# A Review on Pharmacological Activities of Gardenia Jasminoides (Rubiaceae) A Plant Having Immense Medicinal Potentiality

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**Abstract**

Various medicinally active plants are used in India's folk medicine, Ayurveda and Unani. Indian Vaids, Unani hakims, European and Mediterranean cultures used different parts of the plants like bark, leaves, flower, and roots used for treating disease for over 4000 years as medicine. Therefore, herbal medicine is gradually increasing in all developed and developing countries. Gardenia jasminoides belong to the family Rubiaceae, generally known as Cape jasmine in Assam, Gandhraj in Bengali, Anant in Marathi, etc. It is widely available in the many states of India, like West Bengal, Gujrat, Eastern Himalayas, etc., and many countries like Japan, China, Africa, etc. This evergreen plant is a promising aromatic medicinal plant as per Ayurveda, Siddha, and Unani. An extensive literature survey found that different parts of the plant exhibit significant therapeutic impact. This article's major goal is to highlight the plant's Phytochemicals and pharmacological properties. Various organic solvent extraction of the different parts of the plant reported the presence of glycosides, flavonoids, organic acids, saffron glycosides, monoterpenes, triterpenoids, alkaloids, etc. These are responsible for showing potent pharmacological activities like anti-hyperglycemic, anti-atherosclerotic, anti-inflammatory, anti-arthritis, anti-cancer, anti-apoptotic, antioxidant, anti-angiogenic, anti-thrombotic, anti-microbial, antibacterial, cytotoxic, antioxidants, astringent, emollient, refrigerant, and diuretic, etc. Hence we can conclude that Gandhraj is an important medicinal plant that could be used to develop new drug formulations, which could be used to improve our health conditions.

Keywords: Gardenia jasminoides, Laxative, Antibacterial, Toxicological study.

## 1. Introduction

Chinese herbal remedies have been used for thousands of years, and it has been demonstrated that they are quite effective in treating a variety of illnesses and boosting health. Because of their low toxicity and superior performance, natural goods have particularly drawn more attention in recent years. As a result, numerous nations have progressively turned their attention to studying therapeutic plants. The traditional herbal sector has a significant competitive advantage and huge market potential in the knowledge economy[1,2].Natural dyes have been utilized in numerous industries, including cotton, textiles, drinks, and food, since the dawn of time . Natural dyes are currently becoming more and more popular as a result of the public's growing worries regarding the negative consequences of synthetic pigment. They also play a significant part in the current industrial system as food additives, nutritious foods, and potentially effective medications[3,4].The evergreen Gardenia jasminoides, also known as ZhiZi in Chinese, is cultivated across China. It is a member of the Rubiaceae family[5].

It also is mentioned in Koreanpharmacopoeias for its therapeutic effects. It is also known as Gardenia Augustaand FructusGardeniae, it is popularly known as Anant in Marathi, Gandharaj in Hindi. An evergreen flowering plant known by several names, including gardenia, cape jessamine, danh-danh, and jasmine[6].It produces fragrant white flowers and spreads in many temperate climates . It has been used for many years as natural yellow dyes as well[5,7,8]. The fruit of the Gardenia jasminoides plant has historically been used to create traditional medicines for the treatment of liver diseases, fever, edoema, headaches, and hypertension[6]. But also has a variety of biological properties, including antidiabetic[9], anti-inflammatory[10],antidepressant[11],antioxi- dant[12]and sleep-quality enhancement properties, anti-hyperglycemic, anti—atherosclerotic, anti-arthritis, anti-cancer, anti—apoptotic, anti-oxidant,anti-angiogenic, anti-thrombotic, anti-microbial and miscellany eous activities[13].Many Asian continents, including Vietnam, Southern China, Taiwan, Japan, Myanmar, and India, are where it first appeared. Warm temperate and subtropical areas have it growing in the wild as well as in gardens[6]. The extraction methods have recently received the

doi.org/10.31838/hiv23.03.95 Received: 26.10.22, Revised: 27.11.22, Accepted: 15.12.22.

majority of attention in the chemical analysis of G. jasminoides. Both in vitro and in vivo, obtained extracts have demonstrated specific biological activity. According to recent studies, G. jasminoides oil extract has antidepressant properties[11].Additionally, G. jasminoides is a commonly used food colourant and health food in oriental nations for creating porridge and tea, and it is the medicine food homology published by the National Health Commission of the People's Republic of China[14].Multiple studies on G. jasminoides must be advanced, according to the pertinent information, and a thorough review is required. The findings of various studies on G. jasminoides that have been published recently are reviewed here[15].

## 2. Pharmacological Activities

Gardenia jasminoides has been used in traditional medicine for thousands of years as a folk remedy for a variety of diseases, including the treatment of inflammation. Various pharmacological constituents has been found from various parts of the Gardenia jasminoides.

### 2.1 Anti-diabetic activity and improving insulin sensitivity

Type 2 diabetes is brought on by insulin resistance. With an ideal dose of 200 mg/kg of G. jasminoides water extract, insulin sensitivity is improved in rats that have been made resistant to insulin by steroids[16].Age-related insulin resistance was reduced by genipin, which also improved hepatic oxidative stress, mitochondrial dysfunction, and impaired insulin signaling[17].Geniposide reduced hyperinsulinemia and impaired glucose tolerance, which are known in patients with type 2 diabetes and are brought on by visceral fat buildup[18].In diabetic mice, geniposide (200 mg/kg and 400 mg/kg) was demonstrated to be an effective hypoglycemic drug that markedly reduced blood glucose, insulin, and triglyceride levels in a dose-dependent manner. Inhibiting the adherence of monocytes to human umbilical vein endothelial cells and the production of cell adhesion markers produced by high glucose, geniposide also revealed positive effects on diabetic vascular damage[19,20].By reducing blood triglycerides, free fatty acids, and serum insulin, crocetin may be able to counteract the development of insulin resistance brought on by dexamethasone[21].Meanwhile, we discovered that geniposide may stop palmitate from forming[22], hIAPP[23], and damage to pancreatic cells brought on by excessive glucose[24].In China, G. jasminoides has long been used alone or in conjunction with other herbal remedies to treat type 2 diabetes mellitus[25].

### 2.2 Anti-inflammatory Activity

Extracts of G. jasminoides have a potent anti-inflammatory effect[26].water extracts of G. jasminoides demonstrated anti-inflammatory properties by significantly lowering JNK2/1 (c-Jun N-terminal protein kinase) and p38 MAPKs (mitogen-activated protein kinase) phosphorylation and lowering COX-2 (cyclooxygenase-2) expression in LPS-induced BV-2 cells, When rats were exposed to LPS-induced hepatic injury, the liver pathology was significantly reduced when G. jasminoides water extracts were used[27].In 2006, Koo et al. examined the anti-inflammatory properties of the herb's ethanol extract in rat paw and air pouch oedema models that were induced by carrageenan[26]. G. jasminoides aqueous extract has been used for centuries in Asian nations to treat inflammation. The effects of G. jasminoides on mice with cerulein-induced acute pancreatitis (AP) showed that treatment with G. jasminoides significantly lessened the severity of pancreatitis and pancreatitis-related lung injury by reducing pancreatic edoema, neutrophil infiltration, serum amylase and lipase levels, serum cytokine levels, and mRNA expression of multiple inflammatory mediators[28].Additionally, the combination of G. jasminoides and Sandostatin helps prevent pancreatic mitochondrial damage in cases of severe acute pancreatitis[29].Geniposide had an anti-inflammatory impact by lowering the expression of Toll-like receptor 4, which was increased by LPS and inhibited the downstream NF-kB (nuclear factor-kB) and MAPK signalling pathways. Acute liver injury, acute lung injury, and mastitis may all be treated with geniposide, an anti-inflammatory medication[30].Crocin might suppress COX-1 and COX-2 activity, produce prostaglandin E2, and prevent paw inflammation in rats and mice caused by xylene and carrageenan[31].

### 2.3 Antidepressant activity

One of the most common and serious mental illnesses in the world is depression. It is one of the leading causes of disability and is defined by depressive moods.In the family and society, it poses a serious threat to health. To quickly and effectively lessen mental illnesses, a number of traditional Chinese medicines have been developed. It's interesting that G. jasminoides is present in many traditional herbal remedies for the treatment of psychiatric disorders, such as irritability, anxiety, and depression, such as "Yueju Wan" and "Zhi-Zi-Hou-Pu Tang." Yueju pills, in instance, are regularly given to alleviate anxiety and sadness. A pilot study found that the Yueju ingredient G. jasminoides is what gives the herb its quick antidepressant effect[32].The drug was isolated from G. jasminoides using supercritical fluid extraction, and the geniposides it contained had antidepressant properties that were assessed using tail suspension tests and forced swim tests[11].In the 24-hour tail suspension test, G. jasminoides demonstrated an antidepressant effect[33]. The mechanism of antidepressant ingeniposide may be related to an increase in serotonin levels in mouse striatum and hippocampal regions and monoamine oxidaseB[34,35]. By controlling glycolysis/gluconeogenesis TCA cycle and hepatic dlipid metabolism, genipin has antidepressant effects[36].Depression can occur as a result of ongoing stress and an overactive hypothalamus, pituitary, and adrenal axis. It has also been demonstrated that geniposide, which is derived from G. jasminoides, has a strong, antidepressant-like effect[37].

## Anti-arthritis activity

Inhibiting colonic inflammation damage by lowering the expression of tumor necrosis factor-alpha (TNF-), interleukin-1(IL-1) and interleukin-6(IL-6), upping the production of interleukin-10(IL-10), and reducing the expression of phospho-p38 (p-p38) related proteins in fibroblast-like synoviocyte proliferation were some of the mechanisms by which genipositetreated arthritis. By down-regulating the expression of p-JNK signalling in mesenteric lymph node lymphocytes (MLNL) and peripheral blood lymphocytes (PBL) of adjuvant arthritis (AA) rats and decreasing the expression of phospho-JNK (p-JNK) in MLNL and PBL of AA rats, geniposide significantly reduced paw swelling and arthritis index and exerted immunoregulatory effects in the pathogenesis of rheumatoid arthritis[38].In the earlier study, its potential for treating rheumatoid arthritis was demonstrated[39].

## 2.5 Anti–oxidant activity

Aqueous extract of Gardenia jasminoides fruit showed higher anti-oxidant activity than its ethanolic extract in terms of reducing power[12] and free radical scavenging activities, and its anti-oxidant potential of methanolic extract of Gardenia jasminoides contributed because of phenolics and flavonoids in leaves[40].The fruit of G. Jasminoides contains the water-soluble carotenoid crocin, which has been shown to have anti-oxidative properties. The anti-oxidative activity of crocin is comparable to that of BHA at 20 g/mL[41].Additionally, due to its antioxidant and antiapoptotic qualities, crocin may be able to significantly lessen the harm that ischemia/reperfusion (IR) injury causes to the retina[42]. Induction of endogenous antioxidative proteins appears to be a reasonable strategy for delaying the progression of ageing and neurodegenerative disorders because oxidative stress in the brain plays a crucial role in both ageing and age-related neurodegenerative disorders. In order to increase the adaptation to oxidative stress and reduce the cell apoptosis induced by 3-morpholinosydnonimine hydrochloride (SIN-1), the main bioactive compound of G. Jasminoides, geniposide, up-regulated the expression of heme oxygenase-1 (HO-1) via PI3K/Nrf2 signalling pathway in primary cultured hippocampal neurons[43].Due to its scavenging ability, neutrophil infiltration and colonic lipid peroxidation resulted[44].Gardenia jasminoides Ellis was responsible for the discovery of a novel anti-oxidant water-soluble polysaccharide that exhibited impressive scavenging abilities[45].

## 2.6 Anti-apoptotic and anti-cancer activities

The Gardenia jasminoides extract's dichloromethane fraction was the most effective when compared to the other fractions, which included n-hexane, ethyl acetate, n-butanol, and aqueous. This mechanism of apoptosis caused a partial uptick in caspase-3, caspase-8, and caspase-9 activities as well as the cleavage of poly (ADP-ribose) polymerase[46].Geniposide inhibits the effects of formaldehyde on stress and apoptosis by up regulating the activity of intracellular antioxidants (superoxide dismutase and glutathione peroxidase); mRNA and protein levels of the anti-apoptotic gene Bcl-2; and geniposide shields SH-SY5Y cells from apoptosis by downregulating the expression of the apoptotic-related gene P53[47].In human non-small-cell lung cancer H1299 cells, genipin significantly increased the expression of phosphorylated p38MAPK, activated downstream signalling by phosphorylating ATF-2, and increased levels of Bax, a protein that is antagonistic to p38MAPK signalling. These effects were mediated by genipin's strong induction of apoptotic cell death[48].By reducing UVB-induced mRNA expression of tumour necrosis factor (TNF) and interleukin-1 (IL-1), gardenia jasminoides extract showed anti-oxidative and anti-apoptotic effects in HaCaT cells[49].According to a similar mechanism as in earlier studies[48,50], genipin exerted anti-proliferative activity in MDA-MB-231 human breast cancer cells[51].

## 2.7 Anti-angiogenic activity

The butanol portion of Gardenia jasminoides the bioassay revealed that Ellis fruit had the greatest impact on the anti-angiogenic activity of the successive fractions of hexane, ethyl acetate, and water[52].NIH3T3 cell line growth was inhibited by geniposide at concentrations between 25 and 100 micro, demonstrating dose-dependent antiangiogenic activity[53]. Human umbilical vein endothelial cells (HUVECs) and human retinal micro vascular endothelial cells (HRMECs) migration were inhibited, and p38 was significantly phosphorylated to protect VE-cadherin expression, reducing the anti-angiogenic effects of crocetin on VEGF-induced proliferation[54].

## 2.8 Anti-thrombotic activity

Iridoid glycosides (IGs) have been found to have anti-thrombotic properties, and it has been suggested that they may help treat cerebral ischemic diseases like cerebralapoplexy[55].

Crocetin's antihypertensive and antithrombotic effects increased NO bioavailability, possibly through a reduction in NO inactivation by reactive oxygen species[56].By preventing platelet aggregation in vivo and inhibiting phospholipase-A(2) [(PLA (2)] activity, geniposide exerted an anti-thrombotic effect by opposing the activity of the platelets. The amount of EV71 virus infections and activity at the internal ribosome entry site were both significantly reduced as a result of the activity inhibition. Geniposide inhibited viral IRES activity as well as replication of the anti-enterovirus-71 (EV71)[57].

## 2.9 Anti-microbial activity

Gardenia jasminoides extracts including 13 bioactive components were fractionated under bioassay guidance and demonstrated antiviral activity in vivo against influenza virus strain A/FM/1/47-MA[58]. When Gardenia jasminoides Ellis' air-dried flowers were turned into a dichloromethane extract, it showed moderate activity against Candida albicans, slight activity against E. coli, Pseudomonas aeruginosa, Staphylococcus aureus, and Trichophytonmentagrophytes, and inactivity against Bacillus subtilis and Aspergillusniger[59]. A wood-rotting fungus called Pleurotusostreatus was most effectively combated by a methanolic extract of Gardenia jasminoides Ellis[60].

## 2.10 Miscellaneous activities

With the hippocampus expressing more brain-derived neurotrophic factor (BDNF) after just one administration of Gardenia jasminoides extract, the number of escape failures in the learned helplessness test was significantly reduced, and the latency of food consumption in the novelty suppressed-feeding test was decreased[61]. By decreasing RANKL-induced IB degradation as well as osteoclastic marker mRNA expression such NFATc1, TRAP, and OSCAR and inhibiting c-Fos protein proteolysis in RANKL-treated BMMs, genipin prevented RANKL-induced osteoclast development in bone marrow macrophages (BMMs) during culture. Genipin might be a viable option for the treatment of osteoporosis[62]. By blocking MMP production, such as the release of MMP-1 and MMP-3 from human periodontal cells triggered by TNF, genipin proved effective in treating periodontal disease[63]. Crocetin demonstrated its hypnotic properties[64]. Gardenia jasminoides oil extract is utilized as a depression treatment[65].

## 3.Different Extracts From Gardenia Jasminoides And Their Bioactivities

| G. jasminoides | Bioactivities | Model | Proposed mechanism | Refs |
|---|---|---|---|---|
| Geniposide | Antithrombotic &antiangiogenic. | In vivo | Inhibited collagen-induced, but did not inhibit arachidonate-induced, mouse platelet aggregation. | 53 |
| | Anti-inflammatory | In vivo | Reducing the expression of TLR4 by LPS | 30,66 |
| | Antiarthritis | In vivo | Down regulated the expression of p-JNK. | 67 |
| | | In vivo | Decreased the expression level of TNF-α, IL-1, & IL-6, increasing the production of IL-10 & inhibiting the expression of phospho-p38 (p-p38) related proteins in FLS. | 68 |
| | Genotoxicity | In vitro | Damage of DNA in rec assay using V79 cells. | 69 |
| | Antidiabetes | In vivo | Inhibited the adhesion of monocytes to HUVECs & the expression of CAMs induced by high glucose. | 20 |
| Oil Ethanol extract | Antidepressant activity | In vivo | Associated with the elevated expression of brain-derived neurotrophic factor in the hippocampus | 32,70 |
| Crocetin | Antihypertensive & antithrombotic effects | In vivo | Related to the increase in bioavailable NO | 71,72 |
| | Prevent insulin resistance Inhibit retinal damage | In vivo | Inhibited increase in caspase-3 & -9 activities | 21,73 |
| Crocetin | Alleviate renal dysfunction. Improve the quality of sleep | In vivo | adult men | 13,73 |
| Water extracts | Improvement of insulin sensitivity | In vivomouse | Exert a peroxisome proliferator activated receptor | 16 |
| | Anti-inflammation | In vitro | Reduce JNK1/2, & p38 MAPKs phosphorylation, & slightly reduce cyclooxygenase (COX)-2 expression in BV-2 cells | 27 |
| | PREVENTION OF ARTERIOSCLEROSIS & THROMBOSIS | In vivo | The hot water extracts of G. jasminoides did not stimulate the proliferation of cultured vascular smooth muscle cells | 74 |
| n-Butanol fraction Genipin | Inhibit gastric lesions | In vivo | Was relevant with the antioxidant activities, acid-neutralizing capacities, & anti-Helicobacter pylori | 75, 76 |
| | Reduce insulin resistance | In vivo | A close relationship with the improvement of hepatic oxidative stress, mitochondrial dysfunction & insulin signal impairment | 17 |
| | Protection of liver damage | In vivo | Antioxidative, antiapoptotic activities, & inhibition of NF-kB nuclear translocation & nuclear p-c-Jun expression | 77 |
| | Antidepressant activity | In vivo | Regulating the glycolysis/gluconeogenesis, TCA cycle & lipid metabolism of liver | 36 |

## Conclusion

In the Traditional Chinese Medicine (TCM),Gardenia jasminoides has long been used over many years. G. Jasminoides a excessive component of traditional Ayurvedic medicine as well as a crucial raw material for the food and chemical industries. From G. Jasminoidescrocin is isolated as yellow pigment which has long been used as yellow food colorent. Over thousands year genipin ,geniposides, crocin, and crocetin major constituents of G. Jasminoides have been used . In future G. Jasminoides study is till need especially for its various mechanism and affecting target area. Now a day's research on G. Jasminoides extract are being observed on many animals . Although, G. Jasminoides bioactive ingredients are also being performed on animal. The extract of G. Jasminoides like Crocin has many medicinal effects Such as antioxidant and anti-Inflammatory activities, is anti-hyperlipidemic, and is protective of the injured liver. Antihypertensive and anti-thrombotic effects, prevents insulin resistance, inhibits retinal damage, alleviates renal dysfunction, and improves sleep quality are been found in Crocetin extract. Most importantly, oil extract of G. Jasminoides exhibited antidepressant activity. Ideally, oil from G. Jasminoides Will be available soon, G. Jasminoides might be used to create a type of therapeutic agent for treating depression. To date, numerous pharmacologic activities have been investigated, and numerous active phytoconstituents have been isolated and used in the treatment of illnesses and diseases. This information's scientifically accurate scenario will be useful for formulating research plans, and the patenting process will also aid in identifying any research limitations that could prevent the creation of intellectual property.

Conflicts of interest: nil

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