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Pharmacological and Antioxidant Activities of *Rhus coriaria* L. (Sumac)

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Abstract

Rhus coriaria L. (Anacardiaceae), generally known as sumac, is a commonly used powder spice, condiment, and flavoring agent, especially in the Mediterranean region. Owing to its bountiful beneficial values, R. coriaria (RC) has been used in traditional medicine for the management and treatment of many ailments including hemorrhoids, wound healing, diarrhea, and reduction of blood sugar, cholesterol and uric acid levels. R. coriaria is rich in various classes of phytochemicals including polyphenol compounds, flavonoids, anthocyanins, tannins, organic acids, and many others. By virtue of its bioactive, R. coriaria possesses powerful antioxidant capacities that have ameliorative and therapeutic benefits for many common diseases including neurodegenerative disease, diabetes, and cancer. The purpose of this study is a brief review of the effects of R. coriaria on diabetes, cancer, hyperlipidemia, as well as the study of anti-inflammatory and antioxidant properties of this plant. Due to its mineral elements, neurotransmitters, organic acids and high antioxidant ability, Sumac plant can cause significant changes in various organs of the body when consumed. Overall, the findings summarized here can be used as a useful dietary supplement and an attractive target for drug discovery.

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Introduction

Today, following the spread of diseases, the desire for alternative and traditional treatments has increased. In addition to reducing the cost of treatment, the use of medicinal plants has had satisfactory results in many communities [1]. *Rhus coriaria* L., (RC) belongs to Anacardiaceae family, is commonly known as sumac, which

includes more than 250 different species. It is traditionally used as a spice with food in West Asia, Africa, the Mediterranean region and North America [2]. RC is traditionally used as an herbal medicine in the treatment of various disorders including diabetes, cancer, stroke, diarrhea, hypertension, stomach pain, diuresis, atherosclerosis, measles, smallpox and liver disease. Used for teeth and gums, dermatitis and liver diseases in Mediterranean countries [2, 3]. RC has antioxidant [4], anti-fibro genic [5], anti-tumor [6] and hypoglycemic [7] activities. In addition, RC has non-mutagenic, antipyretic, DNA protective, antiseptic properties. Antifungal, antibacterial, which supports its traditional applications [8]. Numerous studies have examined the fat-reducing effects of RC and have had positive effects on fat content [9-11]. RC contains various substances including phenolic acids and flavonoids such as Gallic acid, methyl gallate, kaempferol and quercetin [12]. The potential mechanism of action of RC in lowering blood lipids further helps polyphenols that can effectively reduce fat absorption [13]. Some studies have reported that RC contains phenolic compounds such as anthocyanins, hydrolysable tannins, and organic acids including malic acid and citric acid [14, 15]. In a recent study, more than 200 compounds Phenols and phytos, including flavonoids, isoflavones, tannins, terpenoid and anthocyanins, have been described in RC fruits. Phenolic compounds are plant secondary metabolites [16], which have antioxidant, antibacterial, antiviral, anti-cancer, anti-inflammatory and vasodilator effects [18, 17].The purpose of this study was to provide an overview of published pharmacological studies of *R. coriaria* for wider application of plant extracts in the food industry.

Methodology

Search Strategy

To conduct this review, relevant articles published between 2001 and 2022 were retrieved from the Information Sciences Institute (ISI), PubMed, Scientific Information Database (SID), Scopus, and Google Scholar using search terms *R. coriaria*, antioxidant, diabetes, cancer, learning and memory, blood pressure, inflammation, blood lipids and *R. coriaria* extract. Then, the eligible articles were reviewed.

Results

Phytochemical Compounds in Rush Coriaria

R. coriaria is relatively rich in phytochemicals. In studies conducted in 1896, myristin and Gallic acid were the first compounds identified in the components of the leaf extract [14]. Since then, many other components have been identified in various parts of Sumac. The overall composition of the dried sumac fruit is mainly composed of moisture (6–11.8%), essential oil content (1.0%), protein (2.3–2.6%), fiber (14.6–22.15%), ash(1.5– 2.66%), and water-soluble extract (63.8%) and fatty oil (17.4%). Dried fruits are also rich in mineral compounds K, Ca, Mg, P, Fe, Na, Zn, Mn, Cu and Al .Of course, mineral contents are different according to environmental factors and geographical places where sumac fruits are collected. In terms of vitamins, sumac fruit contains thiamine, riboflavin, pyridoxine, cyanocobalamin, nicotinamide, and biotin [47].

Anti-Inflammatory Activities

The anti-inflammatory effects of RC have been proven in many studies. Because exposure to oxidative stress leads to chronic inflammatory diseases, antioxidant compounds can be useful in the prevention and treatment of inflammatory disorders. Among cytokines, TNF-α is the major pro inflammatory cytokine that causes inflammatory cascade through TNF activation. Polyphenols, especially RC anthocyanins, exert their potent anti-inflammatory effects by inhibiting NF-κB activation through IκBα phosphorylation. Phytochemical studies of RC extract have shown that the aqueous extract of RC fruit contains flavonoid, terpenoid and cardiac glycosides (18). Previous studies have shown that terpenoid reduce NF-κB by inhibiting the signaling pathway [19].

Anti- Diabetes Activities

Diabetes is a group of metabolic diseases characterized by hyperglycemia due to impaired insulin secretion, insulin function, or both [20]. Giancarlo et al. (2006) showed that the aqueous extract of RC fruit reduced blood sugar by inhibiting the activity of alpha-amylase and attributed this effect to the presence of flavonoids in it [21]. Also in diabetics, a significant increase in AST, ALT, ALP, LDH,

CRE and urea was observed in diabetic (DM) mice. Treatment with RC extract significantly reduced the activities of these enzymes and urea [8]. Decreased glucose levels indicated that RC extract may be applied by releasing insulin by stimulating the regeneration process and regeneration of remaining b cells. May stimulate insulin secretion, regenerate B cells, or release insulin from remaining B cells. Some anti-diabetic herbs may work by stimulating the function or number of b cells, thereby increasing insulin secretion [22, 23]. Plant phytochemicals have been reported to be a rich source of a-glucosidase inhibitors. In this context, intestinal a-glucosidases play an important role in the digestion and absorption of carbohydrates and, therefore, inhibition of a-glycosidase is an effective anti-diabetic option. Provides post-meal hyperglycemia by targeting. Recent evidence has shown that some plant compounds such as pine bark, green tea and ginseng are potent inhibitors of a-amylase and a-glycosidase [24]. The anti-diabetic effect of *R. coriaria* had already been proven in vivo. Daily administration of RC hydro alcoholic extract on experimentally induced diabetic rats was shown to increase serum insulin levels and decrease blood glucose levels compared to diabetic control rats [25]. In addition, RC has been reported to be used in the treatment of some diseases, including diabetes, in folk and traditional herbal medicines [3].

Anti- cancer Activities

Past studies have shown that the tannins in RC fruit are not only effective in preventing cancer; they also have anti-tumor activity. Previously, different species of RC and their isolated compounds were studied for their anti-proliferative activity against different human cancer cell lines. For example, the ethanol extract of *Rhus verniciflua* stokes showed apoptotic and cytotoxic effects against thymus in mice by fragmentation and inhibition of DNA synthesis [26]. The same plant has been shown to inhibit the proliferation of human B lymphoma cells in a dose- and time-dependent manner [27].

The effects of RC on memory and learning

Prominent symptoms of AD include beta-amyloid deposition and intracellular neurofibrillary tangles, nerve loosening, and cholinergic deficiency. One of the treatment strategies for AD is to increase the level of neurotransmitter ACH by inhibiting AChE [28]. Although synthetic drugs are available to inhibit AChE, their adverse effects, including pneumonia, falls, loss of consciousness, and seizures, make their use incomplete [29]. Therefore, new sources and drugs with fewer or no side effects are needed. [30].

Effects of RC on blood pressure

The data showed that hypertension in *R. coriaria* group significantly decreased compared to baseline and placebo groups after 8 weeks. This finding indicates that *R. coriaria* fruits can be used as an effective natural treatment to control hypertension. To be used. Since flavonoids were the main chemical compounds of this plant, its antihypertensive activity can be attributed to such compounds [31].

Effects of RC on blood lipids

Dyslipidemia has been identified as a potential risk factor for the development and progression of atherosclerosis [32]. Accordingly, many studies have been designed to explore new treatment options in this area, including research on complementary and alternative medicine. RC is a medicinal spice, especially in Middle Eastern countries in traditional Iranian medicine, RC is known as an anti-fat spice [33] Sabzghabai et al. Both showed that RC has the potential to lower total cholesterol and LDL levels in adults and adolescents. Numerous experimental studies have shown similar anti-hyperlipidemic effects [34, 35]. Shafiei et al. showed that RC fruit extract minimizes lipid abnormalities in fat-fed mice, which can emphasize the benefits of consuming RC with high-fat foods [36].

Shidfer et al. showed that RC has a positive effect on ApoA1 and ApoB / ApoA1 ratios. Total ApoB determines the number of potentially atherogenic lipoproteins [37]. Apoa1 is important in removing excess cholesterol from tissues and combining it with HDL for transmission to the liver. Thus, the ApoB/ApoA1 ratio reflects the balance of cholesterol transport; the higher the ratio, the greater the tendency for cholesterol deposition, and consequently the

greater the risk of atherogenesis, which is a valuable predictor of myocardial infarction [38]. The high antioxidant capacity and inhibitory effect of RC free radicals on lipid peroxidation and its inhibitory effect on xanthine oxidase partly explain its serum cholesterol lowering effects [39].

Antioxidant Activities of RC

RC methanolic extract has antioxidant activity against lipid peroxidation and free radicals in vitro. Glycolic acid in RC is also an important antioxidant that is effective against DNA damage caused by ROS. RC exerts its neuroprotective effects by inhibiting ROS [40]. Pyranoanthocyanins 2 and 1 are potent antioxidants and important anti-inflammatory agents in RC [18]. Antioxidants in RC can have protective and neurogenic effects. The anti-inflammatory activity of RC galotanines may be due to the elimination of free radicals and inhibition of the expression of inflammatory mediators such as cytokines and cyclooxygenase (COX) [40, 41].

Discussion

Medicinal plants contain high levels of antioxidant compounds that can be effective in destroying free radicals and prevent the progression of diseases [42] .RC is a medicinal plant, belonging to the family Anacardiaceae and genus Rhus, which grows more than 200 species worldwide. RC is a shrub 1-3 m tall, with compound leaves and whitish green flowers. Brown to red fruits of Coriaria known as RC. It is used as a very popular spice in the production of food with sour lemon flavor. Red fruits have wide applications in traditional Iranian medicine such as treating diarrhea, hemorrhoids, gout and reducing effects on cholesterol, uric acid and blood sugar [43]. Phenolic compounds are non-nutritious plant secondary metabolites that have been considered for their health benefits [44]. Previously, different species of RC and their isolated compounds were studied for their anti-proliferative activity against different human cancer cell lines. For example, the ethanolic extract of Rhus verniciflua stokes showed an apoptotic and cytotoxic effect against mouse thymocytes by causing fragmentation in DNA and inhibiting DNA synthesis [45]. Wang 1 et al. Also showed in 2016 that treatment with RC reduced MDA levels and increased the activity of the antioxidant enzymes SOD, CAT significantly in hypertensive rats [46, 47].

Conclusion

As a result, the present study showed that RC ethanol extract has significant antioxidant, anticholinergic, anti - diabetic and anti - inflammatory activity compared to standard drugs. This may be attributed to the phenolic compounds present in the sample. Thus, RC as a medicinal and food plant may be a promising dietary factor for overall health and well-being, as well as the therapeutic potential for some chronic diseases, including cancer, diabetes and learning memory.

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Conflicts of interest

None of the authors have any conflict of interest to declare.

Consent for publications

All authors approved the final manuscript for publication.

Availability of data and material

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