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SHORT REVIEW

A Brief Review of Medicinal Plant Extracts with Potential Antianxiety Effects

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Abstract

Anxiety is one of the major mental health issues that disrupts mood and behaviour. In severe cases, it may present with symptoms such as insomnia, trembling, sweating, rapid heartbeat, and shortness of breath. Conventional anxiolytic medications act primarily on GABA, a key neurotransmitter in the central nervous system. However, numerous plant-derived compounds have also been shown to alleviate anxiety. An extensive literature search was conducted across Google Scholar, Scopus, and PubMed, covering publications from 2007 to the present, to identify medicinal plants with anxiolytic potential. Most botanicals reviewed share common mechanisms of action, primarily involving GABA modulation—through ion channel regulation, receptor binding, or enzyme inhibition (*e.g.*, GABA transaminase and glutamic acid decarboxylase). Additional pathways include monoaminergic regulation and possible cannabinoid receptor modulation. Many plants contain bioactive constituents such as tannins, terpenoids, saponins, steroids, glycosides, flavonoids, and alkaloids, all of which have been associated with anxiety-reducing effects. Overall, the findings suggest that medicinal plants may provide a safer, more affordable, and potentially effective alternative to synthetic drugs for the management of anxiety.

Major Findings: Major findings indicate that many medicinal plants exhibit anxiolytic effects primarily through GABA modulation, monoaminergic regulation, and cannabinoid receptor pathways. Their bioactive compounds—such as flavonoids, terpenoids, and alkaloids—contribute to anxiety reduction, suggesting that plant-based treatments may be safer and more affordable alternatives to conventional drugs.

Keywords: Anxiety, Anxiolytic, Benzodiazepine, Dopamine, GABA

Abbreviations: AChE - Acetylcholinesterase; BZDs - Benzodiazepine; DA – Dopamine; EPM - Elevated Plus Maze; FST - Forced Swim Test; GABA - Gamma-Aminobutyric Acid; GAD - Generalised Anxiety Disorder; HBT - Hole Board Test; 5HT - Serotonin; LDT - Light/Dark Box Test; MAO - Mechanism of action; NA - Nor adrenaline; OCD - Obsessive-Compulsive Disorder; OFT - Open Field Test; SIT - Social interaction test; ST - Staircase Test; SSRIs - Selective Serotonin Reuptake Inhibitors, TST - Tail Suspension Test.

1. Introduction

Anxiety disorders are among the most common psychiatric conditions, characterised by a tenacious and uncomfortable sense of apprehension often accompanied by physical symptoms such as headaches, sweating, palpitations, chest tightness, and mild stomach pain[1]. This rising prevalence is concerning, with estimates indicating that 13.6%-28.8% of individuals in developed countries are affected.

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Anxiety disorders are more prevalent in females than in males[2,3]. In India, the reported prevalence of anxiety in adult males is 24.4%. Anxiety disorders affect 56.8% of the population. Within this group, 15% have panic disorder, 13% suffer from generalised anxiety disorder, 4% experience separation anxiety, 15.6% have social anxiety, and 9.2% exhibit school avoidance anxiety[4].

Existing treatments for anxiety, such as BZDs and selective serotonin reuptake inhibitors SSRIs, are associated with side effects including sedation, memory disturbances, abuse potential, sexual dysfunction, and pharmacological dependence. Consequently, there is a significant need for more effective treatments that offer promising efficacy with fewer side effects[5]. Despite the development of more effective anxiolytics, benzodiazepines remain the first-line treatment since their introduction in the 1960s[6]. However, the high cost and side effects of synthetic drugs have driven scientists to explore Ethnomedicine as a potential source for new drug discovery. Ethnomedicine offers several advantages, including fewer side effects, lower costs, and greater availability[7]. Anxiety and related disorders involve the complex interaction of multiple brain signalling pathways and neurotransmitters. GABA, the primary inhibitory neurotransmitter, helps counterbalance the effects of the excitatory neurotransmitter glutamate. Other neurotransmitters that influence anxiety responses in the amygdala include oxytocin, serotonin, opioid peptides, endocannabinoids, neuropeptide Y, and corticotropin-releasing hormone[8]. The human brain contains several classes of GABA receptors, such as GABA-A, GABA-B, and GABA-A-rho (formerly GABA-C). The GABA-A receptor, when activated, exerts an inhibitory effect by hyperpolarising the neuron, thereby reducing the likelihood of an action potential. This receptor, along with its various allosteric binding sites and subtypes, is a primary target for anxiolytic drugs[9].

When we experience anxiety, our nervous system releases adrenaline in response to a threat, signalling our brain to prepare for action. This results in increased alertness and energy, gearing us up to either confront the threat or escape to safety. Typically, anxiety is a short-lived response to challenging situations. However, if the symptoms are severe and persist for an extended period, negatively impacting one's personality, work ability, or social interactions, it becomes a significant issue[10].

In recent decades, clinical trials have investigated various plant-based medicines for treating anxiety and mood disorders, with extensive preclinical research conducted in countries including China, India, Brazil, the USA, Spain, and Germany. These preclinical studies often leverage traditional knowledge and can inform potential human applications. While reviews often focus on human clinical trials, integrating both preclinical and clinical data can provide valuable insights. By examining current preclinical evidence, researchers can identify plant medicines for further investigation in Phases II and III trials, and clinicians can assess their potential for new therapeutic uses, especially when traditional evidence is also available[11]. However, despite their widespread use, there is limited evidence supporting the efficacy of herbal products in controlled clinical trials. Many natural products are self-prescribed, and there is insufficient scientific data to confirm their benefits or to identify potential drawbacks when used alone or in combination with patented medications. Studies have shown that various phytochemicals, such as saponins, alkaloids, polyphenols, triterpenoids, essential oils, fatty acids, and flavonoids, possess anxiolytic properties. *In vivo* animal model studies have explored 112 plant species distributed across 63 botanical families. Notably, species from the Asteraceae, Fabaceae, and Lamiaceae families have been most frequently examined. Ethnomedicinal documentation indicates that these species are utilised across various traditional systems worldwide, with a significant proportion of citations originating from India (33.4%) and China (16%)[12].

The main purpose of this article is to introduce several effective medicinal plants used for treating anxiety.

2. Materials and Methods

2.1 Sources of Information

An electronic literature search was conducted using three databases: Google Scholar, Scopus, and PubMed. The key search terms included "medicinal plants," "plants," "medicinal herbs," "anti-anxiety," "stress," and "herbal medicines." The search was restricted to studies focusing on medicinal plants employed in the management or treatment of anxiety.

2.2 Inclusion and Exclusion Criteria

Studies published in English between 2010 and 2024 were included. Eligible studies investigated medicinal plants using *in vitro* (cellular or biochemical assays) or *in vivo* (animal or human) experimental models, reported bioactive phytochemicals, and provided mechanistic insights into anxiolytic effects. Both pharmacologically validated plants and those documented in clinical trials or ethnobotanical studies were considered. Excluded studies involved non-plant compounds, synthetic drugs, combination therapies not primarily plant-based, opinion articles, editorials, non-peer-reviewed sources, duplicates, or studies without full text.

2.3 Data Extraction

From each eligible study, data were extracted on botanical and common names, key phytochemicals, experimental models, dosage and treatment details, and primary mechanisms of action, such as modulation of GABAergic or monoaminergic pathways. Only scientifically validated plant-based studies with measurable anxiolytic outcomes were included to ensure a comprehensive evidence-based review of herbal interventions for anxiety.

3. Results and Discussion

Most investigations on medicinal plants for anxiety were based on *in vitro* and *in vivo* models, with fewer clinical trials available. Plants such as *Withania somnifera*, *Valeriana officinalis*, *Passiflora incarnata*, and *Piper methysticum* showed significant anxiolytic effects mainly through GABAergic pathways, while others acted via serotonergic regulation, antioxidant activity, or HPA axis modulation. Key phytochemicals included flavonoids, alkaloids and terpenoids. Despite promising outcomes, limitations such as extract variability, inconsistent dosing, and insufficient clinical validation highlight the need for more standardised and rigorous studies. Some significant phytochemicals contributing to anxiolytic activity are listed in Table 1, and their corresponding chemical structures are shown in Figure 1.

Table 1. List of plants showing anxiolytic effect

S. No.	Plant (Botanical name)	Local name/ Common name	Phytochemical	Methods	Model	Target of action (Receptor)
1	*Caesalpinia digyna*	Teri Pods	Flavonoids: Naringenin, eriodictyol, quercetin, 8-methoxy bonducellin Phenols: Gallic acid, bergenin and 11-O-galloylbergenin	*in vivo,* mice; *in vitro* test	Mirrored chamber test, EPM, OFT	GABA receptor[4]
2	*Lippia citriodora*	Lemon verbena	Flavonoids: Verbascoside, luteolin	*in vivo,* mice	EPM	GABA receptor[6]
3	*Campomanesia pubescens*	Guabiroba, gabirobeira	Flavonoid: Quercetin, Phenols: Gallic acid	*in vivo* rats; *in vitro* test	EPM, OF, and Marble-Burying	GABA-A receptor[13]
4	*Murraya paniculata*	Orange Jasmine, Mock Orange	Benzopyrone: Coumarin	*in vivo* mice; *in vitro* test	EPM, Chromatography	GABA receptor[14,15]
5	*Withania somnifera*	Ashwagandha, Indian Ginseng	Glycosides: Withanolide, sitoindosides	*in vivo* mice	EPM	GABA receptor[16]
6	*Lavandula officinalis*	English Lavender	Terpenes: Linalool, Linalyl acetate, Camphor	*in vivo* rats; *in vitro* test	EPM, Chromatography	GABA receptor[17]
7	*Rosmarinus officinalis*	Rosemary	Flavonoids: Luteolin, Diterpene: Carnosic acid	*in vivo,* mice	EPM	GABAergic, receptor[18]
8	*Morinda citrifolia*	Indian Mulberry	Phenols: Scopoletin	*in vivo, mice*; *in vitro* test	EPM and LDT	GABA-A, 5HT and adrenergic systems[19]
9	*Annona coriacea*	Custard Apple, Bullock's Heart	Lipids: Palmitone, β -sitosterol Alkoloids: Annomontine	*in vivo, mice*	EPM, OFT and Rota rod test	GABA,5-HT, DA[20]

Table 1. Continued...

S. No.	Plant (Botanical name)	Local name/ Common name	Phytochemical	Methods	Model	Target of action (Receptor)
10	*Elettaria cardamomum*	Cardamom	Flavonoids: Quercetin, kaempferol, rutin	*in vivo, rats; in vitro* test	EPM and LDT	GABA receptors[21]
11	*Thymus vulgaris*	Garden Thyme	Monoterpene: Thymol, p-Cymene, Linalool	*in vivo, rats*; *in vitro* test	EPM	GABA receptor[22]
12	*Albizzia julibrissin*	Mimosa or Silk Tree	Polyphenolic polymer: Lignin	*in vivo,* mice	EPM	GABA and 5HT[23]
13	*Cissampelos pareira*	Velvet Leaf	Alkaloids: Sanjoinine Flavanoids: Chrysin, Kaempferol, Apigenin Phenols: Hypericin, Obovatol	*in vivo,* rats	EPM	GABA-A/BZD binding site receptor[24]
14	*Coriandrum sativum*	Coriander	Monoterpene: Linalool	*in vivo,* mice	EPM, OFT, LDT	GABA receptor[25]
15	*Angelica archangelica*	Angelica	Coumarin: Imperatorin, xanthotoxin, isoimperatorin, oxypeucedanin. Glycosides: Apterin	*in vivo*, rats; *in vitro* test	EPM, FST	GABA receptor[26]
16	*Ocimum sanctum*	Holy Basil and Tulsi	Phenol: Eugenol	*in vivo,* mice	EPM, LDT	GABA receptor[27]
17	*Brassica oleracea*	Cabbage	Flavonoids: Apigenin, chrysin, kaempferol, quercetin	*in vivo, rats*; *in vitro* test	EPM, Hole Board, Mirror Chamber test	GABA receptor[28]
18	Bacopa monnieri *Dammarane sapogenins*	Brahmi	Dammarane triterpenoid glycosides	*in vivo, rat*; *in vitro* test	Novelty-suppressed feeding test, EPM and Measurement of cortices	GABA receptor[29]
19	*Pongamia pinnata*	Indian Beech Tree	Flavonoids: Karanjin	*in vivo*, rats; *in vitro* test	Actophotometer Test, EPM, LDM	GABA receptor[30]
20	*Ilex paraguariensis*	Yerba Mate	Alkaloids: Caffeine, Theobromine Phenols: Chlorogenic acid Flavonoids: Rutin, quercetin	*in vivo,* mice; *in vitro* test	EPM, OFT, (AChE) assay	Cholinergic system AChE activity[31]
21	*Albizia adianthifolia*	Flat-Crown Albizia	Terpenoid: Safranal Alkaloid: Murrayanine Polyphenol: Apigenin	*in vivo,* rats	EPM, FST	GABA-A receptor[32]
22	*Passiflora edulis*	Passion Fruit	Flavonoids: Lucenin-2, vicenin-2, isoorientin, isovitexin	*in vivo,* mice; *in vitro* test	EPM	GABAA/BZD binding site receptor[33,34]
23	*Cnestis ferruginea*	Fura Amarya	Polyphenol: Amentoflavone	*in vivo,* mice	EPM, HBT, LDT, FST, TST	GABA-A/ BZD binding site,5- HT2, NA α1- and α2- adrenoceptor[34]

Table 1. Continued...

S. No.	Plant (Botanical name)	Local name/ Common name	Phytochemical	Methods	Model	Target of action (Receptor)
24	*Capsicum annuum*	Capsicum	Flavonoids: Quercetin, Luteolin, myricetin	*in vivo,* mice	EPM, LDT	GABA receptor[35]
25	*Apocynum venetum*	Sword-Leaf Dogbane	Flavonoids: Kaempferol	*in vivo,* mice	EPM, OFT	GABAA,5-HT1A receptor[36]
26	*Ficus carica L.*	Fig, Anjeer	Flavonoids: Rutin	*in vivo*, mice	EPM, SI	GABA-A receptor[37]
27	*Tabernaemontana divaricata*	Crepe Jasmine	Flavonoids: Quercetin Phenols: Galic acid	*in vivo,* mice	EPM, OF, FST	GABA, 5HT receptor[38,39]
28	*Asparagus racemosu*	SATAVARI, SATAMULI	Glycosides: Asparoside B, shatavarin V, asparanin A, asparinin B, asparoside B, filiasparoside C, and immunoside	*in vivo,* mice	EPM, HBT, OFT	GABAA, 5- HT2A receptor[40]
29	*Cardiospermum halicacabum*	Winter cherry	Alkaloids: Hyoscyamine	*in vivo,* rats	EPM, LDT	GABA receptor[41]
30	*Hallea ciliata*	Abura or Bahia	Alkaloids: Indole alkaloids	*in vivo,* mice	EPM, HBT, OFT	GABAA, 5-HT1, 5-HT2, and 5-HT3 receptor[42]
31	*Nelumbo nucifera*	Sacred Lotus	Alkaloids: Dauricine, lotusine, nuciferine, pronuciferine,	*in vivo, rats; in vitro* test	LDT, OFT	GABAA , 5-HT, and DA receptor[43]
32	*Zizyphi spinosi semen*	Suan Zao Ren	Alkaloids: Sanjoinine A	*in vivo,* rats*; in vitro* test	EPM, Hole-board OF	GABAA/BZD binding site receptor[44]
33	*Blumea lacera*	False-ox Tongue	Flavonoids: Quercetin Steroids: Stigmasterol	*in vivo,* rats	EPM, HBT, LDT, FST, TST	GABA receptor[45]
34	*Galphimia glauca*	Rain of gold	Terpenoid: Glaucacetalin E	*in vivo,* rats	EPM, LDT, FST	GABAA, DA receptor[46]
35	*Magnolia obovata*	White Leaf Magnolia	Phenols: Obovatol	*in vivo,* rats*; in vitro* test	EPM, HBT; Intracellular chloride measurement assay	GABAA-α1receptor[47]
36	*Mangifera indica*	Mango	Phenols: Mangiferin, Gallic acid, Coumarin, Vanillin	*in vivo,* mice	EPM, OFT, FST	GABAA/BZD ,5-HT2 DA, NA: α2-adrenoceptor[48,49]
37	*Montanoa frutescens*	Cihuapatli	Diterpenoid: Kaurenoic, Kauradienoic acids	*in vivo*, rats	EPM, OFT	GABAA receptor[50]
38	*Piper amalago*	Pepper-Elder	Alkaloid: Piperamides	*in vivo,* rats	EPM	GABAA/BZD receptor[51]
39	*Paullinia cupana*	Guarana	Alkaloid: Methylxanthines Flavonoid: Catechins	*in vivo,* rats	EPM	DA, 5HT receptor[52,53]
40	*Cinnamomum tamala*	Indian Cassia	Flavonoids: Quercetin, Kaempferol Terpenoid: Linalool	*in vivo,* rats	Social interaction test, EPM, OFT	Serotonergic and GABAergic receptor[54]

Table 1. Continued...

S. No.	Plant (Botanical name)	Local name/ Common name	Phytochemical	Methods	Model	Target of action (Receptor)
41	*Acorus calamus*	Sweet Flag	Phenol: Phenylpropanoids Terpenoids: Sesquiterpenes	*in vivo,* mice	EPM	Adrenergic and dopaminergic receptor[55]
42	*Euphorbia hirta*	Asthma Weed	Flavonoid: quercetin, rutin, kaempferol and Afzelin Tannin: Euphorbin-A, Euphorbin-B, Euphorbin-C	*in vivo,* rats	EPM	GABAergic receptor[56,57]
43	*Ziziphus jujuba*	Ber, Sour Date	Flavonoids: Quercetin	*in vivo,* mice	EPM, OFT, Rotarod	GABA, DA, 5-HT receptor[58]
44	*Turnera diffusa*	Damiana	Flavonoids: Apigenin	*in vivo,* rats	EPM	GABA receptor[59]
45	*Crocus sativus*	Saffron	Terpenoid: Safranal, picrocrocin Carotenoid: Crocins	*in vivo,* rats	EPM, LDM	5-HT, NE, DA, GLU, GABA receptor[60]
46	*Cecropia glazioui*	Yarumo	Flavonoid: Isoorientin, orientin, isovitexin and isoquercitin Phenols: Chlorogenic acid	*in vivo,* mice	EPM	5-HT, NE, DA receptor[61,62]
47	*Aloysia polystachya*	Horse Mint and Burrito	Terpenoid: Thujone, carvone	*in vivo,* rats	EPM, UPLC-MS and HPLC-DAD	GABA receptor[63]
48	*Nymphaea alba Linn*	White Water-Lily	Flavonoids	*in vivo,* rats	EPM	5-HT 1A receptor[64]
49	*Tanacetum parthenium*	Featherfew	Flavonoid: Quercetagetin, apigenin and luteolin Terpenoid: Parthenolide and santamarin	*in vivo,* mice	EPM, OST, FST	GABAA/BZD receptor[65]
50	*Gastrodia elata*	Tianma	Flavonoids: Kaempferol and quercetin	*in vivo,* rats	EPM	GABAA/BZD,5-HT 1A receptor[66]
51	*Humulus lupulus*	Lupulin, Simple Hops	Flavonoids: Kaempferol, quercetin and rutin	*in vivo,* rats	Radioligand binding assays;	Adenosine A2A receptor[67]
52	*Piper methysticum*	Kava	Lactones: Kavalactones	*in vivo,* mice; *in vitro* test	EPM, OFT; MAO activity	MAO-B receptor[68]
53	*Cuscuta reflexa Roxb*	Dodder and Amarbel	Flavonoids: Kaempferol and quercetin Fatty acid: Linoleic acid Phenols: Coumarin	*in vivo,* rats	EPM, HBT, TST, FST	Potassium (K+) channel[69]
54	*Foeniculum vulgare*	Fennel	Phenylpropanoid: Anethole	*in vivo,* rats	EPM, OFT, FST	MAO-B receptor[70]
55	*Rosa canina*	Dog Rose, Dog Berry	Flavonoids: Rutin, quercetin Terpenoid: Linalool	*in vivo* rats	EPM	GABA, Glutamate: ionotropic and 5-HT receptor[71]
56	*Echium amoenum*	Red Feathers	Flavonoids: Quercetin Phenols: Rosmarinic acid, anthocyanidins	*in vivo,* rats	EPM, OFT	GABAA receptor[72]

Table 1. Continued...

S. No.	Plant (Botanical name)	Local name/ Common name	Phytochemical	Methods	Model	Target of action (Receptor)
57	*Passiflora incarnations*	Passion Flowers or Passion Vines	Fatty acid: Oleamide	*in vivo,* mice	ST	GABAA/BZD binding site receptor[73]
58	*Glycyrrhiza glabra*	Licorice	Flavonoids: Quercetin, Baicalein, Kaempferol, Phenols: Rosmarinic acid	*in vitro,* test	patch-clamp	GABA receptor[74]
59	*Centella asiatica*	Indian Pennywort, Gotukola	Triterpenoid: Madecassoside, asiaticoside	*in vivo,* rats	EPM, OF, SIT locomotor activity.	GABA receptor[75]
60	*Cymbopogon flexuosus*	Lemongrass	Terpenoid: Geraniol	*in vivo,* rats	EPM, LDT, OFT	GABA and 5 HT receptor[76]

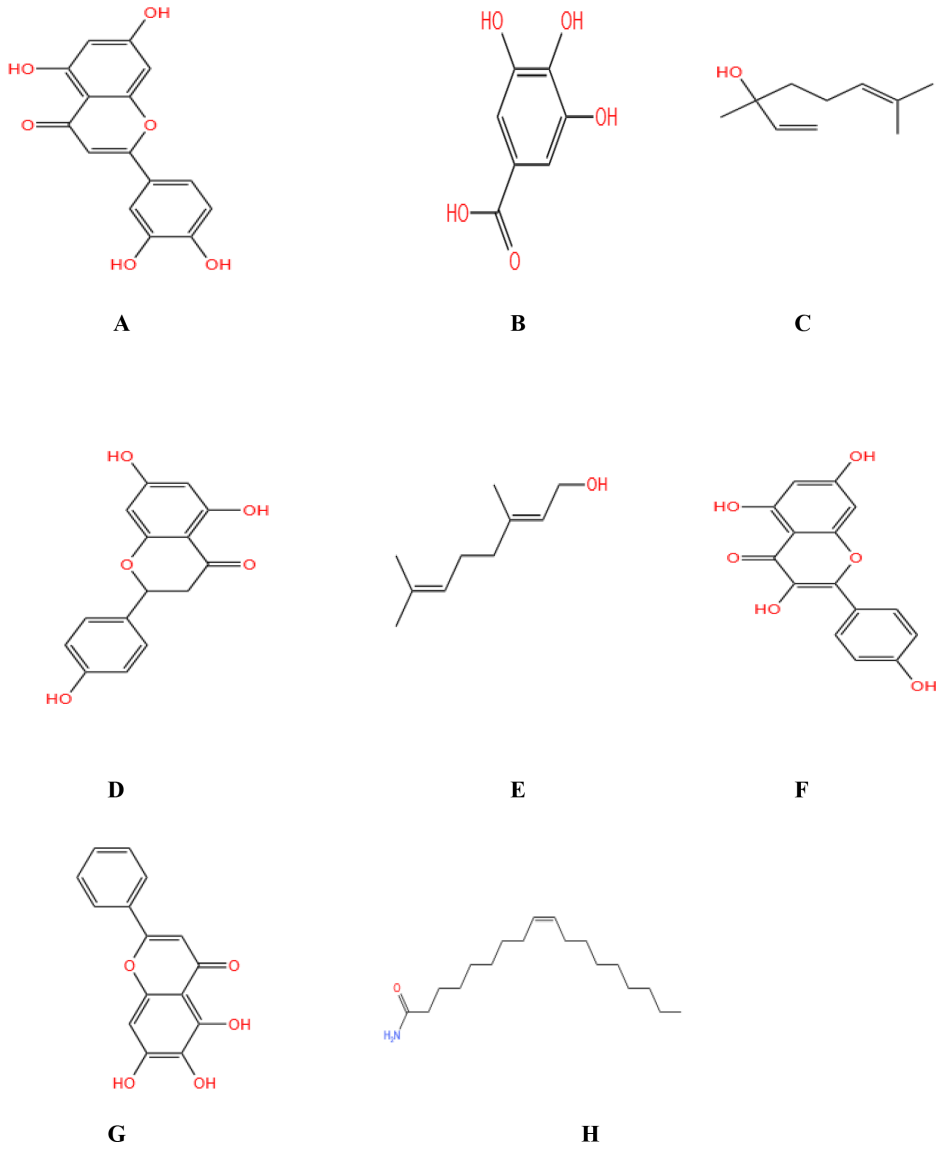


Figure 1. Chemical structures of key bioactive constituents A = Luteolin, B = Gallic acid, C = Camphor, D = Naringenin, E = Geraniol, F = Kaempferol, G = Baicalein, H = Oleamide.

4. Conclusion

This review carried out a comprehensive analysis of the ways in which plants and plant extracts can lower the risk of anxiety. This review includes 60 plants in total. There is currently no thorough analysis that examines the use of plants to treat anxiety disorders from a variety of experimental techniques, despite the fact that research in the field of psychopharmacology is growing. It is feasible to get insights into this topic and identify potential directions for the future by using the targeted multidisciplinary context that is provided here, which contains integrated data from *in vivo* pharmacological investigations, models, and molecular targets. It should be noted that although several of the plants under study showed preclinical anxiolytic properties, no human research has yet examined them as a possible therapy for anxiety problems. While the preclinical findings are encouraging, it remains essential to consider their translational relevance to humans. The biotransformation of phytoconstituents through complex enzymatic and hepatic metabolic pathways often leads to the formation of new metabolites, which may alter their pharmacological activity. Consequently, the mechanistic effects demonstrated in *in vitro* studies may not directly correspond to clinical efficacy in humans. Additionally, although animal models such as the Elevated Plus Maze (EPM) are widely utilised to assess anxiolytic activity and are considered representative of anxiety-like behaviour, their predictive validity for human clinical anxiety disorders remains limited.

5. Future Perspectives

The rich reservoir of bioactive compounds found in medicinal plants holds promise for addressing the multifaceted nature of anxiety disorders, presenting an avenue for innovative and holistic approaches to mental health. While further investigation is warranted to solidify the understanding of specific plant-based treatments, the findings highlight the relevance of exploring natural remedies in addressing the complex challenges of anxiety disorders.

6. Author Contribution

Sudhakar Kaushik - Conceptualisation and Supervision; Priyanka Bhandhari - Conceptualisation and Supervision; Priyanka Bisht - Writing: Original draft preparation; Tapas Mishra - Editing; Bhawana Bhatt - Review and Editing; Heena Mittal - Review and Editing. All authors have read and agreed to the published version of the manuscript.

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