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Sumac (Rhus Coriaria) and Dyslipidemia

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Dyslipidemia is a crucial risk factor for atherosclerosis (Walstra *et al.*, 2005), and an abnormal metabolic condition characterized by disorders in lipid profile (Ference *et al.*, 2019, Rosenson *et al.*, 2011). Dyslipidemia is a critical yet controllable risk factor in coronary vascular disease (CVD) which cause deaths (Afshin *et al.*, 2019). Antioxidant activity of sumac fruits against lipid peroxidation and free radicals was reported previously (Pourahmad *et al.*, 2010). These findings indicated that sumac fruit extract might prevent the development of atherosclerosis. Also, its cardioprotective and hepatoprotective activities will benefit hypercholesterolemic conditions. The bioactive component(s) responsible for the lipid-lowering effect of sumac fruits is not currently identified. Fruit extract decreased high serum lipid concentrations, alleviated abnormally elevated cardiac lipid levels, and modulated some enzyme indices and microscopic changes in the hypercholesterolemic conditions. Various parts of sumac contain a wide variety of medicinally remarkable phytochemical components previously (Ardalani *et al.*, 2016, Pourahmad *et al.*, 2010). Antioxidant properties can be achieved from high amounts of water-soluble tannins in sumac (Beretta *et al.*, 2009).

Sumac may reduce cardiovascular risk factors in patients with mild-to-moderate dyslipidemia. In a clinical trial, the participants with dyslipidemia indicated significantly diminished in Body Mass Index (BMI) and total cholesterol (TC) levels (Saberi-Karimian *et al.*, 2020). Impacts of sumac on dyslipidemia included antioxidant effects and free radical cleaning against lipid peroxidation as the initial stage of atherosclerosis (Rayne and Mazza, 2007). Nowadays, several studies have underlined the function of herbs in the treatment of a sort of disorders, particularly the cardiovascular system (Al Mofleh, 2010). Sumac has

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antihyperlipidemic outcomes (Mamatkulova *et al.*, 2012) which is used as a spice and therapeutic herb (Brunke *et al.*, 1993). Sumac declined blood lipid profiles and the attention of several biomarkers of liver and kidney function in a dose-dependent manner (Ghafouri *et al.*, 2021). These effects were attributed to the polyphenolic combinations present in sumac. These combinations have reduced reverse cholesterol transport, intestinal cholesterol absorption, and raised bile acid excretion. Moreover, some components of sumac, essential oils, such as limonene, may result in a diminished cholesterol synthesis as well as reducing blood cholesterol attention (Golzadeh *et al.*, 2012). These effects emphasize the hypolipidemic action and hepatoprotective and cardioprotective activities of sumac which may be of interest for patients diagnosed with metabolic syndrome. Tannin extracted from sumac has strengthened the protective effect against atherosclerosis (Zargham, 2008). Sumac has diminished TC, low-density lipoprotein cholesterol (LDL-c), triglycerides (TG), and blood sugar (Shafiei *et al.*, 2011). Moreover, a clinical trial in obese adolescents with dyslipidemia revealed a reduction in TC, LDL-c, and TG (Sabzghabaee *et al.*, 2014). Sumac fruits contain flavonoids, phenolic acids, tannins, and anthocyanins (Kurucu *et al.*, 1993). It has been attributed to various biological activities, including antifibrogenic, anti-inflammatory, antimicrobial, antioxidant, and hypoglycemic (Rayne and Mazza, 2007). Another clinical trial study showed the positive effect of sumac consumption on serum glycemic status, apolipoprotein B (ApoB), and apolipoprotein A-I (ApoA-I) levels in patients with type 2 diabetes (Shidfar *et al.*, 2014). A study showed a modification in measurements of endothelial vasodilator process after sumac consumption. In addition, a significant decline in systolic blood pressure (BP), diastolic BP, serum TC and LDL-c, and BMI was observed in the sumac group. Oxidative stress stimulates the expansion and hypertrophy of vascular smooth muscles and collagen deposition (Vendrov *et al.*, 2015). Also, oxidative stress can damage the endothelium and increase vascular contractile activity (Förstermann and Sessa, 2012). These results explained how oxidative stress could be a cause of hypertension and endothelium dysfunction. Treatment with antioxidant components is suggested for improving BP and endothelial function. Sumac is a good source of natural antioxidants (Pourahmad *et al.*, 2010), highly rich in antioxidative phenolic components, such as tannins and flavonoids. Therefore, adjunctive treatment with sumac can be a vital role in preventing free radical-induced damage in vessels' endothelium (Kurucu *et al.*, 1993).

Considering the protective effects of sumac has also been introduced as a vascular protective and CVD-preventive medicinal plant in conventional medicine (Rayne and Mazza, 2007). Polyphenols can effectively reduce lipid absorbance from the gastrointestinal tract due to their high resin-binding capacities. Also, moderately high portions of tannins played an antioxidant role (Beretta *et al.*, 2009). The high inhibitory action of sumac on xanthine oxidase, presents its serum cholesterol-reducing results. Given the significance of antioxidant and free radical–scavenging activities against lipid peroxidation as the initial stage of atherosclerosis, substantial effects of sumac on hyperlipidemia can be elucidated (Canda *et al.*, 2010). The well-described antioxidant activity of sumac (Abu-Reida *et al.*, 2014) may help deter the development of atherosclerosis and other health issues associated with syndrome metabolic. This may be due to differing mechanisms, including inhibiting oxidative stress through the reduced blood glucose levels and lipid peroxidation (Rafieian-Kopaei *et al.*, 2013) and the raised activity of superoxide dismutase and catalase (Rafieian-Kopaei *et al.*, 2013).

Sumac also possesses a significant protective effect against oxidative stress (Dasgupta *et al.*, 2008). Phenolic compounds, particularly garlic acid, which is one of the most abundant in sumac, have been deemed responsible for this effect (Ghafouri *et al.*, 2021). However, other components, including anthocyanins, isoflavones, and flavonoids, may contribute to the antioxidative, antilipidemic and antidiabetic

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activities of R. Coriaria (Rafieian-Kopaei *et al.*, 2013). Studies have shown that sumac decreased cholesterol levels. These observations offer a positive effect of sumac in the management of not only diabetes but of several related complications associated with metabolic syndrome, such as dyslipidemia, liver and kidney disorders, or obesity (Yilmaz *et al.*, 2016).

In general, sumac treatment had benefits in relieving the cardiac damage associated with hypercholesterolemia by reducing the plasma cholesterol levels. As the number and dosage of medicines grow, the threat of side effects is inevitable, and the introduction of complementary treatments, such as herbal medicines, seems believable. An alternative dietary strategy to reducing hyperlipidemia and hypertension is nutritional adjuncts. Herbal drugs may have advantageous pharmacological properties and fewer side effects than chemical drugs by combining clinically valuable components. Therefore, optimizing modifiable cardiovascular risk factors is vital and should be considered. A decline in lipid droplets in cardiac tissue has been shown in treatment with sumac extract.

Authors' contributions

The authors have made a direct and intellectual contribution to this article, and all of them approved the publication.

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