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Review article

Russian olive (*Elaeagnus angustifolia* L.): From a variety of traditional medicinal applications to its novel roles as active antioxidant, anti-inflammatory, anti-mutagenic and analgesic agent

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ABSTRACT

Elaeagnus angustifolia L., which is commonly known as oleaster or Russian olive, is a deciduous plant from *Elaeagnacea* family. This plant can tolerate and survive a wide variety of environmental conditions. Different parts of *E. angustifolia* plant, especially the fruits and flowers, have been used traditionally in treating a variety of common illnesses such as nausea, cough, asthma, fever, jaundice, and diarrhea. The use of fruit powder and extract of *E. angustifolia* L. have shown to be effective in alleviating pain in patients with rheumatoid arthritis and also in reducing the healing time of wounds in injured person. In addition, some recent reports have indicated the anti-oxidant, anti-inflammatory, antimicrobial, anti-cancer and some other properties of oleaster plant. The other important property of this plant would be its role in bio-monitoring the environment for some toxic elements and also its action as a bio-fertilizer agent in distressed lands. It seems that with more advanced studies on *E. angustifolia* L. and its bioactive components, this plant might be potentially effective and can be used as a natural alternative resource in pharmaceutical industries for treating chronic and serious problems, Fig. 1.

1. Introduction

Elaeagnus angustifolia L. (oleaster, Russian olive, Wild olive) belongs to the genus *Elaeagnus* of Elaeagnacea (Araliaceae) family.[1] There are more than 90 species of the *Elaeagnus* found around the world which are mainly distributed in subtropical regions of Asia, Europe and some parts of North America.[2] *E. angustifolia* L. is a deciduous tree or large shrub which is commonly called Russian olive since its appearance resembles an olive tree with small reddish-brown, elliptic shaped fruits.[3]

Russian olive is a long lived tree (80–100 years) which grows rapidly up to 10 m in height and 30 cm in diameter and starts to fruit after 5–6 years.[4] This tree can tolerate a wide range of harsh environmental conditions such as flood, severe drought, stony, sandy and high salinity or alkalinity of the soils.[5] Different parts of the Russian olive plant have been used in a variety of medicinal formats, in perfume industries, as well as in wood-work and musical instruments production.[4]

Russian olive fruits have high nutritional values and contain proteins, sugar, vitamins and minerals.[3,6] The flowers are small, fragrant, and a yellowish-white color and have been used as a source of nectars for honey bees, as well as a flavoring agent in liqueur production.[3,4] The flowers have also been used to treat tetanus in traditional medicine.[7]

The decoction and infusion of the fruit, flower, leaf and bark of *E. angustifolia* L. have been used traditionally to treat a variety of illnesses and their symptoms. The raw or boiled fruit is consumed for

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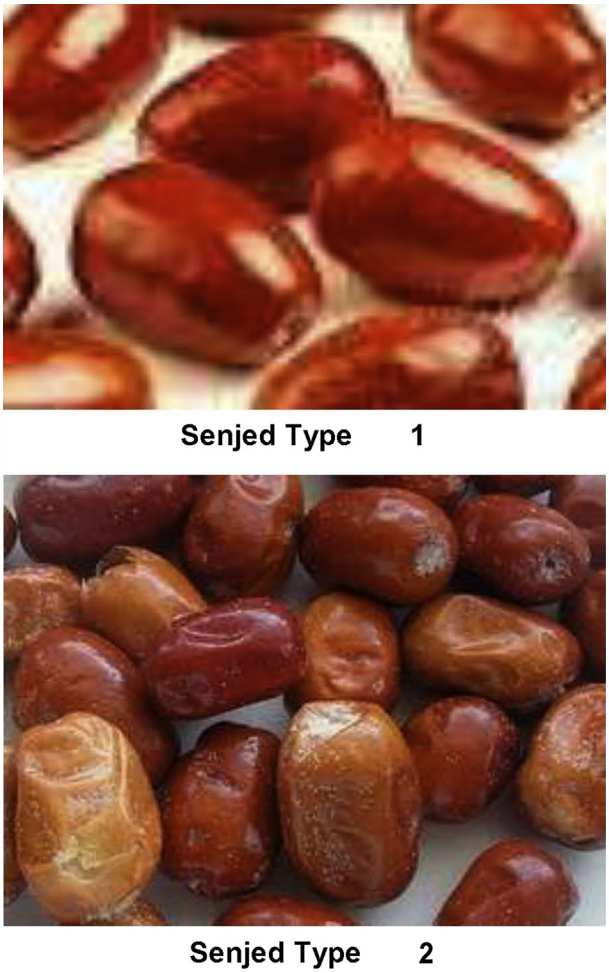

Fig. 1. Photo by Pars Bioscience, LLC, Leawood Kansas.

the treatment of sore throat, cough, flu, cold, fever, nausea, vomiting, jaundice, asthma, diarrhea and some other symptoms and diseases.[5,8,9] In Iranian folk medicine, fruits have been used for the relief of pain and inflammation in patients with rheumatoid arthritis and for accelerating the wound healing process in an injured area.[1]

Recent pharmacological studies have shown that *E. angustifolia* L. has anti-inflammatory, antimicrobial, anti-oxidant and some other health benefits which might be used for treating a number of distresses.[7]

2. Composition

The fruits of *E. angustifolia* L. have been traditionally consumed fresh or dried as a rich source of vitamins such as tocopherol, carotene, vitamin C, thiamine B1, and minerals such as calcium, magnesium, potassium, iron and manganese.[10] The studies have shown that the different parts of *E. angustifolia* L. contain different concentrations of minerals. The root, root bark, branches, stem bark and leaves contain iron, lead, copper, cadmium, zinc, chromium, nickel and cobalt.[11] The most abundant mineral found in *E. angustifolia* L. fruit is potassium (8504 mg/kg), followed by sodium (1731 mg/kg) and phosphorus (635 mg/kg).[12] Exposure to the previously mentioned metals may result in chronic pulmonary disease, nephrotoxicity, cancer, renal toxicity and disease, hypertension, hyperglycemia, and other health problems, but only in high-level, long-term exposure.[46]

Phytochemical studies of *E. angustifolia* L. fruit extract indicate the presence of flavonoid compounds, polysaccharides, sitosteroles, cardiac glycosides, terpenoids, coumarines, phenol carboxylic acids, amino acids, saponins, carotenoids, vitamins, and tannins.[8,13,14] Flavonoids which are mainly present in fruits and vegetables, due to their phenolic hydroxyl groups, are able to chelate metals, reduce lipid peroxidation and have shown a high antioxidant and free radical scavenging activities.[13]

A group of flavonoids such as 4 (+)-catechin, (-)-epicatechin, (+)-gallocatechin, (-)-epigallocatechin, kaempferol, quercetin, luteolin, isorhamnetin and isorhamnetin-3-*O*-β-D-galactopyranoside have been isolated and identified from the extract of *E. angustifolia* L.[13]

The most abundant phenolic compounds found in *E. angustifolia* L. plants, are known to be 4-hydroxybenzoic acid from the benzoic group (45.8 mg/100 g dry weight [wt.]) and caffeic acid from the cinnamic group (32 mg/100 g dry wt.).[14] Among soluble sugars; fructose (27.1% dry wt.) and glucose (22.3% dry wt.) were found to be the major monosaccharide responsible for the sweet taste of *E. angustifolia* L. fruit along with phenolic compounds.[14]

E. angustifolia L. contains a high amount of condensed tannins.[15] The contents of condensed tannins are variable among different parts of the plant. Bark of the tree has the maximum amount of tannins, followed by the leaves and annual branches.[15]

In many studies, the health benefits of condensed tannins which are present in teas, red wines and some fruits and vegetables, have been proven. Tannins have been shown to have anti-cholesterol, anti-inflammatory, anti-cancer, cardioprotective and chemopreventive effects in our body, and in addition increase the angiogenesis activites in the wounded area of skin tissues which assist to lessen the healing time.[15]

In the study, some fatty acids such as, lauric, tridecanoic, myristic, pentadecanoic, palmitic, palmitoleic, heptadecanoic, linoleic, linolenic, oleic, stearic, eicosanoic, and docosanoic acids were identified in the extract of the fruit of *E. angustifolia* L.[16] The study shows that major fatty acids in the samples were palmitic acid (34.31%) followed by oleic acid (26.23%) and lignoceric (17.47%).[17] An abundance of palmitoleic acid in fruit skin and a high amount of linoleic acid and palmitic acid in seeds of *E. angustifolia* L. was reported in the study, which might be explained through the differences in genotypes, climatic condition and soil composition variation.[17]

In conclusion, *E. angustifolia* L. fruit is a rich source of some nutrients, minerals, chemical compounds and antioxidants useful for the human health.[12]

3. Applications

3.1. Wound healing effects

In response to the injury, wound healing is an essential and active process which will return the function back to the damaged tissue and contains four precise and highly programmed phases.[8] These phases include; hemostasis (stop of the bleeding), inflammation, proliferation, and tissue repairing. Following the hemostasis process, the inflammation phase of wound healing is an essential part for the elimination of the infectious micro-organisms, release of the healing factors to the wounded area, and also facilitating the migration and division of cells for the proliferative phase. It is important that the inflammatory response time be short since the continual of inflammation phase can stop the healing process.[8]

The proliferative phase basically involves the deposition of a protein called collagen in the tissue, which is a major part of connective tissue[18] and has an important role in healing the wounds and repairing the tissue.[19]