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A COMPREHENSIVE REVIEW ON THE ASIAN PLANTS UTILISED IN STRESS-RELATED DISORDERS

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ABSTRACT

Asian countries are reckoned for their vast plant-rich regions with a long history of traditional medicine that spans approximately 6,500 years. Asian people inherit knowledge from their ancestors about the use of the surrounding plants to treat many infirmities and diseases, including stress-related disorders such as anxiety and depression. As such, this review provides an ethnopharmacological and phytochemical overview of Asian plants with high antistress potential. This review serves as a baseline for the discovery of new and potent antidepressants. Articles from 2007 to 2020 were reviewed extensively using Google Scholar and Scopus search engines based on the following keywords: 'antidepressant AND Asia AND plants', 'anxiolytic AND Asia AND plants', as well as 'antistress AND Asia AND plants'. In total, 71 Asian plants were documented. Most of the plants were reported from India (36%) and followed by China (31%). Other countries, including Japan, Bangladesh, Thailand, Pakistan, Korea, Taiwan and Algeria, have published several reports regarding local plants with antidepression potential. As a result, 15 pure compounds isolated from these plants displayed antidepressive potential.

Keywords: Major depressive disorder, Phytochemistry, Anxiolytic, Stress, Asia

INTRODUCTION

The past few decades have witnessed a vast increase in studies concerning plant-based antidepressants. Depression refers to a complex and disabling psychiatric disorder that has affected an estimated 21% of the world population. Depression has been projected to be the leading cause of disability by 2030. This disorder is a type of neurodegenerative disease linked with persistent low mood and anhedonia (Qiong *et al.* 2009). Depression refers to a significant disorder across all ages that demands a significant amount of time and money for treatment. Although synthetic antidepressant drugs are easily available and can effectively

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treat clinically-depressed patients, such drugs have been noted for their adverse effects that often compromise the therapeutic effects. This has sparked the emergence of alternative treatments using medicinal plants or plant-based antidepressant concomitants. Although plants are known to have potentially psychoactive effects, extensive studies are sought in alternative and complementary *in vivo* models to further substantiate their benefits.

Plants, apart from being a main source of food, possess a vast range of phytomedicinal properties. The practice and knowledge on the usage of plants for medicinal purposes have originated thousands of years ago. More than 20,000 species of plants have been used as traditional medicine worldwide with potential reservoirs for the discovery of new drugs. Historical Greek/Roman knowledge on the use of using plant extracts was further expanded as an Arabic medicinal art established by Ibn Sina (known as Avicenna, 980–1,037) in his book entitled *Qanun*. This book refers to one of the most influential references used for drug-plant therapeutics after it was translated from Arabic to Latin (Zenk and Juenger 2007). *Qanun*'s materia medica lists 760 drugs, along with their applications and efficacy. *Qanun* has served as a reference for almost a millennium to date (Zenk and Juenger 2007).

METHODS

Online bibliographical databases, such as Scopus and Google Scholar, were used to investigate published papers relevant to the topic at hand. These articles were retrieved using several keywords, including 'antidepressant AND Asia AND plants', 'anxiolytic AND Asia AND plants', as well as 'antistress AND Asia AND plants'. The papers were limited to those published between 2007 and 2020. The articles selected for this review included plants (i) native to Asian regions with wide distribution; (ii) traditionally used in Asia for antidepressant and anxiolytic treatments; only plants with ethnopharmacological evidence for antidepressant and anxiolytic local uses were selected; (iii) reported to have *in vitro* and *in vivo* antidepressant and anxiolytic activities; (iv) observed for pure active antidepressant and anxiolytic constituents isolated or classes of compounds identified, and (v) with toxic effects on living systems. A plant database called 'Plant list' was applied for taxonomic correction of all the documented plant species (Tropicos 2021). The structures of therapeutically active antidepressant and anxiolytic chemical compounds were developed by using ACDLab freeware 2015 software. The information is summarised in Tables 1 to 3 and Figures 1 and 2 for clearer observation.

Table 1: Traditional uses of Asian medicinal plants against stress-related disorder.

Family	Species name	Local name	Country	Part used	Potential mechanism	Reference
Apiaceae	*Centella asiatica*	Pegaga Gotu Kola Indian-Pennywort Jal Brahmi Mandooka-parmi	India, Malaysia	Leaves	Anxiolytic, antidepressant	Wanasuntronwong *et al.* (2012); Selvi *et al.* (2012)
Apiaceae	*Apium graveolens*	Chinese celery	Northern Asia	Whole plant	Anxiolytic	Tanasawet *et al.* (2017)
Apocynaceae	*Calotropis gigantean*	Milkweed	Indonesia, India, Malaysia, Philippines, Thailand, Sri Lanka, China	Leaves	Anxiolytic	Khan, Sarker and Ajrin (2014)
Apocynaceae	*Apocynum venetum* (L)	Luobuma or Rafuma	China	Leaves	Antidepressant (brain monoamine and dopaminergic system)	Zheng *et al*. (2013)
Araliaceae	*Panax ginseng*	Ginseng root, panax ginseng	China	Roots	Cognition/memory, sleep disturbance, anxiety, depression, pain	Yennurajalingam *et al.* (2015); Sarris, McIntyre and Camfield (2013)
Asteraceae	*Sonchus oleraceus*	Sow Thistle	Asia	Leaves and aerial parts	Anxiolytic	Sarris, McIntyre and Camfield (2013)
Asparagaceae	*Anemarrhena asphodeloides* Bunge	Zhimu (China) Yanghuziin Chimo (Japan) Jimo (Korea)	China, Japan, Korea	Rhizomes	Alzheimer, Parkinson, Schizophrenia	Wang *et al.* (2014)
Asteraceae	*Lactuca sativa*	NA	India	Leaves	Anxiety	Harsha and Anilakumar (2012)
Asteraceae	*Taraxacum officinale* F.	NA	China	Leaves and roots	Involved neuroendocrine system	Li *et al.* (2014)
Asteraceae	*Sphaeranthus indicus*	East India Globe Thistle	India	NA	Anxiolytic	Sarris, McIntyre and Camfield (2013)
Burseraceae	*Protium serratum* Wall	Chitrika, Hiliabhadi, Gutgutya, Neul, Neuor, Gutgutiya, Shu Dui Shi, Thai Cherem	Bangladesh, Assam, Philippines	Leaves	Anxiolytic	Islam *et al.* (2014)

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Table 1: (*continued*)

Family	Species name	Local name	Country	Part used	Potential mechanism	Reference
Convolvulaceae	*Convolvulus pluricalis* Choisy	Evolvulus alsinoides, Clitorea ternatea, Canscora decussate schult, Aloe weed (English)	India, China	Whole plant, roots	CNS disease, anxiety, depression, tranquilising, antistress	Agarwa *et al.* (2014)
Cucurbitaceae	*Luffa echinata* Roxb	Bristly Luffa (English), Koshataki (Sanskrit), Bindal, Bidali, Kukurlata, Ghagerbel (India)	Pakistan, India, China	Fruits	Antidepressant, anxiolytic, antiepileptic	Modi, Jain and Kumar (2014)
Cyperaceae	*Cyperus rotundus*	Xiangfuzi (TCM)	China	Bark and cortex	Antidepressant, anxiolytic, serotonergic	Zhou *et al.* (2016)
Fabaceae	*Albizia julibrissin*	Mimosa, Shabkhosb	India	Leaves, roots and seeds	Neuroprotective	Sarris, McIntyre, Camfield (2013)
Fabaceae	*Abrus precatorius*	Gunja Jequirity	India	NA	Antidepressant	Garaniya and Bapodra (2014)
Fabaceae	*Albizia procera*	NA	India, Myanmar, Southern Asia	Leaves	Antidepressant	Khatoon *et al.* (2014)
Fabaceae	*Glycyrrhiza uralensis*	NA	China	Roots	Liquitin can defense from oxidative stress	Zhao *et al.* (2008)
Fumariaceae	*Fumaria indica*	Fumitory	India, Pakistan	Whole plant	Anxiolytic activity	Gireesh *et al.* (2013)
Ganodermataceae	*Ganoderma lucidum*	Lingzhi mushroom	China	Whole plant	Antidepressant	Matsuzaki *et al.* (2013)
Gentianaceae	*Hericium erinaceus*	Houtougu (Chinese)	China, Japan, Korea, India	Mushrooms	CNS	Inanaga *et al.* (2015)
Hericiaceae	*Sarcostigma kleinii*	Ingudi (Sanskrit)	China, Iran	Aerial parts	Antidepressant, anxiolytic, hypnotic	Sabu, Jayachandran and Ganesan (2015)
Iridaceae	*Crocus sativus*	Saffron, Fan-Hong-Hua	Korea, Japan, China, Cambodia	Flowers and stigmas	Antidepressant	Wang *et al.* (2010)

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Table 1: (*continued*)

Family	Species name	Local name	Country	Part used	Potential mechanism	Reference
Labiatae	Perilla frutescens (L.)	Zisu (Chinese)	China, Japan, Korea, Vietnam	Leaves	Antidepressant	Ito *et al.* (2008)
Lamiaceae	*Leonurus japonicus*	Chinese motherwort	Western Asia	Flowers, leaves, and aerial parts	Antistress, Dopaminergic	Rauwald *et al.* (2015)
Lamiaceae	*Stachys lavandulifolia*	Wood betony	India	Essential oils	Relation between alteration of serotonergic responses and anti-inflammatory effect	Sarris, McIntyre, Camfield *et al.* (2013)
Lamiaceae	*Ocimum anctum*	Holi basil, Tulsi	China, Korea, Japan	Roots	Nervous disorder	Husain *et al.* (2007)
Lamiaceae	*Perilla frutescens*	Jasoyup (Korea), Shiso, (Japan), Pinyin (China)	India, Sri Lanka, Himalaya	Flowers	Antidepressive via enhance serotonine and noradrenaline	Ji *et al.* (2014)
Liliaceae	*Asparagus racemosus*	Satawar, Satamuli, Satavari.	China, Japan, Korea	Seeds	Antidepressive activity via serotonergic and dopaminergic system	Alok *et al.* (2013)
Liliaceae	*Hemerocallis citrina*	Day Lily	Middle East, India, China, Pakistan	Roots	Anxiolytic, serotonergic and GABAergic	Yi *et al.* (2012)
Nitrariaceae	*Peganum harmala* L.	Esfand, Wild rue	China	Roots	Modulating glutamatergic synapses	Sassoui *et al.* (2015)
Orchidaceae	*Gastrodia elata*	Tianma (Chinese)	Korea, Japan, China	NA	Antistress, antidepressant	Chen *et al.* (2009)
Polygalae	*Polygala tenuifolia*	Yuan Zhi	India, Sri Lanka, Philippines	Leaves	Anxiolytic	Shin *et al.* (2014)
Plantaginaceae	*Bacopa manniera*	NA	India	Fruits	Antistress	Husain *et al.* (2007)
Pinaceae	*Abies pindrow*	Western Himalayan Fir	India, Sri Lanka, Malaysia, China	Stems	Antidepressant	Sarris, McIntyre, Camfield (2013)
Phyllanthaceae	*Emblica officianalis*	Amia maharasayana	Pakistan, Bangladesh	Stems	Serotonergic	Husain *et al.* (2007)

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Table 1: (*continued*)

Family	Species name	Local name	Country	Part used	Potential mechanism	Reference
Piperaceae	*Piper nigrum* L	Black pepper	Malaysia, Thailand	Leaves	Insomnia, Anxiety	Phani Kumar, Anilakumar and Naveen (2015)
Piperaceae	*Piper laetispicum*	NA	Indonesia, Malaysia	Seeds	Anxiolytic - serotonergic	Xie *et al.* (2011)
Rubiaceae	*Mitragyna speciosa*	Kratom	China	Steam and aerial parts, Leaves	Antidepressant	Swogger *et al.* (2015)
Rhamnaceae	*Zizipus mauritiana* Lam.	Jujube, Chinese date	India, Pakistan, China	Leaves	Antidepressant	San *et al.* (2013)
Rubiaceae	*Uncaria rhynchophylla*	Chinese cat's claw	India, China, Nepal	Roots	Antistress, Tranquilizer	Sarris, McIntyre and Camfield (2013)
Rhamnaceae	*Zizyphus xylopyrus (Retz)* Willd	Ghoti (Sanskrit), Kulphal (Bengali), Jujab (English), Ghunta/Kakora (Hindi) Bitter orange	India, Pakistan, China	Roots	Anxiolytic	Modi, Jain and Kumar (2014)
Rutaceae	*Citrus aurantium* L.		South East Asia	Essential oil	Anxiolytic	Neto *et al.* (2017)
Solanaceae	*Withania somnifera*	Ashwaganda	China, Thailand, other South East Asian countries		Nervous	Saki, Bahmani and Rafiein-Kopaei (2014)
Simaroubaceae	*Eurycoma longifolia*	Long Jack Tongkat Ali	Indonesia, Malaysia, Vietnam, Thailand, Laos	Roots	Anxiety, CNS, Depression	Sarris , McIntyre and Camfield (2013)
Vitaceae	*Leea indica*	Bandicoot berry	Bangladesh	Leaves	Antidepressant	Sarris, McIntyre and Camfield (2013)
Zingiberaceae	*Alpinia nigra* Burtt	Galangal, black fruit, kala	China, Thailand	Leaves	Antidepressant	Sharmen *et al.* (2014)
Zingiberaceae	*Curcuma longa*	Turmeric	Asia	Rhizomes	Antidepressant	Hurley *et al.* (2013)

Table 2: *In vivo* antidepressive properties of Asian medicinal plants.

Family	Species name	Plant part	Model organism	Dose (mg/kg)	Route of administration	Behavioural test method	Secondary metabolites	Group	Reference
Amaranthaceae	*Spinacia oleracea*	All parts except roots	Mice	0.34, 0.4 and 0.8	p.o	TST, sucrose preference test	NA	NA	Son *et al.* (2018)
Apiaceae	*Centella asiatica*	Leaves	Rats	30, 100, 200	i.p	EPM, FST	Asiatic Acid	Triterpenoids	Selvi *et al.* (2012)
Asteraceae	*Taraxacum officinale*	Leaves and roots	Mice	50, 100, 200	p.o	FST, TST, OFT	NA	NA	Li *et al.* (2014)
Apocynaceae	*Apocynum venetum* L.	Leaves	Mice	50, 100	i.g	FST, TST, OFT	NA	Flavonoids	Zheng *et al.* (2013)
Asphodelaceae	*Hemerocallis citrina*	Flowers	Rats	65, 130	p.o	FST	NA	NA	Yi *et al.* (2012)
Asteraceae	*Eclipta alba* (L.)	Leaves	Rats	100, 200, 400	p.o	FST, TST	NA	NA	Mishra, Jena and Pal (2013)
Asparagaceae	*Anemarrhena asphodeloides*	NA	Rodents	50	NA	TST, FST	Sarsasapogenin	Saponins	Wang *et al.* (2014)
Asparagaceae	*Asparagus racemosus*	Roots	Rats	100, 200, 400	p.o	FST, LH	NA	Saponins	Alok *et al.* (2013)
Caprifoliaceae	*Valeriana jatamansi* Jones	Roots and rhizomes	Mice	5.73, 11.47, 22.94	p.o	TST, Sucrose consumption test	NA	NA	Li *et al.* (2020)
Convolvulaceae	*Convulvulus pluricaulis* Choisy	Whole plant	Mice	50, 100	p.o	TST, FST	NA	NA	Agarwa *et al.* (2014)
Cucurbitaceae	*Luffa echinata*	Fruits	Mice	200	p.o	OFT, EPM	NA	NA	Modi, Jain and Kumar (2014)
Cucurbitaceae	*Momordica charantia* Linn	Whole plant	Mice	50, 100, 200, 400	i.g	FST, TST	Rotunduside G, Rotunduside H	Iridoid glycosides	Ishola, Akinyede and Sholarin (2014)

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Table 2: (*continued*)

Family	Species name	Plant part	Model organism	Dose (mg/kg)	Route of administration	Behavioural test method	Secondary metabolites	Group	Reference
Convolvulaceae	*Convulvulus pluricaulis* Choisy	Whole plant	Mice	50, 100	p.o	TST, FST	NA	NA	Agarwa *et al.* (2014)
Cucurbitaceae	*Luffa echinata*	Fruits	Mice	200	p.o	OFT, EPM	NA	NA	Modi, Jain and Kumar (2014)
Cucurbitaceae	*Momordica charantia* Linn	Whole plant	Mice	50, 100, 200, 400	i.g	FST, TST	Rotunduside G, Rotunduside H	Iridoid glycosides	Ishola, Akinyede and Sholarin (2014)
Cyperaceae	*Cyperus rotundus*	Rhizomes	Mice	50	p.o	OFT, Hole cross test	NA	NA	Dhingra and Sharma (2006)
Euphorbiaceae	*Euphorbia hirta* L.	Leaves	Mice	100, 200, 300	p.o	EPM test, Hole-board test	NA	NA	Munshiur Rahman *et al.* (2019)
Fabaceae	*Albizia procera*	Leaves	Mice	500, 200	p.o	OFT, Hole cross Test	NA	NA	Khatoon *et al.* (2014)
Fabaceae	*Glycyrrhiza uralensis*	Roots	Rat	10, 20, 40	gastric intubation	OFT FST	Liquiritine, isoliquiritine	Flavonoids	Zhao *et al.* (2008)
Fabaceae	*Glycyrrhiza glabra* L.	Roots	Mice	75, 150, 300	p.o	TST, FST	Glycyrrhizin	Saponin	Dhingra and Sharma (2006)
Ganodermataceae	*Ganoderma lucidum*	Fruiting bodies	Rats	1000	p.o	FST, EPM, OFT	NA	NA	Matsuzaki *et al.* (2013)
Iridaceae	*Crocus sativus*	Corms and stigmas	Rats	150, 300, 600	p.o	OFT, FST, TST	Crocin	Carotenoids	Wang *et al.* (2010)
Lamiaceae	*Perilla frutescens*	Essential oils	Mice	3, 6, 9	p.o	FST, OFT, EPM	NA	NA	Ji *et al.* (2014)
Nitrariaceae	*Peganum harmala*	Seeds	Mice	100, 300	p.o	FST,	Harmaline, Harmin,	β-carboline	Sassoui *et al.* (2015)

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Table 2: (*continued*)

Family	Species name	Plant part	Model organism	Dose (mg/kg)	Route of administration	Behavioural test method	Secondary metabolites	Group	Reference
Orchidaceae	*Gastrodia elata*	Rhizo-mes	Rats	0.5, 1.0	p.o	FST	NA	NA	Chen *et al.* (2009)
Piperaceae	*Piper laetispicum*	Seeds	Rats	60, 120	p.o	FST	Laetispiamide A, Laetispicine	Alkaloid amides	Xie *et al.* (2011)
Polygalae	*Polygala tenuifolia*	Roots	Mice	0.1, 1, 10	p.o	TST, FST, LH	NA	Saponins, Xanthones	Shin *et al.* (2014)
Zingiberaceae	*Alpinia nigra*	Leaves	Mice	400, 200	p.o	EPM, OPM, Hole Cross Test	NA	NA	Sharmen *et al.* (2014)
Zingiberaceae	*Curcuma longa*	Rhizomes	Rats	50, 100, 200	i.p	OFT FST	NA	NA	Hurley *et al.* (2013)

Notes: i.p. = intraperitoneal injection; p.o. = per os.

Table 3: *In vivo* anxiolytic activity of Asian medicinal plants.

Family	Species	Plant part	Model organism	Dose (mg/kg)	Route administration	Test	Secondary metabolite	Groups	Reference
Apiaceae	*Centella asiatica*	Leaves	Mice	10, 30, 100, 300	p.o	EPM, Light Dark Box, OFT	Madecassoside (16 mg/kg), Asiaticoside (10 mg/kg)	Triterpenoid	Wanasuntronwong *et al.* (2012)
Amaryllidaceae	*Crinum glaucum* A. Chev	Bulbs	Mice	200, 400, 800, 1200	p.o	EPM	NA	NA	Ishola, Olayemi and Idowu (2013)
Asteraceae	*Achillea biebersteinii*	Essential oil from stem, leaves and flower	Rats	1% and 3%	inhalation	Y-maze test, Radial Arm-maze test, EPM, FST	NA	NA	Akbaba *et al.* (2018)
Asteraceae	*Lactuca sativa*	Leaves	Mice	100, 200, 400	p.o	EPM, OFT	NA	NA	Harsha and Anilakumar (2012)
Asteraceae	*Artemisia indica*	Whole plant	Mice	10, 30, 100	i.p	Light and dark test, Tail suspension test	Carnosol, oleanolic acid, ursolic acid	Terpenoids	Khan, Sarker and Ajrin (2014)
Asclepiadaceae	*Calotropis gigantea*	Leaves	Mice	400	p.o	Hole-cross test, OFT, EPM	NA	NA	Vijusha *et al.* (2013)
Bignoniaceae	*Tabebuia rosea*	Leaves	Mice	500	p.o	EPM, Dark and light test, Staircase test, Swim Test	NA	NA	Das *et al.* (2015)
Combretaceae	*Terminalia citrine*	Leaves	Mice	200, 400	p.o	EPM	NA	Flavonoids	Sabu, Jayachandran and Sri Ganesan (2015)
Icacinaceae	*Sarcostigma klenii* Wight and Arn	Aerial parts	Mice	400	p.o	Light and Dark Test, EPM	NA	NA	Sabu, Jayachandran and Sri Ganesan (2015)

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Table 3: (*continued*)

Family	Species	Plant part	Model organism	Dose (mg/kg)	Route administration	Test	Secondary metabolite	Groups	Reference
Lamiaceae	*Leucas lavandulifolia*	Whole plant	Mice	200, 400	p.o	OFT, FST	NA	NA	Areful *et al.* (2017)
Lauraceae	*Litsea floribunda*	Leaves and stem bark	Mice	100, 200	p.o	EPM, LDT	NA	NA	Devika and Nalini (2018)
Oxalidaceae	*Oxalis corniculata*	Whole plant	Mice	100, 300	i.p	OFT, EPM, Antifighting test	NA	Flavonoids, tannins	Gupta *et al.* (2012)
Rutaceae	*Murraya koenigii* Linn	Leaves	Mice	250, 500, 750 (extract) 3 (mahanimbine)	p.o	EPM	Mahanimbine	Carbazole	Dahiya *et al.* (2016)
Rosaseae	*Syzygium aromaticum*	Flowers	Rats	100, 200	i.p	EPM, Light dark Test	NA	Flavonoids, alkaloid	Tiwari *et al.* (2014)
Verbanaceae	*Lantana camara*	Leaves	Mice	25, 50	p.o	EPM, OFT, Light and dark test	Ursolic acid strearoyl glucoside	Triterpenoids	Kazmi *et al.* (2013)

Notes: i.p. = intraperitoneal injection; p.o. = per os.

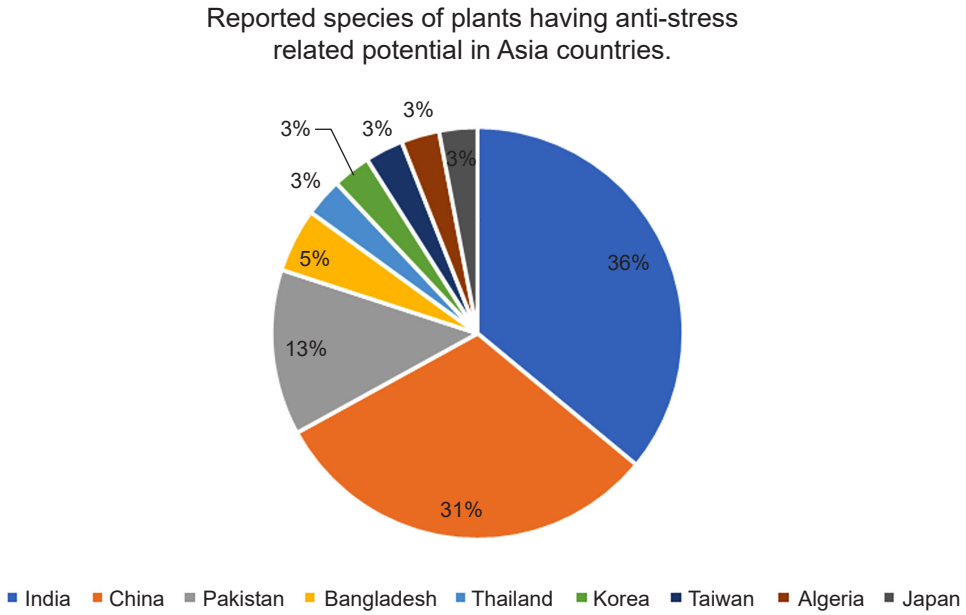

Figure 1: Distribution of Asian plants species having potential antistress-related disorder activity.

**These data are only based on literature from Scopus and Google scholar on monotherapy preparation.*

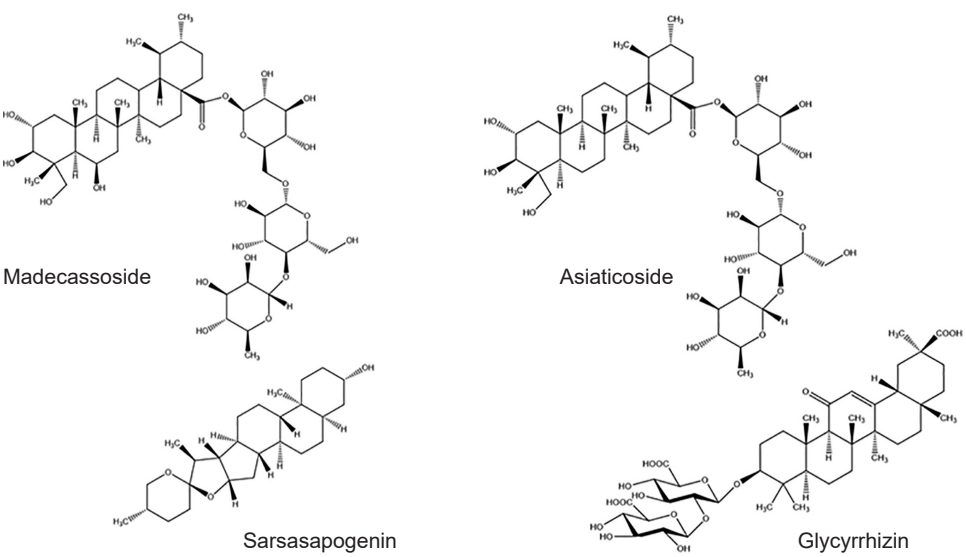

Figure 2: Triterpenoid/Saponins compounds have potential antistress-related disorder activity.

Asian Antistress-Related Plants

The variations in climate, ecological, geographical, physiographical and topographical conditions are some of the core reasons on the vast diversity of plant growth within the Asian region (Tariq, Mussarat and Adnan 2015). A total of 71 Asian medicinal plants were reviewed in this article. Some plants appear to be endemic worldwide, while others are native to this region. The distribution of Asian plants species having potential antistress-related activity was summarised in Figure 1. Eight species of anxiolytic plants were reported from India and followed by two each from Bangladesh, Thailand and Pakistan. Eleven species of plants with antidepressive potential were reported from China, five from India, and one each from Bangladesh, Korea, Taiwan, Algeria and Japan. Some plants have been applied in monotherapy treatment alone, while others for multi-therapy treatment. Some plants, such as *Centella asiatica* (44) and (68) *Convolvulus pluricaulis* Choisy (14) and (52), *Leonurus japonicas* (26) and *Albizia julibrissin* (9), seemed to possess both anxiolytic and antidepressant potential. Most of these plants can be found in other parts of the world, such as Africa, America and Europe.

Depression and Ethnomedicinal Plants

Asian elderly are familiar with plants that can be utilised to treat a vast range of diseases, including stress-related disorders such as anxiety and depression. In this review, 71 plant species from 59 families have been traditionally applied to treat stress-related conditions. The Asteraceae, Fabaceae and Lamiaceae families comprise of four species (13.3%), while Apocynaceae, Liliaceae, Piperaceae, Rubiaceae and Zingiberaceae with two species each contribute to 10% of the list of plant species. Nevertheless, studies on pure constituents that equip these plants with antistress properties are in scarcity. Most of the studies have reported attributes of antistress properties in terms of flavonoids (Zheng *et al.* 2013; Zhao *et al*. 2008; Das *et al*. 2015; Gupta *et al.* 2012 and Tiwari *et al.* 2014), triterpenoids or saponins (Selvi *et al*. 2012; Wang *et al.* 2014; Alok *et al*. 2013; Shin *et al*. 2014; Wanasuntronwong *et al*. 2012; Khan *et al*. 2016; Kazmi *et al*. 2013) and alkaloids (Xie *et al.* 2011; Tiwari *et al*. 2014). Examples of constituents that have potential antistress-related activity were presented in Figure 2.

Most plants have been used in monotherapy, while only a handful of studies have probed into multiple ethnomedicinal therapies (mixing two or more plants) to treat stress-related and depression disorders. For instance, three Chinese herbs, namely, Rhizome Chuanxiong, *Radix Scutellaria* and *Radix Phellodendri*, were evaluated *in vitro* to assess their neuroproliferation-promoting potential *in vitro* and followed by *in vivo* study by using an experimental setting of chronic mild stress (CMS) for 14 days. Another popular traditional Chinese medicine that has been used to treat stress-related disorders in Japan, Korea and China is Kami-Shoyo-San, which is a combination of nine plants for therapy purposes (Park *et al*. 2007).

Clinical Study of Antistress-Related Disorder Activity Plants

Antistress-related activity displayed by plants has been noted since ages ago. A survey was carried out in Taiwan to study the prescription patterns of Chinese herbal products among patients with sleep and depression disorders. Out of 11,571 patients, 11,389 used Western medication, 131 used Chinese herbal formula, while 77 used both Western and Chinese herbal medications (Chen *et al.* 2015). A number of studies revealed that the constituents

of Asian plants have indeed been used in clinical studies. One of these studies refers to the use of *Nepeta menthoides Boiss & Buhse* aqueous extract to evaluate the antidepressant properties of the plant, along with its side effects to human (Chen *et al.* 2015).

Meanwhile, several studies had adopted the *in vitro* analysis. For instance, a study used the ischaemia-hypoxia cell model. After the cells were treated with 10 nmol/L and 100 nmol/L of Asiaticoside extracted from *Centella asiatica*, a significant increase was observed in the survival rate of the cells (Sun, Liu and Li 2015). Nonetheless, behavioural studies are being sought to assess mood disorders.

CONCLUSION

The diverse plant species native to the Asian region are renowned for its valuable and irreplaceable assets. These plants possess medicinal values for the treatment of stress-related disorders. Although roots and leaves are mostly applied for ethnomedicinal preparation, it is noteworthy to highlight that root harvesting may be destructive. Therefore, care must be taken to avoid exploiting these plants. Some information, such as method of preparation, dosage of ethnomedicine and method of administration, has been excluded from the review. Knowledge pertaining to the mechanism of action of these medicinal plants is still in its infancy phase. This calls for further exploration within this subject matter for the discovery of a potent antidepressant.

REFERENCES

AGARWA, P., SHARMA, B., FATIMA, A. & JAIN, S. K. (2014) An update on Ayurvedic herb *Convolvulus pluricaulis* Choisy, *Asian Pacific Journal of Tropical Biomedicine*, 4(3): 245–252. https://doi.org/10.1016/S2221-1691(14)60240-9

AKBABA, E., HASSAN. S., SUR, T. M. & BAGCI, E. (2018) Memory enhancing, anxiolytic and antidepressant effects of *Achillea biebersteinii* (Asteraceae) essential oil on scopolamine-induced rats, *Journal of Essential Oil Bearing Plants*, 21(3): 825–839. https://doi.org/10.1080/0972060X.2018.1483741

ALOK, S., JAIN, S. K., VERMA, A., KUMAR, M., MAHOR, A. & SABHARWAL, M. (2013) Plant profile, phytochemistry and pharmacology of *Asparagus racemosus* (Shatavari): A review, *Asian Pacific Journal of Tropical Disease*, 3(3): 242–251. https://doi.org/10.1016/S2222-1808(13)60049-3

AREFUL, I., HUSSAIN, M. S., SEN, N., ABEDIN, F., MILLAT, M. S., ISLAM, M. S., et al. (2017) Investigation of *in vitro* thrombolytic and anti-helminthic activity and in vivo anxiolytic and antidepressant potentiality with phytochemical nature of methanolic extract of *Leucas lavandulifolia*, *Sustainable Chemistry and Pharmacy*, 6: 61–66. https://doi.org/10.1016/j.scp.2017.09.001

CHEN, P. -J., HSIEH, C. -L., SU, K. -P., HOU, Y. -C., CHIANG, H. -M. & SHEEN, L. -Y. (2009) Rhizomes of *Gastrodia elata* B_L possess antidepressant-like effect via monoamine modulation in subchronic animal model, *The American Journal of Chinese Medicine*, 37(6): 1113–1124. https://doi.org/10.1142/S0192415X09007533

CHEN, Y. -L., LEE, C. -Y., HUANG, K. -H., KUAN, Y. -H. & CHEN, M. (2015) Prescription patterns of Chinese herbal products for patients with sleep disorder and major depressive disorder in Taiwan, *Journal of Ethnopharmacology*, (171): 307–316. https://doi.org/10.1016/j.jep.2015.05.045

DAHIYA, J., SINGH, J., KUMAR, A. & SHARMA, A. (2016) Isolation, characterisation and quantification of an anxiolytic constituent - mahanimbine, from *Murraya koenigii* Linn. spreng leaves, *Journal of Ethnopharmacology*, 193: 706–711. https://doi.org/10.1016/j.jep.2016.10.014

DAS, N., GOSHWAMI, D., HASAN, M. S., MAHMUD Z. A., RAIHAN, S. Z. & SULTAN, M. Z. (2015) Evaluation of antinociceptive, anti-inflammatory and anxiolytic activities of methanolic extract of *Terminalia citrina* leaves, *Asian Pacific Journal of Tropical Disease*, 5(Suppl 1): S137–S141. https://doi.org/10.1016/S2222-1808(15)60875-1

DEVIKA, M. & NALINI, M. S. (2018) Evaluation of antidepressant of *Litsea floribunda* (BL.) Gamble — Lauraceae using animal models, *International Journal of Pharmaceutical Sciences and Research*, 37: 3427–3432. https://doi.org/0.13040/IJPSR.0975-8232.9(8).3427-32

DHINGRA, D. & SHARMA, A. (2006) Antidepressant-like activity of *Glycyrrhiza glabra* L. in mouse models of immobility tests, *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 30(3): 449–454. https://doi.org/10.1016/j.pnpbp.2005.11.019

GARANIYA, N. & BAPODRA, A. (2014) Ethnobotanical and phytopharmacological potential of *Abrus precatorius* L.: A review, *Asian Pacific Journal of Tropical Biomedicine*, 4(Suppl 1): S27–S34. https://doi.org/10.12980/APJTB.4.2014C1069

GIREESH, K. H., SUDIR, K. C., GEETA, R., SHYAM, S. C. & KUMAR, V. (2013) Potential antianxiety activity of *Fumaria indica*: A preclinical study, *Pharmacognosy Magazine*, 9(33): 1–9.

GUPTA, G., KAZMI, I., AFZAL, M., RAHMAN, M. & ANWAR, F. (2012) Anxiolytic effect of *Oxalis corniculate* (Oxalidaceae) in mice, *Asian Pacific Journal of Tropical Disease*, 2(Suppl 2): S837–S840. https://doi.org/10.1016/S2222-1808(12)60275-8

HARSHA, S. N. & ANILAKUMAR, K. R. (2012) Effects of *Lactuca sativa* extract on exploratory behavior pattern, locomotor activity and anxiety mice, *Asian Pacific of Tropical Medicine*, 2(Suppl 1): S475–S479.

HURLEY, L. L., AKINFIRESOYE, L., NWULIA, E., KAMIYA, A., KULKARNI, A. A. & TIZABI, Y. (2013) Antidepressant-like effects of curcumin in WKY rat model of depression is associated with an increase in hippocampal BDNF, *Behavioural Brain Research*, 239(1): 27–30. https://doi.org/10.1016/j.bbr.2012.10.049

HUSAIN, G. M., MISHRA, D., SINGH, P. N., RAO, C. V. & KUMAR, V. (2007) Ethnopharmacological review of native traditional medicinal plants for brain disorders, *Pharmacognosy Review*, 1(1): 19–28.

INANAGA, K., YOSHIDA, M., TOMITA, O. & UCHIMURA, N. (2015) Treatment of mild neurocognitive disorder with compounds from *Hericium erinacium*, *International Medical Journal*, 22(3): 152–153.

ISHOLA, I. O., AKINYEDE, A. A. & SHOLARIN, A. M. (2014) Antidepressant and anxiolytic properties of the methanolic extract of *Momordica charantia* Linn (Cucurbitaceae) and its mechanism of action, *Drug Research*, 64(7): 368–376. https://doi.org/10.1055/s-0033-1358712

ISHOLA, I. O., OLAYEMI, S. O. & IDOWU, A. R. (2013) Anticonvulsant, anxiolytic and hypnotic effects of aqueous bulb extract of *Crinum glaucum* A. Chev (Amaryllidaceae): Role of GABAergic and nitrergic systems, *Pakistan Journal of Biological Science*, 16(15): 701–710. https://doi.org/10.3923/pjbs.2013.701.710

ISLAM, M. R., KABIR, M. F., ALAM, R., DHAR, R., RANA, M. N., ISLAM, M. E., et al. (2014) Sedative, membrane stability, cytotoxic and antioxidant properties of methanol extract of leaves of *Protium serratum* wall, *Asian Pacific Journal of Tropical Disease*, 4(Suppl 2): S928–933. https://doi.org/10.1016/S2222-1808(14)60760-X

ITO, N., YABE, T., GAMO, Y., NAGAI, T., OIKAWA, T., YAMADA, H., et al. (2008) Rosmarinic acid from Perillae Herba produces an antidepressant-like effect in mice through cell proliferation in the hippocampus, *Biological and Pharmaceutical Bulletin*, 31(7): 1376–1380. https://doi.org/10.1248/bpb.31.1376

JI, W. W., LI, R. P., LI, M., WANG, S. Y., ZHANG, X., NIU, X. X., et al. (2014) Antidepressant-like effect of essential oil of *Perilla frutescens* in a chronic, unpredictable, mild stress-induced depression model mice, *Chinese Journal of Natural Medicine*, 12(10): 753–759. https://doi.org/10.1016/S1875-5364(14)60115-1

KAZMI, I., AFZAL, M., ALI, B., DAMANHOURI, Z. A., AHMAOL, A. & ANWAR, F. (2013) Anxiolytic potential of ursolic acid derivative-a stearoyl glucoside isolated from *Lantana camara* L. (Verbanaceae), *Asian Pacific Journal of Tropical Medicine*, 6(6): 433–437. https://doi.org/10.1016/S1995-7645(13)60069-3

KHAN, I., KARIM, N., AHMAD, W., ABDELHALIM, A. & CHEBIB, M. (2016) GABA-A receptor modulation and anticonvulsant, anxiolytic, and antidepressant activities of constituents from *Artemisia indica* Linn., *Evidence-Based Complimentary and Alternative Medicine*, 2016: 1–12. https://doi.org/10.1155/2016/1215393

KHAN, I. N., SARKER, M. M. I. & AJRIN, M. (2014) Sedative and anxiolytic effects of ethanolic extract of *Calotropis gigantea* (Asclepiadaceae) leaves, *Asian Pacific Journal of Tropical Biomedicine*, 4(Suppl 1): S400–S404. https://doi.org/10.12980/APJTB.4.2014C1147

KHATOON, M. M., KHATUN, M. H., ISLAM, M. E. & PARVIN, M. S. (2014) Analgesic, antibacterial and central nervous system depressant activities of *Albizia procera* leaves, *Asian Pacific Journal of Tropical Biomedicine*, 4(4): 279–284. https://doi.org/10.12980/APJTB.4.2014C348

LI, Y. -C., SHEN, J. -D., LI, Y. -Y. & QI, H. (2014) Antidepressant effects of the water extract from *Taraxacum officinale* leaves and roots in mice, *Pharmaceutical Biology*, 52(8): 1028–1032. https://doi.org/10.3109/13880209.2013.876432

LI, Y., WU, L., CHEN, C., WANG, L., GUO, C., ZHAO, X., et al. (2020) Serum metabolic profiling reveals the antidepressive effects of the total iridoids of *Valeriana jatamansi* Jones on chronic unpredictable mild stress mice, *Frontiers in Pharmacology*, 11(338): 1–13. https://doi.org/10.3389/fphar.2020.00338

MATSUZAKI, H., SHIMIZU, Y., IWATA, N., KAMIUCHI, S., SUZUKI, F., IIZUKA, H., et al. (2013) Antidepressant-like effects of a water-soluble extract from the culture medium of *Ganoderma lucidum* mycelia in rats, *BMC Complementary and Alternative Medicine*, 13(370): 1–8. https://doi.org/10.1186/1472-6882-13-370

MISHRA, S., JENA, M. & PAL, A. (2013) Evaluation of antidepressant activity of *Eclipta alba* using animal models, *Asian Journal of Pharmaceutical and Clinical Research*, 6(Suppl 3): 118–120.

MODI, A., JAIN, S. & KUMAR, V. (2014) *Zizyphus xylopyrus* (Retz.) Willd: A review of its folkloric, phytochemical and pharmacological perspectives, *Asian Pacific Journal of Tropical Disease*, 4(Suppl 1): S2–S7. https://doi.org/10.1016/S2222-1808(14)60408-4

MODI, A. & KUMAR, V. (2014) *Luffa echinata* Roxb. - A review on its ethnomedicinal, phytochemical and pharmacological perspective, *Asian Pacific Journal of Tropical Disease*, 4(Suppl 1): S7–S12. https://doi.org/10.1016/S2222-1808(14)60409-6

MUNSHIUR RAHMAN, S. M., RANA S., ISLAM, M. N., KUMER, A., HASSAN, M. M., BISWAS, T. K., et al. (2019) Evaluation of anxiolytic and sedative-like activities of methanolic extract of *Euphorbia hirta* leaves in mice, *Pharmacology & Pharmacy*, 10: 283–297. https://doi.org/10.4236/pp.2019.106023

NETO, G. C., BRAGA, J. E. F., ALVES, M. F., PORDEUS, L. C. D. M., SANTOS, S. G. D., SCOTTI, M. T., et al. (2017) Anxiolytic effect of *Citrus aurantium* L. in crack users, *Evidence-based Complementary and Alternative Medicine*, 2017: 1–8. https://doi.org/10.1155/2017/7217619

PARK, S. -W., KIM, Y. -K, LEE, J. -G., KIM, S. -H., KIM, J. -M., YOON, J. -S., et al. (2007) Antidepressant-like effects of the traditional Chinese medicine kami-shoyo-san in rats, *Psychiatry and Clinical Neuroscience*, 61(4): 401–406. https://doi.org/10.1111/j.1440-1819.2007.01676.x

PHANI KUMAR, G., ANILAKUMAR, K. R. & NAVEEN, S. (2015) Phytochemical having neuroprotective properties from dietary sources and medicinal herbs, *Pharmacognosy Journal*, 7(1): 1–17. https://doi.org/10.5530/pj.2015.1.1

QIN, T., FANG, F., SONG, M., LI, R., MA, Z. & MA, S. (2016) Umbelliferone reverses depression-like behavior in chronic unpredictable mild stress-induced rats by attenuating neuronal apoptosis via regulating ROCK/Akt pathway, *Behavioral Brain Research*, 317: 147–156. https://doi.org/10.1016/j.bbr.2016.09.039

QIONG, L., BING, L., HAI-YAN, Z., YAN-QING, W., JIN, Y. & GEN-CHENG, W. (2009) Clomipramine treatment reversed the glial pathology in a chronic unpredictable stress-induced rat model of depression, *European Neuropsychopharmacology*, 19: 796–805. https://doi.org/10.1016/j.euroneuro.2009.06.010

RAUWALD, H. W., SAVTSCHENKO, A., MERTEN, A., RUSCH, C., APPEL, K. & KUCHTA, K. (2015) GABA A receptor binding assays of standardized *Leonurus cardiaca* and *Leonurus japonicus* extracts as well as their isolated constituents, *Planta Medica*, 81: 1103–1110. https://doi.org/10.1055/s-0035-1546234

SABU, N. S., JAYACHANDRAN, T. P. & SRI GANESAN, P. (2015) Evaluation of anxiolytic activity of aerial parts of *Sarcostigma kleinii* Wight and Arn, *Asian Journal of Pharmaceutical and Clinical Research*, 8(2): 412–416.

SAKI, K., BAHMANI, M. & RAFIEIAN-KOPAEI, M. (2014) The effect of most important medicinal plants on two important psychiatric disorders (anxiety and depression)-a review, *Asian Pacific Journal of Tropical Disease*, 7(Suppl 1): 34–42. https://doi.org/10.1016/S1995-7645(14)60201-7

SAN, A. M. M., THONGPRADITCHOTE, S., SITHISARN, P. & GRITSANAPAN, W. (2013) Total phenolics and total flavonoids contents and hypnotic effect in mice of *Ziziphus mauritiana* Lam. seed extract, *Evidence-Based Complementary and Alternative Medicine*, 2013: 1–4. https://doi.org/10.1155/2013/835854

SARRIS, J., MCINTYRE, E. & CAMFIELD, D. A. (2013) Plant-based medicines for anxiety disorders, part 1: A review of preclinical studies, *CNS Drugs*, 27(3):207–219. https://doi.org/10.1007/s40263-013-0044-3

SASSOUI, D., SERIDI, R., AZIN, K. & USAI, M. (2015) Evaluation of phytochemical constituents by GCMS and antidepressant activity of *Peganum harmala* L. seeds extract, *Asian Pacific Journal of Tropical Disease*, 5(12): 971–974. https://doi.org/10.1016/S2222-1808(15)60967-7

SELVI, P. T., SENTHIL KUMAR, M., RAJESH, R. & KATHIRAVAN, T. (2012) Antidepressant activity of ethanolic extract of leaves of *Centella asiatica* Linn by *in vivo* method, *Asian Journal of Research in Pharmaceutical Sciences*, 2(2): 76–79.

SHARMEN, F., MANNAN, A., RAHMAN, M. M., MAU, C., UDDIN, M. E. & ABU AHMED, A. M. (2014) Investigation of *in vivo* neuropharmacological effect of *Alpinia nigra* leaf extract, *Asian Pacific Journal of Tropical Biomedicine*, 4(2): 137–142. https://doi.org/10.1016/S2221-1691(14)60222-7

SHIN, I. -M., SON, S. U., PARK, H., KIM, Y., PARK, S. H., KELLEY SWANBERG, K., et al. (2014) Preclinical evidence of rapid- onset antidepressant-like effect in *Radix polygalae* extract, *PLoS ONE*, 9(2): e88617. https://doi.org/10.1371/journal.pone.0088617

SON, H., JUNG, S., SHIN, J. H., KANG, M. J. & KIM, H. J. (2018) Anti-stress and anti-depressive effects of spinach extracts on a chronic stress-induced depression mouse model through lowering blood corticosterone and increasing brain glutamate and glutamine levels, *Journal of Clinical Medicine*, 7(11): 406. https://doi.org/10.3390/jcm7110406

SUN, T., LIU, B. & LI, P. (2015) Nerve protective effect of Asiaticoside against ischemia-hypoxia in cultured rat cortex neurons, *Medical Science Monitor*, 21: 3036–3041. https://doi.org/10.12659/MSM.894024

SWOGGER, M. T., ELAINE, H., FIRE, E., EARTH, E., NICOLE, T., KAILA, Y., et al. (2015) Experiences of Kratom users: Qualitative analysis, *Journal of Psychoactive Drugs*, 47(5): 360–367. https://doi.org/10.1080/02791072.2015.1096434

TANASAWET, S., BOONRUAMKAEW, P., SUKKETSIRI, W. & CHONPATHOMPIKUNLERT, P. (2017) Anxiolytic and free radical scavenging potential of Chinese celery (*Apium graveolens*) extract in mice, *Asian Pacific Journal of Tropical Biomedicine*, 7(1): 20–26. https://doi.org/10.1016/j.apjtb.2016.11.003

TARIQ, A., MUSSARAT, S. & ADNAN, M. (2015) Review on ethnomedicinal, phytochemical and pharmacological evidence of Himalayan anticancer plants, *Journal of Ethnopharmacology*, 164: 96–119. https://doi.org/10.1016/j.jep.2015.02.003

TIWARI, P., VERMA, R., AHIRWAR, D., CHANDY, A., & DWIVEDI, S. (2014) Evaluation of anxiolytic effect of *Syzygium aromaticum*: A traditional herb of India, *Asian Pacific Journal of Tropical Disease*, 4(Suppl 1), 77–80. https://doi.org/10.1016/S2222-1808(14)60418-7

TROPICOS.ORG. MISSOURI BOTANICAL GARDEN. (2021) Tropicos, connecting the world to botanical data since 1982. http://www.tropicos.org

VIJUSHA, K. K. S., RAJANI, M., HEMAMALINI, A. & SUNDARI, E. G. R. (2013) Screening of behavioural, muscle co-ordination & anxiolytic activities of methanolic extract of *Tabebuia rosea* (Bertol), *Asian Journal of Pharmaceutical and Clinical Research*, 6(Suppl 5): 4–7.

WANASUNTRONWONG, A., TANTISIRA, M. H., TANTISIRA, B. & WATANABE, H. (2012) Anxiolytic effects of standardised extract of *Centella asiatica* (ECa 233) after chronic immobilisation stress in mice, *Journal of Ethnopharmacology*, 143(2): 579–585. https://doi.org/10.1016/j.jep.2012.07.010

WANG, Y., DAN, Y., YANG, D., HU, Y., ZHANG, L., ZHANG, C., et al. (2014) The genus *Anemarrhena* Bunge: A review on ethnopharmacology, phytochemistry and pharmacology, *Journal of Ethnopharmacology*, 153(1): 42–60. https://doi.org/10.1016/j.jep.2014.02.013

WANG, Y., TING, H., YU, Z., CHENG-J, Z., QIAN-L, M., KHALID, R., et al. (2010) Antidepressant properties of bioactive fractions from the extract of *Crocus sativus* L., *Journal of Natural Medicine*, 64: 24–30. https://doi.org/10.1007/s11418-009-0360-6

XIE, H., YAN, M. -C., JIN, D., LIU, J. -J., YU, M., DONG, D., et al. (2011) Studies on antidepressant and antinociceptive effects of ethyl acetate extract from *Piper laetispicum* and structure-activity relationship of its amide alkaloids, *Fitoterapia*, 82(7): 1086–1092. https://doi.org/10.1016/j.fitote.2011.07.006

YENNURAJALINGAM, S., REDDY, A., TANNIR, N. M., GARY, B. C., RICHARD, T. L. & GABRIEL, L. (2015) High-dose Asian ginseng (*Panax ginseng*) for cancer-related fatigue: A preliminary report, *Integrative Cancer Therapies*, 14(5): 419–427. https://doi.org/10.1177/1534735415580676

YI, L. -T., LI, J., LI, H. -C., ZHOU, Y., SU B, -F., YANG, K. -F., et al. (2012) Ethanol extract from *Hemerocallis citrina* attenuate the decreases of brain-derived neurotropic factor, TrkB levels in rat induced by corticosterone administration, *Journal of Ethnopharmacology*, 2012: 328–334. https://doi.org/10.1016/j.jep.2012.09.016

ZENK, M. H. & JUENGER, M. (2007) Evolution and current status of the phytochemistry of nitrogenous compounds, *Phytochemistry*, 68: 2757–2772. https://doi.org/10.1016/j.phytochem.2007.07.009

ZHAO, Z., WANG, W., GUO, H. & ZHOU, D. (2008) Antidepressant-like effect of liquiritin from *Glycyrrhiza uralensis* in chronic variable stress induced depression model rats, *Behavioural Brain Research*, 194(1): 108–113. https://doi.org/10.1016/j.bbr.2008.06.030

ZHENG, M., FAN, Y., SHI, D. & LIU, C. (2013) Antidepressant-like effect of flavonoids extracted from *Apocynum venetum* leaves on brain monoamine levels and dopaminergic system, *Journal of Ethnopharmacology*, 147: 108–113. https://doi.org/10.1016/j.jep.2013.02.015

ZHOU, Z., YIN, W., YANG, Y., HE, C. & LI, X. (2016) New iridoid glycosides with antidepressant activity isolated from *Cyperus rotundus*, *Chemistry Pharmaceutical Bulletin*, 64(1): 73–77. https://doi.org/10.1248/cpb.c15-00686