



Phytochemical Profile and Pharmacological Action of *Viburnum Opulus* L. A Comprehensive Review

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Abstract

Viburnum opulus L., commonly known as the European cranberry bush or The guelder rose is a widely distributed deciduous shrub in Asia, Europe, and North America. Traditionally, its fruits and bark have been used to treat various ailments, including uterine cramps, inflammation, and gastrointestinal disorders. The plant is rich in diverse phytochemicals such as phenolic acids, flavonoids, anthocyanins, triterpenes, coumarins, and iridoids, which contribute to its wide range of pharmacological effects. Experimental studies have demonstrated significant antioxidant, anti-inflammatory, antispasmodic, antimicrobial, cardioprotective, and antidiabetic activities. Primarily, these biological effects attributed to compounds like cyanidin-3-glucoside, chlorogenic acid, and derivatives of ursolic acid. The present review consolidates current knowledge on the botanical characteristics, phytochemical composition, extraction processes, and pharmacological properties of *Viburnum opulus*, emphasizing its potential as a valuable source of natural therapeutics and functional food ingredients.

Keywords: *Viburnum opulus*, phytochemicals, antioxidant, anti-inflammatory, antidiabetic, pharmacological activity.

Introduction

Viburnum Opulus

There are more than 230 species in the genus *Viburnum*, many of which are used for ornamental purposes. However, *Viburnum opulus* L. (European cranberry bush) is also well-known for its bitter, edible fruits. *V. opulus* is common in eastern, northeastern, western, and central Europe, as well as in western and eastern Siberia. [1]

Recent research suggests that *V. opulus* can be used as a treatment for ulcers, rheumatism, colds, coughs, tuberculosis, stomach and intestinal kidney issues.

[2]

Anthocyanins are a group of naturally occurring phenolic compounds that play an important role in determining the color quality of numerous flowers, fruits, vegetables, and their derived products. Anthocyanins have recently been linked to significant biological activities,

demonstrating antioxidant, antimutagenic, anticancer, and anti-obesity properties, as well as reducing the risk of coronary heart disease.[3]



Fig: Berries of Viburnum Opulus



Fig: Flowers OF Viburnum Opulus

Taxonomy and Botanical Description

Scientific Name: *Viburnum opulus* (VO)

Genus: *Viburnum* L.

Family: Adoxaceae (previously classified under Caprifoliaceae; sometimes placed in the monotypic family Viburnaceae)

Common Names: Guelder rose, European cranberry bush, water elder, rose elder, rose ebru, cherry-wood, cramp bark, snowball tree, gilaburu (Turkey)

Geographical Distribution: Naturally found across Europe, North Africa, and North Asia; grows in the central region of Russia

Habitat: Commonly occurs in natural habitats within the European continent and neighboring regions. [4]

Morphological Characteristics of *Viburnum opulus*

It is a fast-growing deciduous shrub that can reach 4–5 meters in height. The leaves are transverse, three-lobed, rounded at the base, and have roughly serrated

margins. The upper surface of the leaves is bare and dark green, while the lower surface is lighter and slightly hairy with star-shaped hairs. When the flowers mature, the leaves turn a scarlet-reddish-purple color.

White flowers at the top of the stem develop in clusters with a diameter of 4–11 cm. Each inflorescence is made up of large, sterile flowers in the outer ring and smaller, fertile flowers in the inner ring. The ornamental cultivar, dubbed “Roseum,” contains only sterile flowers, giving it a snowball-like appearance. [5]

Phytochemical Constituents

Phenolic Compounds

According to Turek and Cisowski, the phenolic compounds of *V. opulus* bark include three cinnamic acid derivatives (caffeic, p-coumaric, and ferulic acids), four derivatives of benzoic acid (syringic, gallic, protocatechuic, and 3,4,5-trimethoxybenzoic acids), and two derivatives of phenylacetic acid (homogentisic and 3,4-dihydroxyphenylacetic acids). Two depsides (ellagic acid and chlorogenic acid) were also identified.[6]

Flavonols and Anthocyanins

Three hydroxybenzoic acids, five hydroxycinnamic acids, three flavanols, nine flavonols, and ten anthocyanins were identified in *V. opulus*. The main compounds include gallic acid, chlorogenic acid, cyanidin-3-glucoside, quercetin-3-sambubioside, and cyanidin-3-xylosyl-rutinoside. [4]

Triterpenes

Triterpenes are common constituents of many traditional herbal medicines and possess strong anti-inflammatory effects. Two uncommon ursolic acid derivatives—cis-3-O-p-hydroxycinnamoyl ursolic acid (12–16 mg/100 g FW) and trans-3-O-p-hydroxycinnamoyl ursolic acid (42–60 mg/100 g FW)—have been identified. The iridoids monotropein and 6,7-dihydromonotropein have also been described in cranberry. [7]

Other Compounds

Scopoletin, a coumarin, is primarily responsible for the antispasmodic effects. Viopudial aids in the treatment of spasms, while viburnin is an antispasmodic bitter compound specific to the uterus and peripheral vasculature. [8]

Extraction Process of *Viburnum opulus*

The dried and powdered leaves of the plant were extracted using water. To prepare the aqueous extract, 100 g of plant powder was soaked in 1000 mL of cold distilled water for 24 hours. After maceration, the mixture was evaporated and freeze-dried. The final extract yield was 22.4% (w/w). [9]

Pharmacological Activities of *Viburnum opulus*

Antioxidant Activity

Groups of compounds that have antioxidant properties include polyphenols, vitamins A, C, and E, and carotenoids [10]. Antioxidant levels in plant and food samples are examined using various test methods, including ABTS radical scavenging, ferric reducing antioxidant power (FRAP), cupric reducing capacity (CUPRAC), total phenolic content (Folin–Ciocalteu method), and DPPH radical scavenging. [11]

Anti-inflammatory Activity

Inflammation is a defense mechanism against infections, chemicals, and toxins. However, chronic inflammation may play an important role in the development metabolic of numerous non-communicable diseases, including cardiovascular disease, syndrome, neurodegenerative diseases, and some cancers.[12]

The ability of *V. opulus* methanol extract to reduce inflammation was demonstrated using LPS-stimulated macrophages and HCl/EtOH-induced gastritis model mice. The butanol fraction of the methanolic extract showed the highest activity in inflammatory reactions.[13]

Antispasmodic and muscle Relaxant Activity

Viburnum opulus, also known as cramp bark, exhibits antispasmodic, anti-inflammatory, astringent, mild hypotensive, and mild sedative effects. It is mainly used to relax muscle spasms, especially in the genito-urinary tract, but can also reduce spasms in other smooth and skeletal muscles. Cramp bark is sometimes used as an alternative to *Viburnum prunifolium* (black haw), though it is less effective in preventing premature contractions that may lead to miscarriage. [14]

Antimicrobial Activity

Secondary metabolites, particularly phenolic phytochemicals, protect plants against biological and environmental stresses such as fungal or bacterial infections. [15] The juice of *V. opulus* slowed the growth of *E. coli* by 3.19%, *P. aeruginosa* by 0.77%, and *C. albicans* by 2.05%. It showed the highest antimicrobial activity against *E. coli*. [16]

The antimicrobial activity of *V. opulus* juice was evaluated against Gram-positive (*Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus subtilis*, *Listeria monocytogenes*, *Enterococcus faecalis*, *Micrococcus luteus*) and Gram-negative (*Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella typhimurium*, *Salmonella agona*) microorganisms. [17]

Cardioprotective Activity

Studies on cranberries and other berries have shown potential positive impacts on blood pressure and cardiovascular health, reducing risk factors associated with hypertension, stroke, arterial stiffness, ischemic necrosis, and endothelial dysfunction.[18]

KCNQ4 and KCNQ5 channels, expressed in arteries of rodents, swine, and humans, play role in vasorelaxation. Activation of these channels in vascular smooth muscle cells prevents vasoconstriction, while their inhibition can attenuate relaxations produced by endogenous pathways such as cGMP, cAMP, and adipose-derived relaxing factors. These channels also contribute to nitric oxide release in endothelial cells, promoting vasorelaxation.[19]

Antidiabetic Activity:

Previous research showed that the phenolic extract from *V. opulus* fruit inhibited lipid and carbohydrate metabolism-related enzymes such as α -amylase and α

glucosidase, as well as the protein PTP-1B phosphatase, which is a major negative regulator of insulin and leptin signaling. [20]

Fruit components from *V. opulus* reduced the uptake of 2-(N-(7-nitrobenz-2-oxa-1,3-diazol-4-yl) amino)-2-deoxyglucose, a fluorescent glucose analogue, by human adenocarcinoma Caco-2 cells. [15] The study also showed that the mouse insulinoma cell line's free fatty acid uptake and lipid accumulation were enhanced by *V. opulus* fruit juice and juice enriched with phenolic compounds, which reduced glucose-stimulated insulin secretion and increased insulin secretion at low glucose concentrations in MIN6 cells. [21]

Other Effects

Clinical experiments have demonstrated that regular consumption of cranberries and their products can suppress influenza virus infections, urinary tract infections, and *H. pylori* infections in epidemically affected populations. These findings are supported by the discovery that cranberry extracts contain high molecular weight materials that inhibit viral adhesion and infectivity of influenza viruses A and B. Additionally, they may have therapeutic potential.[22]

Cranberry juice prevents *H. pylori* and *E. coli* from adhering to the bladder, inner lining of the stomach, and urinary system. Because of its abundant antioxidant properties, it is also beneficial for Alzheimer's disease, prostate cancer, and colon cancer. [23]

Conclusion

Viburnum opulus L. shows great medicinal value because it contains many active natural compounds. Its phenolic and flavonoid components are mainly responsible for antioxidant and anti-inflammatory effects, while triterpenes and coumarins help in relaxing muscles and reducing spasms. The plant also shows positive effects against diabetes and heart-related problems. Although several studies support these benefits, more animal and human research is needed to confirm its safety and effectiveness. Overall, *Viburnum opulus* is a promising medicinal plant with wide potential for future use in natural medicine and health products.

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