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A REVIEW ON THE THERAPEUTIC AND MEDICINAL ACTIVITIES OF *COSTUS SPECIOSUS*

Safia M. Bahshwan[1], Buthaina M. Aljehany[2*]

1. ***Department of Biology, Faculty of Science, Al-Baha University, Al-Baha, Saudi Arabia.***
2. ***Department of Food and Nutrition, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, Saudi Arabia.***

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ABSTRACT

Background: *Costus speciosus* (*C.speciosus*), family Costaceae (Zingiberaceae), is a popular medicinal herb that was cultivated in India.It has numerous bioactive compounds that possess multiple pharmacological benefitslike β-carotene, ascorbic acid, glutathione, and α-tocopherol. *C. speciosus*is among the mosteffective Islamic traditional medicinal plants as has been confirmed in the creditable Hadith found in SunanAbiDawud. In prophetic medicine, *C. speciosus*was mostly advised as a treatment for pharyngitis and tonsillitis in children, pleurisy, and antidote for snake venom. **Objective:** This review aimed to collect the studies which proved the different medicinal activities of *C. speciosus* extract. **Results:** The different researches proved that *C. speciosus* extract possesses many medicinal properties such as antioxidant, antidiabetic, anticholinesterase, antibacterial, anthelmintic, antifungal, anticancer, analgesic, anti-inflammatory, antipyretic, antihyperlipidemic, anxiolytic, mosquito larvicidal, estrogenic, nephroprotective and hepatoprotective activities. **Conclusion:** *C. speciosus*was shown to exerts many therapeutic properties in several*in vitro* and *in vivo* experimental researches.

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Introduction

Recently, medical plants are the subject of numerous scientific researches [1].They contain numerous bioactive substances that can be used to prevent and treat severalailments, besides they are safe in contrast to the synthetics medicines [2]. *Costus speciosus* (*C.speciosus*), family Costaceae (Zingiberaceae), is a popular medicinal herb widely used to cure and prevent several illnesses [3]. *C. speciosus* is among the most effective Islamic traditional therapeutic plants [4]. It has numerous bioactive compounds that possess multiple pharmacological benefits [5]. The plant commonly named Kushta, Katar Katar, Kashmira, Kemuka, and Shura in Sanskrit [6], kashmeeramu in Telugu, pushpamoola in Kannada [7], Keu, keukand in Bengali and Hindi, 'Pushkarmula' or 'Penava' in Marathi, Chengalva Koshta' in Kannada and Telegu, and 'Koshtam' or 'Kottam' in Tamil [8], Crepe ginger in English, and Jom lakhuti in Assamese [9].

Costusspeciosus is a succulent, vertical, everlasting, herbaceous, ornamental, tuberous stem, sub-woody at the base, stout crawling rhizomes growing up to 2.0-2.7 m tallness with long lanceolate leaves and essential white flowers [9-11]. The herb blossom by July and August, whereas the aerial parts lose during the cold weather [7, 12]. Flowers of *C. speciosus*resemble crepe paper. The herb has a red color fruit, whereas the seeds are black [8].

Costusspeciosus rhizomes are a perfect origin of saponin such as sapogenin, diosgenin, steroids, tigogenin, and alkaloids [10, 13]. The plant also contains sitosterol-β-D-glucoside, dioscin, α-tocopherol, 5α-stigmast-9(11)-en-3β-ol, prosapogenins A and B of dioscin, quinones, curcumin, gracillin, tricontanol, and tricontanoic acids [14, 15]. Furthermore, *C. speciosus* rhizomes have hydroxyl ketones, aliphatic, starch mucilage, abscisic acid, triterpenes, fatty acids, and corticosteroids [7]. The oil extract from seed contains oleic acid, linoleic acid, palmitic acid, stearic acid, and arachidic acid. Defatted seeds

Corresponding Author: Buthaina M. Aljehany, Department of Food and Nutrition, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, Saudi Arabia.

contained glucose, diosgenin, rhamnose, and galactose [8]. Also, two new quinones are isolated from seeds named dihyrophytilplastoquinone and its methyl derivatives including α-tocopherol quinone. Also, the plant contains an important bioactive sesquiterpene compound named costunolide. The leaves, the flower, and the woody parts of the plant contain flavonoids such as anthocyanins and proanthocyanidins [12, 16]. Besides, *C. speciosus* contains many antioxidants active constituents like glutathione, ascorbic acid, β-carotene, and α-tocopherol [6].

In India, *C. speciosus* is utilized as a food and medicinal remedy [8]. *Costusspeciosus*is among the most effective Islamic traditional medicinal plants as has been confirmed in the creditable Hadith found in SunanAbiDawud. In prophetic medicine, *C. speciosus*was mostly advised as a treatment for pharyngitis and tonsillitis in children, pleurisy, and antidote for snake venom [17]. Nowadays, the plant is used in medication manufacturing as a natural precursor of diosgenin, which is a steroidal sapogenin, it has an important value in the manufacture of cortisone, sex hormones, and oral contraceptives [18]. The *C. speciosus*rhizomes contain about 3.4% diosgenin [19]. *Costusspeciosus* possesses numerous therapeutic benefits. The juice of the rhizome is used to treat a headache, while bruised leaves are used to treat fever [5].

The *C. speciosus* rhizomes are bitter, astringent, expectorant, tonic, and improve digestion [20]. Also, the rhizomes exerted anti-fertility and anabolic actions [21]. Furthermore, the rhizomes extract encourages uterine contraction [22]. The rhizomes also showedcardiotonic and central nervous system (CNS) depressant efficacy. The decoction of the stem is utilized to treat dysentery and fever [8]. Young stems are used to manage diarrhea, cough, jaundice, arthritis, bronchitis, asthma, anemia, inflammations, antiemetic, intestinal worms, and spermatorrhoea [23].

This review aimed to collect the studies which proved the different medicinal activities of *C. speciosus* extract.

Medicinal Activities of *Costus Speciosus*

Antibacterial and Antifungal Effects

Costusspeciosus rhizomes exerted antibacterial activities against many Gram-positive bacteria like *Staphylococcus epidermidis* and *Staphylococcus aureus,* also Gram-negative bacteria like *Pseudomonas aeruginosa*, *Escherichia coli*, and *Salmonella typhimurium*. This action of *C. speciosus* was attributed to the presence of diosgenin, the substrate for steroid formation [23]. The hexane extract of *C. speciosus*rhizomes exhibited significant antibacterial properties against Gram-positive bacteria, including *Escherichia coli, Staphylococcus epidermidis*, *Klebsiellapneumoniae, Staphylococcus aureus*, and *Bacillus subtilis*[24].

The hexane extract also produces significant antifungal activity towards *Trichophytonmentagrophytes*, *Trichophytonrubrum, Epidermophytonfloccosum*, and *Magnaporthegrisea*. In the same study, the researchers isolated two important active constituents from the rhizome extract, eremanthin, and costunolide. The two compounds significantly suppress the growth of many pathogenic fungi at very small doses [25]. Another study revealed the antifungal role of *C. speciosus* rhizome methanolic extract versus multiple *Aspergillus* species that separated from pulmonary infection cases [26]. Furthermore, the methanolic extract of *C. speciosus* rhizome effectively inhibited *Aspergillus fumigatus* in experimental rats [27].

Another recent *in vitro* study to assess the antimicrobial and antifungal activities of *C. speciosus*ethanolic and aqueous extracts against nine pathogenic bacterial strains (*Escherichia coli*, *Salmonella Typhimurium*, *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, *Streptococcus pygenes, Klebsella pneumonia*, *Bacillus species*, and *Proteus mirabillus*) and three pathogenic fungal strains (*Fusarium species, Penicillum species,* and *Aspergillus fumigates*) was reported. The results proved that ethanolic extract has a potent antifungal and antibacterial, while the aqueous extract has an only antibacterial effect against the pathogenic microorganisms [28].

Anticholinesterase Effect

The entire alkaloids extracted from the *C. speciosus* rhizome enhanced the pharmacological impacts of acetylcholine both *in vivo* and *in vitro*. Biological assay of these alkaloids both on frog rectus abdominis and dog blood pressure revealed anticholinesterase action. This anticholinesterase activity may underly the utilization of rhizome in the treatment of ocular diseases [29].

Antioxidant Effect

*Costusspeciosus*extracts proved to have potent antioxidant activities *via* its content of antioxidants molecules as β-carotene, glutathione, α-tocopherol, and ascorbic acid. I*n vitro* studies have shown free radical scavenging effects of the alcoholic and chloroform extracts of the aerial parts and rhizome of *C.speciosus* in 2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid; 1,1-diphenyl-2-picrylhydrazyl (DPPH); and thiobarbituric acid assays [30]. In a different *in vitro* trials, it was established that *C. speciosus* rhizome alcoholic extract possesses a potent reactive oxygen and nitrogen species quenching efficacy compared to ascorbic acid and quercetin [31].Furthermore, *in vitro* investigation of the antioxidant potency of different *C. speciosus* rhizomes extract, many of them showed strong radical, nitric oxide, and hydroxyl radical scavenging action, which could be attributed to the phenolic constituents of *C. speciosus*. Besides, the benzene extract showed the maximum antioxidant activities besides maximum phenolics constituents [12].

An *in vivo* study, both costunolide and eremanthin (*C. speciosus* active constituents) provoked a significant lowering in lipid peroxidation products (malondialdehyde) in STZ-induced diabetes in rats. Both costunolide and eremanthin increase the levels of both reduced glutathione and the action of antioxidant enzymes in various tissues [32]. In another study on the impact of consuming *C. speciosus* ground rhizomes (2.5-5 Kg/ton) added to buffalo heifers' diets, it was revealed that *C.*

speciosus feeding animals gained an increase antioxidant power as demonstrated by the significant reduction in lipid peroxidation and the amelioration of total antioxidant ability [15].

Anticancer Effect

Various *C. speciosus* rhizome extracts produced a dose-dependent antioxidant and antiproliferative properties against human colon adenocarcinoma cell lines (COLO 320 DM) [33]. Also, it was proved that methyl alcohol extract of *C. speciosus* leaf (100 µg/ml) significantly decreased hepatocellular carcinoma (HepG2) cell viability [34]. In another study revealed that diosgenin an important active constituent of *C. speciosus* produced a significant cytotoxic activity against HepG2 cells and breast adenocarcinoma MCF-7 cells. Also, the cytotoxic action of diosgenin is comparable to that of paclitaxel. Diosgenin promotes MCF-7 cell apoptosis *via* increasing the expression of death receptor-4 and caspase-3 [35].

Another recently published study conducted to assess the anticancer activity of *C. speciosus* extracts against proliferation, invasion, apoptosis, migration, and cell cycle distribution of human prostate cancer PC-3 cells. The results showed that *C. speciosus*extracts inhibited the clonal growth, invasion, proliferation, and migration of PC-3 cells *via* apoptosis induction [36].

Anti-inflammatory, Antipyretic and Analgesic Effects

Costusspeciosus has been proved to possess strong anti-inflammatory, analgesic, and antipyretic activities [37, 38]. The *C. speciosus* aerial parts alcoholic extract induced anti-inflammatory (against carrageenan-induced paw edema), analgesic (acetic acid-induced writhing, and Eddy's hot plate method), and antipyretic (Brewer's yeast-induced pyrexia) actions in rats [38]. Also, a clinical study conducted at King Abdulaziz University, Saudi Arabia, the *C. speciosus* aqueous extract used as nasal drops on 15 participants with acute pharyngitis and tonsillitis, produced amelioration in acute signs in 60% of the subjects during the initial twenty-fourhours and the remission rate (93 %) after five days [39].

Antidiabetic Effect

Methyl alcohol, hexane, and ethyl acetate extracts of *C. speciosus* rhizomes significantly reduced the plasma glucose level in the STZ rat model of diabetes. Also, hexane extract markedly lowered the glycosylated hemoglobin, total cholesterol, and triacylglycerol. The study referred to this hypoglycemic action to the enhanced insulin secretion provoked by *C. speciosus* consumption [40]. The *C. speciosus* rhizome ethanolic extract administered to alloxan-induced diabetic rats produced antihyperglycemic and antihypercholesterolemic actions. The extract induced glycogenesis and inhibited gluconeogenesis, thus pulled the blood glucose to its average levels [20].

The methanol, ethyl acetate, hexane, and aqueous extracts of *C. speciosus*, supplemented orally to STZ-diabetic rats for about eight weeks significantly reduced blood glucose levels compared to the diabetic rats. Moreover, *C. speciosus* hexane extract restored the normal levels of both plasma insulin and C-peptide [41]. Other research confirmed the inhibitory action of *C. speciosus* leaves extract on porcine pancreatic α-glucosidase and α-amylase activities. The authors explained the effects of *C. speciosus* leaves extract *via* retard the carbohydrate metabolism, lowered glucose absorption, reducing the postprandial rise of blood glucose level, and lessen advanced glycation end products [42].

Antihyperlipidemic Effect

Costunolide, isolated from *C. speciosus* (20 mg/kg) administration for 30 days in STZ-diabetic rats markedly reduced serum low-density lipoprotein-cholesterol, triglyceride, and total cholesterol compared to diabetic rats, this hypolipidemic effect may induce *via* the stimulation of β-cells to insulin secretion by costunolide [43]. In a similar study, the ingestion of eremanthin (20 mg/kg) for 2 months in STZ-diabetic rats reduced serum triglyceride (TG), total cholesterol (TC), and low-density lipoprotein-cholesterol together. Also, it increased both tissue glycogen and high-density lipoprotein-cholesterol [44].

In another study, the effect aqueous and alcoholic extracts of *C. speciosus* leaves (500 and 1500 mg/kg) on rats fed high-fat diet was studied. The results documented that *C. speciosus* leaves aqueous and alcoholic extracts significantly decreased serum insulin level, insulin resistance (IR), and serum triglycerides in IR rats. The extracts reverse the peripheral IR induced by the high-fat diet in rats [45].

Anxiolytic Effect

*Costusspeciosus*extracts markedly decreased the stress-induced elevation of serotonin concentration in the brain by inhibiting the feedback mechanism that triggers a marked rise in serotonin [46]. Furthermore, *C. speciosus* extract ameliorates cold immobilization-induced stress, brain neurotransmitters, and enzyme monoamine oxidase changes in male rats. The extract also normalizes norepinephrine, dopamine, 5-hydroxy tryptamine, and monoamine oxidase enzyme [47].

Nephroprotective Effect

In a research study comparing the diuretic effect of *C. speciosus* roots extract with furosemide, the herbal extract markedly increased urine output an effect comparable to the standard diuretic agent [10]. Recently the extracts of *C. speciosus*have been found to ameliorate the hepatorenal toxicity-induced by cisplatin in rats [48].

Estrogenic Effect

The methanolic extract of *C. speciosus* rhizome produced a marked reduction in ovarian weight besides, a marked rise in uterine weight of adult female rats. *C. speciosus* is suggested to prevent pituitary gonadotrophic hormone. The herb may also have an estrogenic action, which explains the uterine weight increase [9]. In another study, it was proved that *C.*

*speciosus*rhizomesethanolicextract triggersphasic activity in female rats' uterus and increase uterotonic contraction. The extract has an effective uterine stimulant [22].

Hepatoprotective Effect

Methanolic extract of *C.speciosus* rhizomes (100 mg/kg, for 14 days) markedly improved serum levels of liver function enzymes (alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP)) after carbon tetrachloride (CCl_4)-induced hepatotoxicity in mice [49]. In another study, the ethanolic extract of *C. speciosus* (500 mg/kg, for 14 days) significantly ameliorated liver function enzymes against hepatotoxicity induced *via*CCl_4 in rats,and these effects are comparable to the universal hepatoprotective agent, silymarin [50]. Furthermore, the pretreatment with methanol extract of *C. speciosus*rhizomes for seven days against acute liver injury induced by paracetamol in mice was evaluated. Administration of *C. speciosus*rhizomes extract (200 mg/kg) showed hepatoprotective action as shown by thesignificant improvement of the liver enzymes, as well asthe marked reduction of the inflammatory reactioncompared to silymarin [51].

Anthelmintic Effect

Aqueous and alcoholic extracts of *C. speciosus* aerial parts (25, 50, and 100 mg/ml) displayed a marked anthelmintic effect against Indian adult *Pheretimaposthuma* compared to regular therapy (Albendazole), the aqueous was more effective on paralyzing the warms than alcoholic extract [5].

Mosquito Larvicidal Effect

Aqueous extract of *C. speciosus* leaves showed a marked larvicidal activity against Aedes aegypti larvae with very high percentage mortality [9].

Conclusion

From the collected studies, we could conclude that *C. speciosus* extract possesses many medicinal activities such as antioxidant, anticancer, anti-inflammatory, antibacterial, anticholinesterase, anthelmintic, antifungal, analgesic, antipyretic, antidiabetic, antihyperlipidemic, diuretic, estrogenic, anxiolytic, mosquito larvicidal, nephroprotective, and hepatoprotective activities.

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