WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 14, 156-168. Review Article ISSN 2277–7105

INTRODUCTION AND PHARMACOLOGICAL ACTIVITY OF ELETTARIA CARDAMOMUM: A REVIEW

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Article Received on
24 May 2024,

Revised on 13 June 2024,
Accepted on 03 July 2024

DOI: 10.20959/wjpr202414-32984

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ABSTRACT

Medicinal herbs of Cardamom biological source of Elettaria cardamomum family Zingiberaceae. it is cultivated mainly in India specially in south India of western ghat, out of India it is origin in Sri Lanka, Indonesia, and Guatemala. Guatemala is a largest exporter of Cardamom. It have medicinal properties with spices properties. Regular consumption of cardamom can confer several health benefits. Cardamom available in vary size and shape and works in Indian kitchen as a spice of queen. Also used in tea for flavoring agent. It is a leafy shoots plant size of the plant 5 to 20 feet. Fruits are used. Also essential oil are very useful in Indian market. Cardamom are very costly in Indian market just because of These labor-intensive harvesting processes drive up the cost of these delicate spices, which, when combined with the additional factor of supply and demand, is responsible for making them some of the most expensive ingredients by weight in the world.. Cardamom is very effective in various disease. Effective chemical constituents are components are cineole and α-terpinyl acetate. Elettaria cardamomum is used as a treatment of shore throat, edema, antidiabetic, anti-scabies. Eating Cardamom daily can be beneficial to your overall health. It can help support digestive health, circulation, and the respiratory system. It can also help reduce inflammation as it is a good source of antioxidants.

KEYWORDS: Cardamom, Health Benefits, Herbal Medicine, 'queen of spices, Zingiberaceae.

INTRODCTION

Cardamom is the dried fruit of Elettaria cardamomum Maton (Zingiberaceae). It is popularly known as the 'queen of spices. 'There are many varieties, which are classified on the basis of

their capsule size and color. Some of the important varieties are Alleppey, Mysore, Malabar, and Mangalore cardamoms.[1]

Physical description of Cardamom (*Elettaria cardamomum*) is Leafy shoots of the cardamom plant arise 1.5 to 6 metres (5 to 20 feet) from the branching rootstock. Flowering shoots, approximately 1 metre (3 feet) long, may be upright or sprawling; each bears numerous flowers about 5 cm (2 inches) in diameter with greenish petals and a purple-veined white lip.[2] The whole fruit, 0.8 to 1.5 cm, is a green three-sided oval capsule containing 15 to 20 dark, reddish brown to brownish black, hard, angular seeds. The essential oil occurs in large parenchyma cells underlying the epidermis of the seed coat. The essential oil content varies from 2 to 10 percent; its principal components are cineole and α-terpinyl acetate.[3]

Cardamom, spice consisting of whole or ground dried fruits, or seeds, of Elettaria cardamomum, a herbaceous perennial plant of the ginger family (Zingiberaceae). The seeds have a warm, slightly pungent, and highly aromatic flavour somewhat reminiscent of camphor. They are a popular seasoning in South Asian dishes, particularly curries, and in Scandinavian pastries.[4]

Introduced to Europe in the mid-16th century, cardamom bears a name that blends the Greek words for “spice” and “cress.” The name is sometimes mistakenly applied to similar spices in the ginger family, but it properly describes two related varieties of the spice, black and green, the latter being the more common. Black cardamom is aromatic and smoky, whereas green cardamom has a milder flavour.

Species used for cardamom are native throughout tropical and subtropical Asia. The first references to cardamom are found in Sumer, and in Ayurveda. In the 21st century, it is cultivated mainly in India, Indonesia, and Guatemala.[5]

It is a A multi-ingredient herbal formulation with *Elettaria cardamomum* as one of the ingredients is found to be useful in the treatment of sore throats. Cardamom is one of the ingredients of a Tibetan herbal formulation that was found to inhibit cell proliferation accompanied by the accumulation of CEM-C7H2 cells in sub G1 phase, fragmentation of poly (ADP-ribose) polymerase (PARP), and nuclear body formation. The volatile oils from *Elettaria cardamomum* are also reported to reduce edema by increasing the permeation of ion-paired DS across viable skin. Eugenol inhibited tobacco-

induced mutagenicity at concentrations of 0.5 and 1 mg/plate, and eugenol and the plant extracts also inhibited the nitrosation of methyl urea in a dose-dependent manner. The antispasmodic activity was studied in a rabbit intestine preparation, using acetylcholine as agonist. The results from this study showed that cardamom seed oil exerts its antispasmodic action through muscarinic receptor blockage. The extract from the seeds of cardamom also exhibited diuretic properties.[6]

Elettaria cardamomum seed extract is one of the ingredients of the polyherbal formulation for treating the dementia of Alzheimer's disease. The extract is also used in herbal combinations utilized in the treatment of anxiety, tension, and insomnia.[7]

Traditional Uses: Traditionally, it is used for controlling asthma, teeth and gum infections, digestive and kidney disorders, cataracts, cardiac disorders, nausea, and diarrhea, asthma and constipation, bronchitis, carminative, cold, cough, congestion of lungs, diuretic, kidney disorders, teeth and gum infections, urinary and pulmonary tuberculosis and irritation of eyelids bladder infections, constipation, stomach ache and dysentery in children, in manufacturing of some plant-based hand creams and soaps, digestive ailments, headaches and inflammation, controlling cold and related symptoms, improves the eyesight.[8,9,10,11]

Chemical Constituents: 1, 8-cineole (28.94%), α-terpinyl acetate (26.7%), α-terpineol (14.6%), sabinene (13.5%), nerol (5.0%) and α-pinene (2.4%) 37 α-terpinyl acetate, 1, 8-cineole and α-terpineol 38 α-terpinyl acetate, 1, 8-cineole, sabinene, linalyl acetate, linalool 39 limonene (2.9%), 4-terpineol (1.4%), α-pinene (1.1%), β-pinene (0.8%), myrcene (0.8%), octanal (0.2%), δ-3-carene (0.4%), p-cymene (0.7%), (E)- nerolidol (0.7%) cis-sabinene hydrate (0.6%), geranylacetate (0.3%), cis-sabinene hydrate acetate (0.2%), β-caryophyllene (0.2%), β-selinene (0.2%), γ-cadinene (0.2%), translinalooloxide (0.1%) 40 α-tocopherol, γ-tocopherol, δ-tocopherol, oleic acid, palmitic acid, linoleic acid α-terpinyl acetate, 1,8-cineole, Linalyl acetate, Sabinene 42; α-terpinyl acetate, Linalool, Sabinene, α-terpineol, Geraniol α-terpinyl acetate, Linalool, 1,8 Cineole, β-terpineol 4-terpineol, 1,8-Cineol, α-terpene, Linalool.[12,13,14]

Pharmacological Activity of *Elettaria Cardamomum*

Anticonvulsant Activity: *Elettaria cardamomum* is an aromatic spice (cardamom) native to the humid Asian areas, which contains some compounds with a potential anticonvulsant activity. Various pharmacological properties such as anti-inflammatory, analgesic,

antioxidant, and antimicrobial effects have been related to this plant. This research was conducted to examine the probable protective impact of the essential oil and methanolic extract of *E. cardamomum* against chemically (pentylentetrazole)- and electrically (maximal electroshock)-induced seizures in mice. In addition, neurotoxicity, acute lethality, and phytochemistry of the essential oil and methanolic extract were estimated. The TLC method showed the presence of kaempferol, rutin, and quercetin in the extract, and the concentration of quercetin in the extract was 0.5 µg/mL. The major compounds in the essential oil were 1,8-cineole (45.6 %), *α*-terpinyl acetate (33.7 %), sabinene (3.8 %), 4-terpinen-4-ol (2.4 %), and myrcene (2.2 %), respectively. The extract and essential oil showed significant neurotoxicity in the rotarod test at the doses of 1.5 g/kg and 0.75 mL/kg, respectively. No mortalities were observed up to the doses of 2 g/kg and 0.75 mL/kg for the extract and essential oil. The essential oil was effective in both the pentylentetrazole and maximal electroshock models; however, the extract was only effective in the pentylentetrazole model. The study suggested that *E. cardamomum* methanolic extract had no significant lethality in mice. Both the essential oil and methanolic extract showed movement toxicity. Anticonvulsant effects of *E. cardamomum* were negligible against the seizures induced by pentylentetrazole and maximal electroshock.[15]

Natural Anti-Inflammatory Activity: The genus *Zingiberaceae* has been widely used for phytotherapeutic purposes in traditional medicine throughout the world for its anti-inflammatory activity. Experimental studies have established that inflammation caused by chronic infections represents a risk factor for different forms of cancer. The objective of this study was focused on determining the anti-inflammatory capacity and cytotoxic activity of aqueous extracts of *Elettaria cardamomum* (cardamom) and *Curcuma Longa* (turmeric). The extracts were obtained by maceration and, through GC-MS/MS, a total of 11 different chemical components were determined in the aqueous extract of cardamom and 7 in the extract of turmeric. The main compounds found in cardamom and turmeric were *α*-terpinyl acetate (54.46%) and *β*-turmerone (33.45%), respectively. RT-qPCR results showed significantly lower gene expression levels of innate inflammatory cytokines (IL-6 and TNF-*α*) compared to the control (LPS). Also, it was observed that the extracts do not possess cytotoxic activity against different cell lines, where *E. cardamomum* showed EC_{50} (µg/mL) of 473.84 (HeLa cells), 237.36 (J774A.1 cells), 257.51 (Vero E6 cells), and 431.16 (Balb/C peritoneal cells) and *C. longa* showed EC_{50} (µg/mL) of 351.17 (HeLa cells), 430.96 (J774A.1 cells), 396.24 (Vero E6 cells), and 362.86 (Balb/C peritoneal cells). The results of this

research suggest that natural extracts of *E. cardamomum* and *C. longa* possess anti-inflammatory effects and no cytotoxic activity against HeLa, J774A.1, Vero E6, and Balb/C peritoneal cell lines. Finally, it was observed that the extracts also decreased nitric oxide (NO) production in peritoneal macrophages.[16]

Antimicrobial and Gastrointestinal activity: The present study examined the chemical composition and antimicrobial and gastrointestinal activity of the essential oils of *Elettaria cardamomum* (L.) Maton harvested in India (EC-I) and Guatemala (EC-G). Monoterpenes were present in higher concentration in EC-I (83.24%) than in EC-G (73.03%), whereas sesquiterpenes were present in a higher concentration in EC-G (18.35%) than in EC-I (9.27%). Minimum inhibitory concentrations (MICs) of 0.5 and 0.25 mg/mL were demonstrated against *Pseudomonas aeruginosa* in EC-G and EC-I, respectively, whereas MICs of 1 and 0.5 mg/mL were demonstrated against *Escherichia coli* in EC-G and EC-I, respectively. The treatment with control had the highest kill-time potential, whereas the treatment with oils had shorter kill-time. EC-I was observed to be more potent in the castor oil-induced diarrhea model than EC-G. At 100 and 200 mg/kg, P.O., EC-I exhibited 40% and 80% protection, respectively, and EC-G exhibited 20% and 60% protection, respectively, in mice, whereas loperamide (10 mg/kg, i.p., positive control) exhibited 100% protection. In the in vitro experiments, EC-I inhibited both carbachol (CCh, 1 µM) and high K^+ (80 mM)-induced contractions at significantly lower concentrations than EC-G. Thus, EC-I significantly inhibited *P. aeruginosa* and *E. coli* and exhibited more potent antidiarrheal and antispasmodic effects than EC-G.[17]

Metabolic syndrome: Metabolic syndrome (MetS), as a health-threatening factor, consists of various symptoms including insulin resistance, high blood sugar, hypertension, dyslipidemia, inflammation, and abdominal obesity that raise the risk of diabetes mellitus and cardiovascular disease. Cardiovascular diseases are important causes of mortality among the world population. Recently, there has been a growing interest in using phytomedicine and natural compounds in the prevention and treatment of various diseases. The data was gathered by searching various standard electronic databases (Google Scholar, Scopus, Web of Science, and PubMed) for English articles with no time limitations. All *in vivo, in vitro,* and clinical studies were included. *Elettaria cardamomum* (cardamom) is a rich source of phenolic compounds, volatile oils, and fixed oils. Cardamom and its pharmacologically effective substances have shown broad-spectrum activities including antihypertensive, anti-

oxidant, lipid-modifying, anti-inflammatory, anti-atherosclerotic, anti-thrombotic, hepatoprotective, hypocholesterolemic, anti-obesity, and antidiabetic effects. This review aims to highlight the therapeutic effects of cardamom on MetS and its components including diabetes, hyperlipidemia, obesity, and high blood pressure as well as the underlying mechanisms in the management of MetS. Finally, it can be stated that cardamom has beneficial effects on the treatment of MetS and its complications.[18]

Analgesic Activity: Cardamom oil from seeds of *E. cardamomum* (133-400µl/kg) was evaluated for analgesic activity by using the p-benzoquinone-induced writhing method and compared with standard drug aspirin (50-175 mg/kg). It was observed that aspirin (175 mg/kg) and cardamom oil (400µl/kg) prevented the writhing in treated mice by 100% protection of control values.[19]

Anti-convulsant Activity: The methanolic extract (1, 1.5, and 2 g/kg) and essential oil (0.25, 0.50, 0.75 and 1 ml/kg) from *E. cardamomum* seeds were evaluated for anti-convulsant activity against seizures induced by pentylentetrazole (PTZ) or electrically (maximal electroshock; MES) in NMRI male mice. The essential oil (1 ml/kg) significantly delayed the onset of clonic seizures and increased the onset time of tonic convulsions at all doses in PTZ model and significantly reduced (dose - 1 ml/kg) the percentage of hind limb tonic extension (HLTE) in MES-induced seizure model. Methanolic extract raised the onset time of tonic seizures at all doses and prevented tonic convulsions by 33% at a dose of 1.5 g/kg. The extract and essential oil showed significant neurotoxicity in the rotarod test (dose - 1.5 g/kg and 0.75 ml/kg). These results concluded that anti-convulsant effects were negligible against the seizures induced by pentylentetrazole and maximal electroshock but showed significant neurotoxicity.[20]

Anti-hypercholesterolemic Effect: Whole cardamom powder, de-oiled cardamom powder, and cardamom oil from seeds of *E. cardamomum* were evaluated for anti-hypercholesdterolemic effect against hypercholesterolemia induced Wistar rats at the dose of 50 g/kg. Cardamom oil reduced total blood cholesterol (31%), LDL cholesterol (44%), total serum cholesterol (17%) and LDL cholesterol (28%), respectively. Serum cholestrol exhibit a decrease in triglycerides by 42% and 24% by cardamom oil and whole cardamom. Whereas elevated serum cholesterol: phospholipid ratio in hypercholesterolemic rats was significantly countered by dietary intervention with cardamom oil (27%), atherogenicity index in serum was brought down from 2.92 in hypercholesterolemic rats to 1.38 and 2, respectively by

cardamom oil and whole cardamom. Cholesterol content of cardiac muscle was lowered by 39% with administration of cardamom oil and elevated hepatic cholesterol: phospholipid ratio was beneficially countered by dietary cardamom oil, which reduced the same by 22%. Moreover, treatment with de-oiled cardamom as well as cardamom oil countered the diminished activity of catalase in hypercholesterolemic animals *i.e.*, 50.25 and 40.94 mmol/min/mg proteins, respectively. Cardamom also enhanced the activity of heart superoxide dismutase in hypercholesterolemic situation. Ascorbic acid concentration in circulation was significantly increased by the dietary interventions with cardamom or its fractions both in hypercholesterolemic and normal situations. In conclusion, a significant reduction of athero-genicity index by dietary intervention with cardamom powder and cardamom oil indicates the potential cardioprotective effect of cardamom.[21]

Anti-inflammatory Activity: Cardamom oil from seeds of *E. cardamomum* (175-280 µl/kg) was evaluated for anti-inflammatory activity against carrageenan-induced hind paw oedema in male albino rats and indomethacin at 30 mg/kg, i.p. (76% inhibition) was used standard drug. Cardamom oil (280 µl/kg) exhibited 86.4% inhibition, while at 175 µl/kg oil showed 69.2% inhibition, concluded that cardamom oil (175 µl/kg) provoked a significant suppressive action on carrageenan-induced oedema but to a slightly lesser extent than indomethacin. However, at a dose of 280 µl/kg, oil exerts a more potent anti-inflammatory effect than indomethacin.[22]

Cardioprotective Effect: Cardamom extracts (100 and 200 mg/kg) from fruits of *E. cardamomum* (cardamom) was evaluated for cardio-protective effect against isoproterenol (ISO)-induced myocardial infarction (MI) in Wistar male albino rats. The result showed that ISO injections induced a significant decrease in heart rate and systolic arterial pressure (SAP), diastolic arterial pressure (DAP) and mean arterial pressure (MAP), decrease in myocytes grievance indicator enzymes, creatinine kinase-myocardial bundle (CK-MB), lactate dehydrogenase (LDH) enzymes, significant fall in reduced glutathione (GSH) content and induction of lipid peroxidation as evidenced by increased malondialdehyde (MDA) level in the heart and decreased the activities of endogenous antioxidant enzymes; superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSHPx) in heart as compared to the normal control group.[23]

Anti-spasmodic Activity: Cardamom oil from seeds (200-900nl) was evaluated for anti-spasmodic activity in rabbits, using acetylcholine as an agonist. The oil inhibits the stimulant

action of acetylcholine in a dose-dependent manner. The atropine (3µg) and cardamom oil (400 nl) produced a 50% reduction of the stimulant action of acetylcholine. In conclusion, cardamom oil exerts its anti-spasmodic action through muscarinic receptor blockage.[24]

Diuretic Activity: Crude extract (1, 3, and 10 mg/kg) from fruit was evaluated for diuretic activity in Sprague–Dawley rats, where 10 mg/kg of furosemide (urinary output 6.93 ml) was used as a reference diuretic drug. Results revealed that extract at 1, 3, and 10 mg/kg increased the urinary volume to 4.13, 5.05, and 5.54 ml, respectively, indicating diuretic effect and also enhanced Na+ and K+ excretion. Whereas, Na+ and K+ contents in pooled urine samples were 0.63, 0.69, 0.84 mmol and 0.16, 0.14, 0.20 mmol at the doses 1, 3 and 10 mg/kg, respectively and compared to furosemide 0.88 and 0.19 mmol, respectively.[25]

Anti-Scabies: Sharma and coworkers examined the anti-scabies activity of *E. cardamomum* essential oil for their *in-vitro* anti-scabies potential against Sarcoptes scabiei mites. The essential oil demonstrated scabicidal potential as its 10% concentration caused 100% mortality within 60 min, whereas 5% diluted solution took 80 min to kill all the mites. It was found that Permethrin (reference) killed all the mites within 60 min, but in the negative control group, mortality was only 1.58%, and most of the mites remained alive after 80 min of treatment.[26]

Immunomodulatory Activity: The aqueous extract (1, 10, 50, and 100 µg/ml) was evaluated for immunomodulatory activity by using ELISA. The aqueous extract significantly enhances splenocyte proliferation in a dose-dependent, synergistic fashion. ELISA revealed that extract significantly enhances and suppresses T helper (Th) 1 and (Th) 2 cytokine released by splenocytes. Whereas, experimental evidence suggested that extract exert pro-inflammatory and anti-inflammatory roles. Moreover, nitric oxide pro-duction by macrophages was significantly augmented and reduced. It is strongly suggested that seeds of this plant exert immunomodulatory roles and hence manifest themselves as natural agents that can promote the maintenance of a healthy immune system 47. The protein extract and total extract from *E. cardamomum* (0.1 mg/ml PBS) were evaluated for immunomodulatory activity on the proliferation of splenocytes by using colorimetric MTT assay, and concanavalin-A (Con-A) (7 µg/ml) was used as a positive control. The cell proliferation in the presence of total extract was 102% and cell proliferation induced by Con-A was 93.8%. Whereas cell proliferation in the presence of protein extract was 129%, cell proliferation induced by Con-A was 83.7%.[27]

Protective Effects on Lungs: *E. cardamomum* was evaluated for protective-effect on lungs against pan masala induced damage in the lung of male Swiss mice by using biochemical assay (pNPP kinetic, α- napthylphosphate kinetic and IFCC method). The pan masala treated group (PMT) exhibited marked lung histopathological abnormalities, characterized by a fusion of alveoli and adenocarcinoma with compressive and destructive growth. Extensive fibrosis in peribronchial region and increased thickness of bronchial smooth muscle due to accumulation of collagen. Whereas, on cardamom treatment in the PMT and pan masala with cardamom treated (PMCT) mice, congestion of lungs was mild with almost no medullary hemorrhage. Moreover, enzymatic activities significantly decreased during amelioration, when the treatment groups were exposed only to cardamom, and the values reached almost near the control.[28]

Stimulatory Effect: Crude extract (3-10 mg/ml) and its aqueous fraction from fruit were evaluated for stimulatory effect by measuring the contractile effect in Guinea-pig ileum, where acetylcholine chloride (ACh) was used as a positive control. The extract caused a concentration-dependent contractile effect. The efficacy of the stimulant effect was 9.3, 49.48, and 70.61%, respectively at concentrations of 3, 5, and 10 mg/ml when compared to ACh, while histamine response remained unchanged.[29]

Hepatoprotective Effect: The ethanolic extract was evaluated for hepato-protective effect against high carbohydrate high fat (HCHF) diet-induced obese Male Wistar rats. It observed that HCHF diet feeding in rats developed glucose intolerance, increased peritoneal fat deposition, dyslipidemia, increased fat deposition, and inflammation in the liver compared to control rats. Also, the HCHF diet increased lipid peroxidation, decreased antioxidant enzymes activities, and increased advanced protein oxidation product level significantly in plasma and liver tissue. Whereas supplementation of cardamom improved the glucose intolerance significantly and prevented the rise of lipid parameters significantly, and prevented abdominal fat deposition in HCHF diet-fed rats. Whereas, increased fat deposition and inflammatory cell infiltration in liver, ALT, AST, and ALP enzyme activities in plasma were also normalized by cardamom powder supplementation in HCHF diet-fed rats. Moreover, cardamom powder supplementation ameliorated the fibrosis in liver of HCHF diet-fed rats. These results concluded that cardamom powder supplementation can prevent dyslipidemia, oxidative stress and hepatic damage in HCHF diet-fed rats.[30]

CONCLUSION

In conclusion, cardamom, derived from the seeds of the *Elettaria cardamomum* plant within the Zingiberaceae family, stands as a botanical marvel revered for both its culinary and medicinal properties. Originating from regions such as Sri Lanka, Indonesia, and Guatemala, with Guatemala being the primary exporter, cardamom finds its main cultivation hub in India, particularly in the southern region of the Western Ghats. cardamom serves as a potent medicinal herb, enriched with compounds like cineole and α-terpinyl acetate. Traditionally utilized in treating ailments ranging from sore throat to diabetes and scabies, cardamom boasts a rich history of therapeutic use. offering support for digestive health, circulation, and respiratory function.

Conflict of Interest: No Conflict of Intrest.

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