IJPSR (2024), Volume 15, Issue 12 (Review Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 08 May 2024; received in revised form, 27 August 2024; accepted, 25 October 2024; published 01 December 2024

A REVIEW ON THE ANTISPASMODIC POTENTIAL OF SOME TRADITIONAL MEDICINAL PLANTS OF INDIA

Jyotirmoy Das * and Khyatirupa Sarma

Department of Pharmaceutical Science, Girijananda Chowdhury University Guwahati - 781017, Assam, India.

Keywords:

Gastrointestinal ailments, Antispasmodic, Medicinal plant, Therapeutic, Nutritional

Correspondence to Author:
Jyotirmoy Das

PhD Research Scholar, Department of Pharmaceutical Science, Girijananda Chowdhury University Guwahati - 781017, Assam, India.

E-mail: dasjyotirmoy573@gmail.com

ABSTRACT: For the treatment of many illnesses and disorders, including gastrointestinal (GI) ailments, several medicinal plants have been used. Most children and adolescents often suffer from GI illnesses, which have overlapping clinical manifestations in diagnosis and treatment requirements. In order to address the symptoms of smooth muscle contraction and cramping in gastrointestinal illnesses as well as in other urgent clinical circumstances, medications having antispasmodic properties are typically used. The treatment of GI illnesses by antispasmodic herbs was a major component of alternative medicine. Due to the numerous nutritional and therapeutic advantages of these medicinal plants and the herbal products they produce, they are utilized from generation to generation. Due to the numerous nutritional and therapeutic advantages of these medicinal plants and the herbal products they produce, they are utilized from generation to generation. The existence of chemical components that are physiologically active may be the cause of the many uses. This review's major objective is to concentrate on the therapeutic potential of plants with antispasmodic properties and their suggested mechanisms of action. A number of databases, including Google Scholar, Cochrane D, Scopus, and PubMed, were utilized to look up relevant articles about "plants with antispasmodic activities." The revised and quantified information on some Indian medicinal herbs with antispasmodic action is highlighted in this study.

INTRODUCTION: The majority of the world's youngsters often complain of gastrointestinal issues, which are prevalent sorts of complaints. In addition to gastroenteritis and acute gastrointestinal illnesses, these conditions include functional abdominal discomfort, ulcerative colitis, irritable bowel syndrome (IBS), infantile colic, and constipation. Disorders of the digestive system can result in a worse quality of life and a higher risk of anxiety and depression [1].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.15(12).3406-15

This article can be accessed online on www.ijpsr.com

DOI link: https://doi.org/10.13040/IJPSR.0975-8232.15(12).3406-15

These conditions are characterized by recurring or persistent stomach discomfort, which in IBS is also connected to aggravation, alleviation, or a change in bowel habits [2]. Along with symptoms like discomfort, constipation, or diarrhea, irregularities in intestinal movement are also linked to IBS. People who have diarrhea frequently exhibit symptoms including loose, watery stools [3].

Without distinction between male and female patients, IBD is most frequently diagnosed in individuals in the middle of their third and fourth decades of life. About 25% of the afflicted youngsters had a family history of IBD. There have been no recorded differences between healthy and IBD-affected children with regard to some of these characteristics, such as gender, formula intolerance, nursing, emotional stress, or past gastrointestinal

disease [4]. The gastrointestinal disorder ulcerative colitis (UC) also affects the colon's morphology and has a limited inflammatory response. Histological analysis has shown that crypt abscesses, goblet cell depletion, distortion of the mucosal glands, acute and chronic mononuclear cell-mediated inflammation of the mucosa, polymorphonuclear leukocytes, and mucosal inflammation are some of the symptoms [5]. The oropharynx to the perianal area of the gastrointestinal tract (GIT) may be affected by Crohn's disease, another inflammatory bowel disorder. It has transdermal irritation that could spread to the serosa, which frequently causes the creation of a sinus tract or fistula [6].

Etiology of Gastrointestinal diseases: Abdominal discomfort, indigestion, constipation, and diarrhea are some of the clinical signs of gastrointestinal diseases, which can be caused by a number of infectious pathways, including aberrant GI motility and decreased GI mucosa barrier. The first possible explanation is the ostensibly increased risk of GI illnesses that overlap and are connected to reflux. The regurgitation of lower GIT contents into the upper region of the GIT is referred to as reflux and functional dyspepsia have both been linked to disturbed motility. In addition, a number of muscles throughout the GIT, including the orbicular iris muscle, ileocecal valve, pylorus, proventriculus, and opening of the vermiform appendix, Oddi sphincters, and the anus, may serve as gates or checkpoints. All of these checkpoints have smooth muscle or sphincters fixed as barriers that prevent the opening and effacement challenges brought on by lower abdominal contents. If these barriers fail, lower gut juice will reflux into the upper GIT. The first conceivable mechanism is the reflux-related, allegedly increased incidence of overlaps in GI diseases. Reflux is the process by which the contents of the lower GIT are reabsorbed into the upper GIT [7]. Researchers discovered that individuals with injured smooth muscle and sphincter displayed fluctuations in glucose, GI hormones, and free radicals in oxidative stress [8].

The second pathophysiologic mechanism is GI stimulation that is agitated. Depression, rage, and emotional irritability are common irritable comorbidities in gastrointestinal illnesses [9]. The GI microcirculation's stasis is the third mechanism. Researchers have shown that functional dyspepsia, peptic ulcers, and IBS all have fluctuating catecholamine levels. Additionally, additional investigations have discovered that colitis and IBS have disrupted blood viscosity, which causes an imbalance in myogenic chemometric autoregulation and the stagnation of abdominal circulation [10].

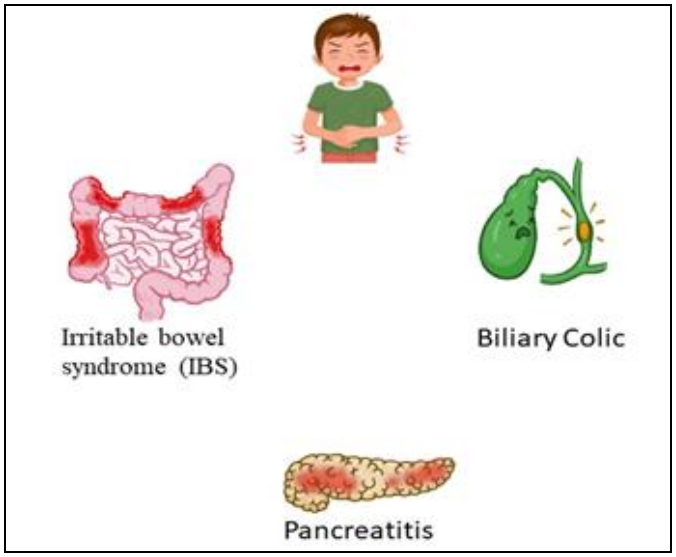


FIG. 1: ETIOLOGY OF GASTROINTESTINAL DISEASE

Traditional Medicine as an Antispasmodic Medication: Traditional remedies have been utilized to treat a variety of disorders since ancient times. Different plant components are frequently employed in the treatment of various diseases. It has been demonstrated that many therapeutic plants

have fewer adverse effects than manufactured medications [11]. When compared to manufactured medications, these natural medicinal substances are less expensive and have less hazardous side effects [12]. Typical examples of medicinal plants that could be applied as an antispasmodic agent against various GIT disorders like constipation, diarrhea, irritable bowel syndrome (IBS), *etc*., include *Ephedra, Datura stramonium, Solanum dulcamara, Atropa belladonna, Grindelia camporum, Hyssopus officinalis, Thymus vulgaris, Glycyrrhiza glabra, Lobelia inflata, Marrubium vulgare, Euphorbia hirta, Coleus forskohlii* and *Inula* are the respiratory spasmolytic. For the treatment of intestinal diseases and menstrual pain, chamomile is an efficient anti-inflammatory and antispasmodic traditional medicine [13].

According to studies, the plants from the Lamiaceae and Asteraceae families have the most isolated spasmolytic components and the strongest antispasmodic effects. Different mechanisms underlie the activity of antispasmodic herbs techniques such as preventing neurotransmitter release like serotonin, acetylcholine, or 5-hydroxytryptamine via opening potassium ATP channels, decreasing extracellular calcium, muscarinic receptors being blocked, Vanilloid receptors, sodium channels, calcium channels and involvement. Natural products achieve their spasmolytic impact in this way [14, 15]. Medical plants are used to treat and control a variety of bodily systems and have a wide range of indications. Additionally, these natural therapeutic treatments are important sources of several chemical components that may prove to be future medication candidates. Numerous medicinal plants are employed in the treatment of various GIT problems [16, 17, 18]. The spasmodic substances may be found all across nature. To find medicinal plants with antispasmodic potential, a basis of traditional knowledge and ethnobotanical research is provided. Determining 15 historically highly regarded medicinal plants with antispasmodic potential through *in-vitro* and *in-vivo* experiments as well as clinical trials, we are offering measured and updated the information in this area.

***Foeniculum vulgare Mill*:** A perennial herb and flowering plant with feathery leaves and yellow blooms known as fennel is used in traditional medicine to treat a variety of illnesses. One of the world's oldest medicinal herbs is this one. It has several medicinal benefits, including those that are anti-inflammatory, antibacterial, antispasmodic, apoptotic, galactagogue, emmenagogue, antioxidant, antifungal, antimicrobial, and memory-enhancing. It has been proven that fennel oil significantly reduces the number of tracheal contractions brought on by methacholine in isolated guinea pigs. This could be related to the potassium channel opening. Primary dysmenorrhea is helped by essential oil, which also lessens the discomfort [19, 26].

***Atropa belladonna*:** additionally known as belladonna or deadly nightshade, is a toxic perennial herbaceous plant. Alkaloids including scopolamine, atropine, and hyoscyamine are present in its roots and leaves. Children are in serious danger of poisoning from A. belladonna since it looks similar to other berries. It is utilized in both homeopathy and allopathy, therefore in allopathy, atropine and scopolamine, which is an extract of A. belladonna, and is used to treat colic and induce spasmolytic activity. It inhibits muscarinic receptors, relaxing smooth muscle. Compared to atropine, scopolamine has a stronger antispasmodic action. This plant contains atropine, a well-known anticholinergic chemical. Atropine's antagonistic activity on muscarinic receptors causes the GIT muscle to relax, relieving spasms and inhibiting diarrhea [27, 28].

***Anethum graveolens* (Apiaceae Family):** In newborns, antispasmodic and anti-hiccup properties are frequently used in ethnopharmacology. The antiemetic, anti-convulsant, and muscle relaxant properties of this substance. Along with these folkloric remedies, it is also used to treat menstruation issues. For newborns, the common ethnopharmacological applications include antispasmodic and hiccup prevention. It possesses antiemetic, anticonvulsant, and muscle-relaxing properties. In addition to these folkloric practices, it is also used to treat menstruation irregularities. It reduces indigestion, stomachache, and flatulence. It provides a relaxing effect and reduces the discomfort associated with primary dysmenorrhea. On the basis of phytochemical investigation, the presence of quercetin, rutin, flavonoids, isorhamnetin, and their

derivatives in dill has been proven. The quercetin and rutin components found in dill extract have an antispasmodic impact on the rat ileum that has been separated from the rest of the body [19, 25].

Ficus carica: In the conventional approach, several components of *Ficus carica*, including fruits, roots, and latex, are utilized. The main chemical byproducts of this medicinal plant are ferulic acid, coumarin, lupeol acetate, sitosterol, and other metals as well as salt, gum, and other substances like salt. *F. carica* is used as an appetizer, an antianemia, an anti-inflammatory, and an antitussive in ethnopharmacology. In addition, it is utilized locally as an antibacterial, constipating, and TB therapeutic agent. Also somewhat laxative, expectorant, diuretic, cytotoxic, and anthelmintic, the herb has several other properties. *F. carica* has reportedly been shown to have antispasmodic properties. A study was conducted on the plant's aqueous-ethanol extract. The experimental work utilized isolated rabbit jejunum preparations [36, 37, 28].

Acorus calamus: *Acorus calamus* is an essential medicinal plant used to treat a variety of illnesses, and its primary chemical constituents include alpha-asarone, calamine, methyl eugenol, methyl isoeugenol, and volatile and essential oil. This herb is used to treat skin, vascular, and neurological disorders. Additionally, this herb is utilized to treat digestion and neurological system issues [38]. Antispasmodic, anti-inflammatory, anti-depressive, antipyretic, antiemetic, expectorant, carminative, tranquilizer and antibacterial are some of this plant's pharmacological effects [39]. It has been noted that *A. calamus* has the ability to relax muscles by blocking calcium channels. Using isolated rabbit jejunum preparation, a crude extract of *A. calamus* was tested for antispasmodic efficacy. The use of *A. calamus* prevented high K+ (80mm) generated contractions and showed antispasmodic efficacy. Additionally, tissues were pretreated with a plant extract that made the Ca+2 dose-response curves shift to the right. This impact was comparable to that of common calcium channel blockers like verapamil. Additional fractionation work revealed that the n-hexane fraction is more effective than the ethyl acetate fraction. This research showed that *A. calamus* has antispasmodic properties [40].

Calendula officinalis L.: There are many purposes for which *C. officinalis* is utilized. *Calendulin*, *coumarin*, loliolide, and carotenoids are typical examples of the biological components found in these plants [41]. Burns, hemorrhoid hemorrhage, fever, cramping, and diabetic foot are just a few of the problems that *C. officinalis* is used to treat. It showed the ability to be hepatoprotective, nephroprotective, antiedematous, anti-inflammatory, and antioxidant [42]. Additionally, *C. officinalis* flowers have antispasmodic qualities. *C. officinalis'* aqueous-ethanolic extract was utilized to treat isolated gastrointestinal preparations for spasms. In the rabbit jejunum, the plant extract demonstrated dose-dependent (0.03-3.0 mg/mL) relaxing activity. Calcium channel blockage was used to mediate relaxation activity [43].

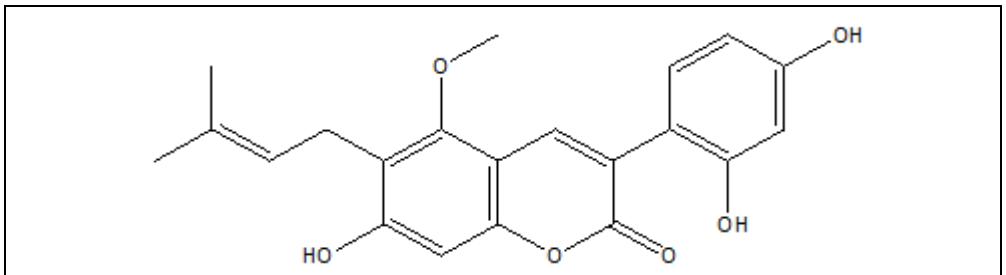
TABLE 1: SOME ANTISPASMODIC COMPOUNDS WITH MECHANISM OF ACTIONS

Antispasmodic plant	Compound name	Part used	Mechanism of Action	References
Glycyrrhiza uralensis	Glycycoumarin	Root	Inhibitory action of acetylcholine and histamine-induced contractions	44
Plectranthus barbatus	Myrcene	Leaf	Acetylcholine inhibition	45
Cynara scolymus	Cynaropicrin	Leaf, flower	Acetylcholine inhibition	46
Artemisia vulgaris	Ezozlantonin	Leaf	Blockade of muscarinic receptors and calcium influx	47
Thymus vulgaris	Thymol	Whole plant	Effect on anticholinergics and serotonergic pathways	48
Radix aucklandiae	Costunolide	Rhizome	Inhibition of muscarinic receptors and calcium influx	49
Allium elburzense	Agapanthagenin	Bulb and flower	Decrease the activities of methanogenesis	50
Allium cepa	Tropeoside B1 and B2	Bulbs	Spasmolytic effect via calcium channels	51
Tylophora hirsuta	α-Amyrin acetate	Aerial parts	Calcium channel blockade	52
Zingiber officinale	Phellandrene	Rhizome	Antihistaminergic, antiserotonergic	53

Moringa oleifera	Niazinin	Seed	Inhibited acetylcholine-induced contractions	54
Drosera rotundifolia	Quercetin	Dried aerial parts	Affecting the allosteric binding site of the muscarinic M3 receptors inhibits neutrophil elastase	55
Tamarindus indica	Compesterol	fruits	Calcium channel blockade	56
Anethum graveolens	Anethin	Dill fruit	Potassium channel opening	50
Matri cariarecutita L.	Flavonoids	flower	Calcium channel blockade	57

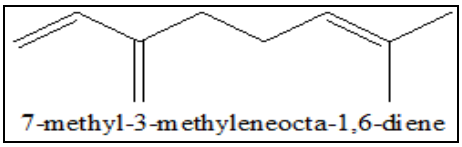
Chemistry of Active Ingredients:

Glycocoumarin: Coumarin derived Glycocoumarin is substituted with hydroxyl group at 7th position, a methoxy group at 5th position, a 2,4-dihydroxyphenyl group at 3rd position.

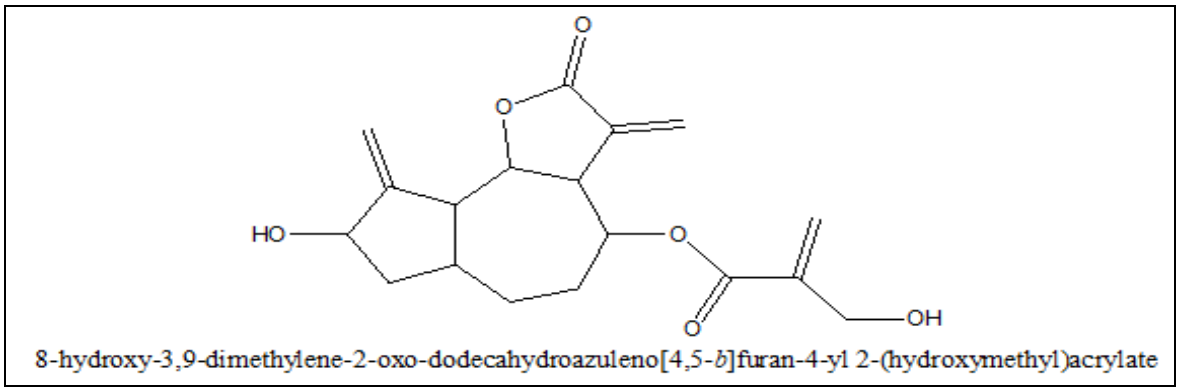


3-(2,4-dihydroxyphenyl)-7-hydroxy-5-methoxy-6-(3-methylbut-2-enyl)-2*H*-chromen-2-one

Myrcene: β-Myrcene, a monoterpene which is octa-1,6-diene substituted with methylene and methyl group at 3rd and 7th position.

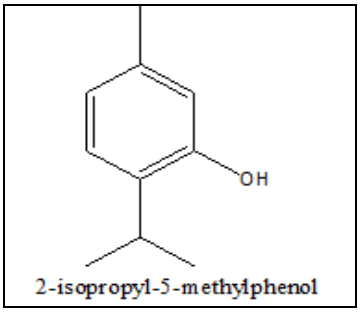

7-methyl-3-methyleneocta-1,6-diene

Cynaropicrin: Cynaropicrin is a tricyclic analog that contain two hydroxyl group on each side of molecule. Its γ-butyrolactone ring is responsible for most of the biological activity. The unsaturated carbonyl group on lactone ring involves Nucleophilc Michael addition.



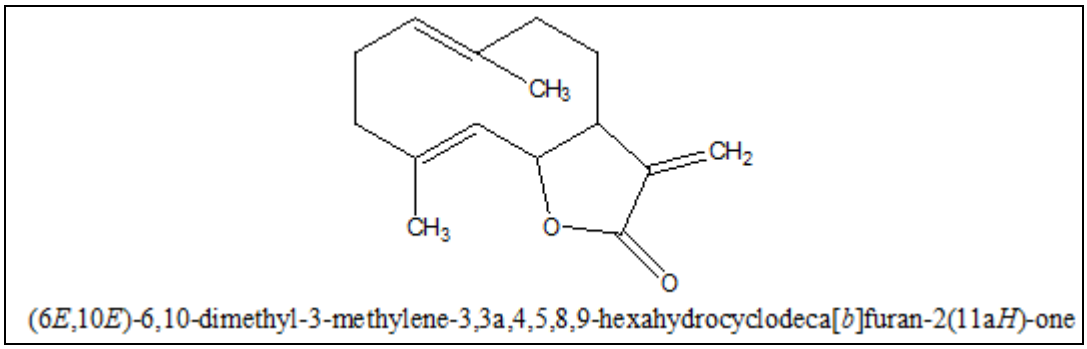
8-hydroxy-3,9-dimethylene-2-oxo-dodecahydroazuleno[4,5-*b*]furan-4-yl 2-(hydroxymethyl)acrylate

Thymol: It is a phenol which is obtain from cymene. It is a promising component for therapeutic activities. It consist of a methyl group in 5th position.



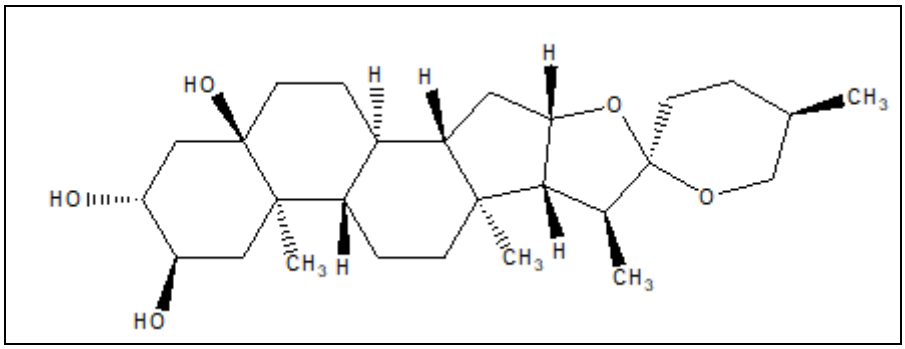
2-isopropyl-5-methylphenol

Costunoloid: The γ-butrolactone structure of Costunoloid undergo Michael reaction with SH-containing component which are essential for the inhibitory activities.

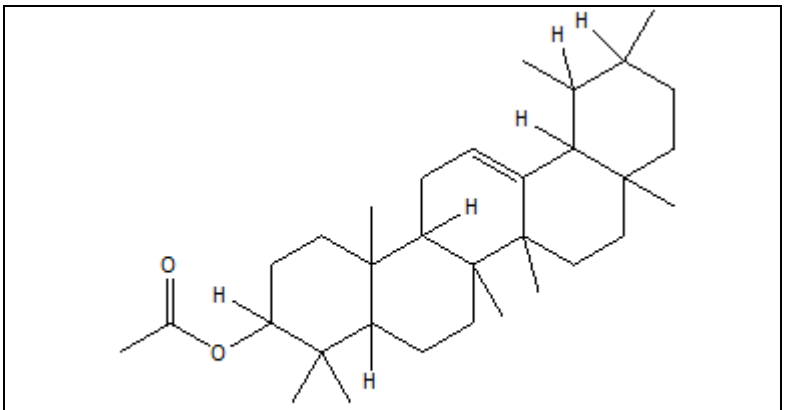


(6*E*,10*E*)-6,10-dimethyl-3-methylene-3,3a,4,5,8,9-hexahydrocyclodeca[*b*]furan-2(11a*H*)-one

Agapanthagenin:

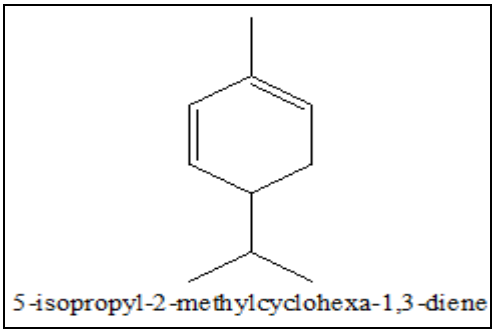


α- Amyrin Acetate:



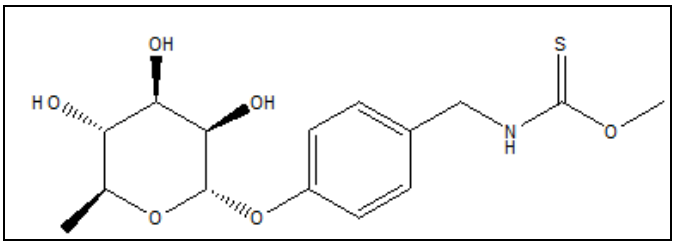
4,4,6a,6b,8a,11,12,14b-octamethyl-1,2,3,4,4a,5,6,6a,6b,7,8,8a,9,10,11,12,12a,14,14a,14b-icosahydropicen-3-yl acetate

Phellandrene:

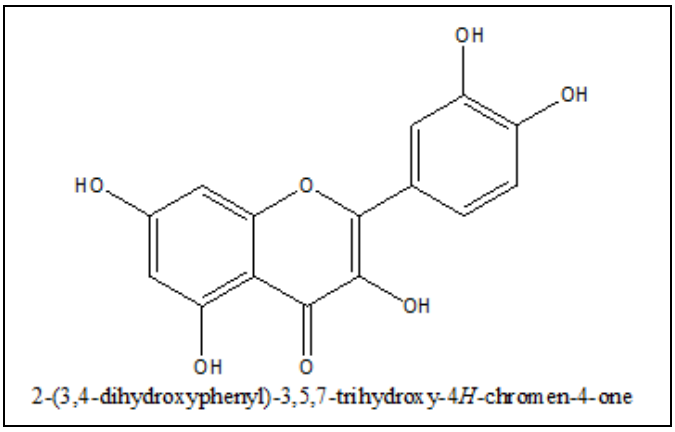


5-isopropyl-2-methylcyclohexa-1,3-diene

Niazinin: Niazinin is a thiocarbamate glycoside with various activities. It carries a methyl group in ortho position in the phenyl ring.



Quercetin: Quercetin inhibits angiotensin-II induced by NADPH oxidase. It prevents endothelial dysfuntion by intracellular redox process.



Present Overview: Antispasmodic therapeutic drugs are the treatments that may result in a better level of GIT muscle spasm relief and also reduce the liquid component of GIT to inhibit diarrhea. The activation of cholinergic/muscarinic, opioid, and histaminic receptors causes the spasm. Along with other body parts, the GIT also has these receptors. The M1, M3, and M5 cholinergic receptors are stimulated, which stimulates intracellular signaling and activates PKA and PKC. The calcium channel is stimulated by both of these kinase enzymes, which also increase intracellular calcium through increasing calcium inflow. The opening of calcium gates at ER and the release of calcium to the cytoplasm also result in an increase in intracellular calcium. The interaction between the elevated calcium level and the smooth muscle (SM) induces complete contraction, which also results in diarrhea. The primary working principle of antispasmodic experiments is this. The plant components or the extract/fraction in the medicinal plants mentioned above that have antispasmodic effects inhibited these receptors.

When these receptors are blocked, the amount of cAMP significantly decreases, and PKA/PKC is inhibited, which leads to a reduction in intracellular calcium. This decreased calcium level will cause the SM to relax because it is no longer adequate to constrict it. Antispasmodic effect or antidiarrheal effect are two terms used to describe this relaxing impact on SM.

In besides this, other writers have lately shown the antispasmodic potential of various plants. Regarding this, researchers from Algeria have reported on the inflammatory, antispasmodic, and healing activities of *Juglans regia* L. utilizing *in-vivo* models (58). The spasmolytic effects (spontaneous and precontracted tissues) of Digas colic drops (DCD-684), a polyherbal formulation of five distinct medicinal plants (*Carum carvi L.*, *Foeniculum vulgare Mill.*, *Mentha arvensis L.*, *Mentha piperita L.*, and *Zingiber officinale Roscoe*), were assessed. Both spontaneous (IC50: 0.75%) and KCl-induced contractions (IC50: 1.6%) were spasmolytically affected by DCD-684. Due to the inclusion of many bioactive substances, the DCD-684 displayed synergistic effects. Its postulated molecular mode of action is controlled by muscarinic and/or nicotinic receptors, serotonergic histaminergic, coupled with calcium channel blocking mechanisms [59]. Papaverine (derived from *Papaver somniferum*) and its synergistic benefits with the well-known medication Imatinib were discussed in another research by *Parcha et al*. against Chronic Myeloid Leukaemia [60].

CONCLUSION: Based on the information collected, it may be stated that traditional natural remedies are a reliable, cost-effective method of treating spasmodic pain. Numerous plant species have been found as a result of this analysis that reduce spasmodic pain with little toxicity or negative effects. The use of herbal remedies for a number of diseases is supported by current study results. In light of this, additional research is being done to determine the possible antispasmodic effects of various plant species, which merit further attention in terms of in vivo and clinical trial investigations. The thorough literature review of medicinal plants may be a rich source of antispasmodic chemicals, opening up new study opportunities for academics and researchers in this

subject. Therefore, more pharmacokinetic and pharmacodynamic studies should be conducted together with clinical trials to confirm the effectiveness and outline the safety profile of conventional medications used to treat spasmodic diseases.

ACKNOWLEDGMENT: The authors convey sincere gratitude to the faculty of Department of Pharmaceutical Science, Girijananda Chowdhury University, Guwahati, Assam, India, for sharing their valuable knowledge and time to create this informative review article.

CONFLICTS OF INTEREST: The authors have no any conflict of interest.

REFERENCES:

1. Di Nardo G, Barbara G, Borrelli O, Cremon C, Giorgio V, Greco L, La Pietra M, Marasco G, Pensabene L, Piccirillo M and Romano C: Italian guidelines for the management of irritable bowel syndrome in children and adolescents: Joint Consensus from the Italian Societies of: Gastroenterology, Hepatology and Pediatric Nutrition (SIGENP), Pediatrics (SIP), Gastroenterology and Endoscopy (SIGE) and Neurogastroenterology and Motility (SINGEM). Italian Journal of Pediatrics 2024; 50(1): 51.
2. Camilleri M and Boeckxstaens G: Irritable bowel syndrome: treatment based on pathophysiology and biomarkers. Gut 2023; 72(3): 590-9.
3. Kitić N, Živković J, Šavikin K, Randjelović M, Jovanović M, Kitić D, Miladinović B, Milutinović M, Stojiljković N and Branković S: Spasmolytic Activity of *Gentiana lutea* L. Root Extracts on the Rat Ileum: Underlying Mechanisms of Action. Plants 2024; 13(3): 453.
4. Zhang Y, Chu X, Wang L and Yang H: Global patterns in the epidemiology, cancer risk, and surgical implications of inflammatory bowel disease. Gastroenterology Report. 2024; 12: 053.
5. Nasser SA, Radi SJ and Abd Al-Jabbar AJ: Ulcerative colitis: diagnosis, treatment, and overall management of adult patients. Current Clinical and Medical Education 2024; 2(5): 175-94.
6. Pandey H, Jain D, Tang DW, Wong SH and Lal D: Gut microbiota in pathophysiology, diagnosis, and therapeutics of inflammatory bowel disease. Intestinal Research 2024; 22(1): 15.
7. Long YQ, Xu WL, Li LX, He HQ, Wang JJ, Shan GD, Dai N and Chen HT: Characteristics and risk factors of functional dyspepsia fulfilling the Rome IV criteria overlapping with gastroesophageal reflux disease, irritable bowel syndrome, and functional constipation in South China. Journal of neurogastroenterology and motility. 2024; 30(2): 184.
8. Ling W, Li Y, Jiang W, Sui Y and Zhao HL, "Common Mechanism of Pathogenesis in Gastrointestinal Diseases Implied by consistent efficacy of single Chinese medicine formula: a PRISMA-compliant systematic review and metaanalysis," Medicine 2015; 94(27): 1111.
9. Chughtai MA, Kerimkulova MK, Mushtaq O, Anand VH, Rehman A, Shehryar A, Hassan B, Islam R, Islam H, Mansoor M and Rehman S: Integrated Approaches in the Management of Gastrointestinal Disorders: A Biopsychosocial Perspective. Cureus 2024; 16(5).
10. Fujita T, Umegaki E, Masuda A, Kobayashi M, Yamazaki Y, Terao S, Sanuki T, Okada A, Murakami M, Watanabe A and Obata D: Factors Associated with Overlap between Functional Dyspepsia and Nonerosive Reflux Disease in Endoscopy-based Helicobacter pylori-uninfected Japanese Health Checkup Participants: A Prospective, Multicenter Cross-sectional Study. Internal Medicine 2024; 63(5): 639-47.
11. Lubis MF, Syahputra H, Illian DN and Kaban VE: Antioxidant activity and nephroprotective effect of *Lansium parasiticum* leaves in doxorubicin-induced rats. J Res Pharm 2022; 26(3): 565-73.
12. Akbaribazm M, Khordad E and Rahimi M: A Review on Male Infertility and Herbal Medicine: Complementary and Alternative Therapies in Animal Models. OBM Genetics 2024; 8(1): 1-7.
13. Vian DA and Aziz FH: Interaction effect of chemical and organic fertilizers on the yield and yield components of *Gundelia rosea* at different plant densities in the field. Iraqi Journal of Agricultural Sciences 2024; 55(3): 962-71.
14. Dutta S, Ghosh T, Sahoo NK, Alugubelli GR, Kumar A, Patidar L, Khanpara P, Tandey R and Thelly MT: Phytochemical profile & pharmacological significance of *Piper nigrum*-King of spices.
15. Kmail A: Mitigating digestive disorders: Action mechanisms of Mediterranean herbal active compounds. Open Life Sciences 2024; 19(1): 20220857.
16. Chaachouay N and Zidane L: Plant-derived natural products: a source for drug discovery and development. Drugs and Drug Candidates 2024; 3(1): 184-207.
17. Likhodii S, Chin AC and Baskin LB: Role of therapeutic drug monitoring to identify clinically significant drug–herbal supplement interaction. In Therapeutic Drug Monitoring Academic Press 2024515-544.
18. Hamedi S, Mahmoodi-Barmesi M, Kermanian H, Ramezani O and Razmpour Z: Investigation of physicochemical and biological properties of bacterial cellulose & zein-reinforced edible nanocomposites based on flaxseed mucilage containing *Origanum vulgare* L. essential oil. IJBM 2024; 254: 127733.
19. Cherbal A, Bouabdallah M, Benhalla M, Hireche S and Desdous R: Phytochemical screening, phenolic content, and anti-inflammatory effect of *Foeniculum vulgare* seed extract. Preventive Nutrition and Food Science 2023; 28(2): 141.
20. Marin VR, Zamunér CF, Santos EA, Ferreira H and Sass DC: Essential oils as alternatives in the control of phytopathogens: A systematic review of the last five years. Journal of Essential Oil Bearing Plants 2024; 1-35.
21. Cherbal A, Bouabdallah M, Benhalla M, Hireche S and Desdous R: Phytochemical Screening, Phenolic Content, and Anti-Inflammatory Effect of *Foeniculum vulgare* Seed Extract. Preventive Nutrition and Food Science 2023; 28(2): 141.
22. Berdimurodov E, Berdimuradov K, Eliboev I, Choriev A, Khamidov A, Yusufov M and Yodgorov C: Polyphenols for dietary polyphenols application. science and engineering of polyphenols: Fundamentals and Industrial Scale Applications 2024; 385-401.
23. Shahrajabian MH and Sun W: Iranian traditional medicine (ITM) and natural remedies for treatment of the common

cold and flu. Reviews on Recent Clinical Trials 2024; 19(2): 91-100.
24. Badgujar SB, Patel VV and Bandivdekar AH: "*Foeniculum vulgare* Mill: a review of its botany, phytochemistry, pharmacology, contemporary application, and toxicology," BioMed Research International, vol. 2014, Article ID 842674, 32 pages, 2014.
25. Zeeshan A, Akram H, Qasim S, Naseer A, Nazar F and Rafique O: The Healing Touch of *Foeniculum vulgare* Mill. (Fennel): a review on its medicinal value and health benefits. Journal of Health and Rehabilitation Research 2023; 3(2): 793-800.
26. Rafieian F, Amani R, Rezaei A, Karaça AC and Jafari SM: Exploring fennel (*Foeniculum vulgare*): Composition, functional properties, potential health benefits, and safety. Critical Reviews in Food Science and Nutrition 2023; 1-8.
27. Alwossabi AM, Albegali AA, Al-Ghani AM, Albaser NA and Alnamer RA: Advancements in transdermal drug delivery systems: innovations, applications, and future directions. Al-Razi University Journal for Medical Sciences 2024; 8(2).
28. Kidima W, Wambura R, Nyigo V, Katani S and Malebo H: Synergy and antagonism in antimalarial crude extract combinations. Tanzania Journal of Health Research 2024; 25(2): 934-46.
29. Celiński R, Krzemińska B, Grzywa-Celińska A, Szewczyk G and Szewczyk KD: A review on the potential use of medicinal plants from the apiaceae and the rosaceae families in cardiovascular diseases experimental evidence and traditional applications. Applied Sciences 2024; 14(9): 3728.
30. Kmail A: Mitigating digestive disorders: Action mechanisms of Mediterranean herbal active compounds. Open Life Sciences 2024; 19(1): 20220857.
31. Sagar K, SU, A. R. GR, Mohan K and Narendran G: "Effect of *Swarnamrita prashana* on growth and development in Indian toddlers. International Journal of Research in Ayurveda and Pharmacy 2018; 9(1): 30–35.
32. Heidarifar R, Mehran N, Heidari A, Koohbor M and Mansourabad MK: "Effect of Dill (*Anethum graveolens*) on the severity of primary dysmenorrhea in compared with mefenamic acid: a randomized, double-blind trial." Journal of Research in Medical Sciences: the Official Journal of Isfahan University of Medical Sciences 2014; 19: 326.
33. Pucker B and Iorizzo M: Apiaceae FNS I originated from F3H through tandem gene duplication. PLoS One 2023; 18(1): 0280155.
34. Mohammed FS, Sevindik M, Uysal İ and Sabik AE: Quercetin: derivatives, biosynthesis, biological activity, pharmacological and therapeutic effects. Prospects in Pharmaceutical Sciences 2023; 21(3): 49-56.
35. Grover P, Mehta L, Malhotra A, Kapoor G, Nagarajan K, Kumar P, Chawla V and Chawla PA: Exploring the multitarget potential of iridoids: advances and applications. Current Topics in Medicinal Chemistry 2023; 23(5): 371-88.
36. Alsenani F, Alsufyani M, Taib M, Almalki W and Bdirah F: A comprehensive review on phytoconstituents, bioactivities, and clinical studies on *Ficus carica* L. (Moraceae) and its role in human health and disease management. Nveo-Natural Volatiles & Essential Oils Journal| NVEO 2023; 10(1): 15-43.
37. Ma YM, Liang XA, Zhang HC and Liu R: "Cytotoxic and antibiotic cyclic pentapeptide from an endophytic *Aspergillus tamarii* of *Ficus carica*," Journal of Agricultural and Food Chemistry 2016; 64(19): 3789-3793.
38. Hao Z, Zhang Y, Cao Y, Sun Y, Wang Y, Zhang C, Liang D, Liu Y and Feng W: Chemical constituents from *Acorus calamus* with potent anti-diabetic and hepatoprotective activities. Fitoterapia 2023; 169: 105591.
39. Rajput SB, Tonge MB and Karuppayil SM: "An overview on traditional uses and pharmacological profile of *Acorus calamus* Linn. (Sweet flag) and other *Acorus species*," Phytomedicine: International Journal of Phytotherapy and Phytopharmacology 2014; 21(3): 268–276.
40. Amrani O, Karim A, Marghich M, Beyi L, Bouknana S and Aziz M: Antispasmodic and antidiarrheal effects of *Juniperus oxycedrus* L. on the jejunum in rodents. Journal of Smooth Muscle Research 2024; 60: 10-22.
41. Ozcan U, Iscan GS, Kulluk E, Sayilkan BU, Esin C, Colak ZN, Meral Y and Dalgın D: First report on the anti-urolithiatic activity of *Viburnum opulus* on urolithiasis/crystalluria in DOGS AND CATS. JAPS: Journal of Animal & Plant Sciences 2023; 33(4).
42. Tanideh N, Jamshidzadeh A and Sepehrimanesh M: "Healing acceleration of acetic acid-induced colitis by marigold (*Calendula officinalis*) in male rats." Saudi Journal of Gastroenterology: Official Journal of the Saudi Gastroenterology Association 2016; 22(1): 50.
43. Matejić JS, Dragićević AV, Jovanović MS, Žarković LD, Džamić AM, Hinić SS and Pavlović DR: Plant products for musculoskeletal, respiratory, circulatory, and genitourinary disorders in eastern and south-eastern serbia–folk uses comparison with official recommendations. Records of Natural Products 2024; 18(1): 1-52.
44. Tang Y, Ou S, Ye L and Wang S: Pharmacological activities and pharmacokinetics of glycycoumarin. Revista Brasileira de Farmacognosia 2023; 33(3): 471-83.
45. Milenković L, Ilić ZS, Stanojević L, Danilović B, Šunić L, Kevrešan Ž, Stanojević J and Cvetković D: Chemical Composition and Bioactivity of Dill Seed (*Anethum graveolens* L.) Essential Oil from Plants Grown under Shading. Plants 2024; 13(6): 886.
46. Beyi L, Marghich M, Karim A, Amrani O and Aziz M: Antispasmodic and Relaxant Effects of *Thymus algeriensis* Dichloromethane fraction on Intestinal Smooth Muscle Motility of Wistar rats. Tropical Journal of Natural Product Research 2023; 7(10): 4916-20.
47. Negri S, Pietrolucci F, Andreatta S, Chinyere Njoku R, Antunes Silva Nogueira Ramos C, Crimi M, Commisso M, Guzzo F and Avesani L: Bioprospecting of Artemisia genus: from artemisinin to other potentially bioactive compounds. Scientific Reports 2024; 14(1): 4791.
48. Pourova J, Dias P, Pour M, Fialová SB, Czigle S, Nagy M, Tóth J, Balázs VL, Horváth A, Csikós E, and Farkas Á: Proposed mechanisms of action of herbal drugs and their biologically active constituents in the treatment of coughs: an overview. Peer J 2023; 11: 16096.
49. Wen J, Zhang JW, Lyu YX, Zhang H, Deng KX, Chen HX and Wei Y: Ethanol extract of *Glycyrrhiza uralensis* fisch: Antidiarrheal activity in mice and contraction effect in isolated rabbit jejunum. Chinese Journal of Integrative Medicine 2023; 29(4): 325-32.
50. Wang H, Zheng Q, Dong A, Wang J and Si J: Chemical Constituents, Biological Activities, and Proposed Biosynthetic Pathways of Steroidal Saponins from Healthy Nutritious Vegetable allium. Nutrients 2023; 15(9): 2233.
51. Yan JK, Zhu J, Liu Y, Chen X, Wang W, Zhang H and Li L: Recent advances in research on Allium plants: Functional ingredients, physiological activities, and applications in agricultural and food sciences. Critical

Reviews in Food Science and Nutrition 2023; 63(26): 8107-35.
52. Pavlović I, Krunić A and Nikolić D: "Chloroform extract of underground parts of Ferulaheuffelii: secondary metabolites and spasmolytic activity," Chemistry & Biodiversity 2014; 11(9): 1417–1427.
53. Gajjar D, Thakkar J, Patel PK and Sagar SR: Phytochemistry, ethnopharmacology and novel formulations based approaches for the treatment of irritable bowel syndrome: a comprehensive review. Phytochemistry Reviews 2024; 1-38.
54. Patel N and Krishnamurthy R: *Moringa oleifera* Accessions: Perspectives and Application as Nutraceuticals and Phytomedicines. In Bioprospecting of Tropical Medicinal Plants. Cham Springer Nature Switzerland 2023; 463-479.
55. Gerschler S, Neumann N, Schultze N, Guenther S and Schulze C: Quality parameters for the medicinal plant *Drosera rotundifolia* L.: A new approach with established techniques. Archiv der Pharmazie 2024; 357(1): 2300436.
56. Rafieian F, Amani R, Rezaei A, Karaça AC and Jafari SM: Exploring fennel (*Foeniculum vulgare*): Composition, functional properties, potential health benefits, and safety. Critical Reviews in Food Science and Nutrition 2023; 1-8.
57. Yazdi H, Seifi A and Changizi S: "Hydro-alcoholic extract of Matricaria recutita exhibited dual anti-spasmodic effects via modulation of Ca2+ channels, NO and PKA2-kinase pathway in rabbit jejunum," Avicenna Journal of Phytomedicine 2017; 7(4): 334–344.
58. Amel B, Cherif HS, Eswayah AA, Abdennour MA and Oliveira IV: "Evaluation of the anti-inflammatory, antispasmodic and healing effects of walnut leaves *Juglans regia* L. aqueous extract," Arabian Journal of Medicinal and Aromatic Plants 2021; 7: 123–140.
59. Roome T, Qasim M, Farooq AD, Ilyas Q, Aziz S and Ali SF: "Antispasmodic activity and mechanism of action of polyherbal formulation DCD-684 on rabbit jejunum." Pakistan Journal of Pharmaceutical Sciences 2021; 34: 711–722.
60. Parcha PK, Sarvagalla S and Ashok C: "Repositioning antispasmodic drug Papaverine for the treatment of chronic myeloid leukemia," Pharmacological Reports 2021; 73(2): 615–628.

How to cite this article:
Das J and Sarma K: A review on the antispasmodic potential of some traditional medicinal plants of India. Int J Pharm Sci & Res 2024; 15(12): 3406-15. doi: 10.13040/IJPSR.0975-8232.15(12).3406-15.