interacts with noradrenergic receptors	Wang *et al.* 2022
Scrophularia ningpoensis Hemsl. [Scrophulariaceae]	--	Antidepressant activity	Xu *et al.* 2004
Securidaca longepedunculata Fresen [Polygalaceae]	--	Antidepressant activity	Martins 2018, Adebiyi *et al.* 2006
Selaginella bryopteris L. [Sellaginellaceae]	--	Antidepressant activity	Rahman *et al.* 2017
Senna occidentalis (L.) Link [Fabaceae]	--	Antianxiety and antidepressant activity	Rahman *et al.* 2017
Senna spectabilis (D.C.) H.S. Irwin & Barneby [Fabaceae]	Iso-6-spectaline	Antidepressant activity	Silva *et al.* 2011, Martins 2018
Siphocamphylus verticillatus (Cham.) G. Don [Campanulaceae]	--	Interaction with Adrenergic, Dopaminergic, Glutamatergic and Serotonergic system	Rodrigues *et al.*2002, Khushboo *et al.* 2017
Sonchus oleraceus L. [Asteraceae]	--	Antidepressant activity	Vilela *et al.* 2010, Martins 2018
Sphaeranthus indicus Gaertn. [Asteraceae]	--	Anxiety, depression and convulsions	Galani and Patel 2010
Tabebuia avellanedae Lorentz ex Griseb. [Bignoniaceae]	--	Antidepressant activity	Freitas *et al.* 2013
#*Tagetes lucida* Cav. [Asteraceae]	--	Inhibits synaptosomal uptake of Serotonin, Noradrenaline and Dopamine	Gabriela *et al.* 2012
Tecoma stans (L.) Juss.ex Kunth [Bignoniaceae]	Flavonoids	Antidepressant activity	Rahman *et al.* 2017
Thymus fallax Fisch. & C.A. Mey. [Lamiaceae]	--	Antidepressant activity	Martins 2018, Semnani *et al.* 2007
Thymus kotschyanus Boiss. & Hohen. [Lamiaceae]	--	Antidepressant activity	Martins 2018, Semnani *et al.* 2007

Scientific name [Family]	Nutraceutical compound reported	Effects on	Reference
Thymus pubescens Boiss. & Kotschy ex Celak. [Lamiaceae]	--	Antidepressant activity	Martins 2018, Semnani *et al.* 2007
Tinospora cordifolia (Willd.) Hook.f. & Thomson [Menispermaceae]	--	Inhibits Mao-A and Mao-B activities, Interaction with serotonergic, noradrenergic and dopaminergic receptor systems	Dhingra and Goyel 2008b, Martins 2018
Trichilia catigua A. Juss. [Meliaceae]	--	Inhibition of dopamine and serotonin uptake	Martins 2018, Campos *et al.* 2005
Trigonella foneum-graceum L. [Fabaceae]	4-hydroxyisoleucine	Via the serotonergic system	Martins 2018, Gaur *et al.* 2012
Urtica dioica L. [Urticaceae]	Roots and leaves extract	Antidepressant activity like classical antidepressants fluoxetine and haloperidol	Rahman *et al.* 2017
Valeriana fauriei Briq. [Caprifoliaceae]	Sesquiterpenes	Antidepressant activity	Liu *et al.* 2012, Oshima *et al.* 1995
Valeriana officinalis L. [Caprifoliaceae]	--	Mild sleep disorders and Nervous tension, Antidepressant activity	Hattesohl *et al.* 2008; Sakamoto *et al.* 1992, Martins 2018
Valeriana wallichii DC. [Valerianaceae]	--	Nitric oxide inhibition	Subhan *et al.* 2010, Sah *et al.* 2011
Vitis vinifera L. [Vitaceae]	--	Antidepressant activity	Martins 2018, Sreemantula *et al.* 2005
Withania somnifera (L.) Dunal [Solanaceae]	Bioactive glycowithanolides	Anxiolytic and antidepressant action	Bhattacharya *et al.* 2020
Xysmalobium undulatum (L.) W.T. Aiton [Apocynaceae]	--	Affinity for SERT	Martins 2018, Pedersen *et al.* 2008
Zingiber officinale Roscoe [Zingiberaceae]	Gingerol, Shogoal	Binding to Serotonin receptor	Martins 2018

Plants are identified in the present study for alike activities.
$ The sign (--) in the table indicates no known phytochemicals responsible for antidepressant activity.

CONCLUSION

People living in remote and hilly places like the Chiru tribe depend on their surrounding forests and vegetation for their livelihood- food, fodder, and medicines. The majority of the population depends on traditional knowledge of medicines as modern healthcare facilities are not easily accessible in these remote areas. Besides, ethnomedicinal plants are easily available, reliable, cost-effective, and safe with no undesired side-effects. Also, there is an increasing trend in the use of herbal remedies and plant-based products to treat depression and related mental disorders worldwide because of their great efficacy. People also have stronger trust in their age-old practice which has been passed over generations.

Nutraceuticals in plant-based food have neuroprotective functions and can be prototypes for antidepressant drugs in the future. In this direction, the present finding will form baseline data for developing a standard protocol for the production of herbal antidepressant drugs. The mechanism of understanding many antidepressant plants still needs to be explored to fill the gaps in depression research and to develop better treatment measures. It is therefore crucial to document the ethnomedicinal knowledge as changes in lifestyle and occupation raise a serious concern for the indigenous knowledge, if not documented properly. Also, increasing encroachment of the forests and environmental degradation either due to natural or man-made calamities pose a serious threat to the medicinal plant diversity. Amidst the rising trend of excessive harvesting of medicinal plants to develop herbal remedies and drugs, it is vital to determine the availability status of these plants and initiate appropriate conservation efforts. It is the need of the hour to conserve selected medicinal plants sustainably for further productive research work.

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