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# Chemistry, Pharmacology and Medicinal Property of Russian olive (Elaeagnus angustifolia L.)

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## Abstract

Russian olive is known as the Functional Novel Natural Medicine, Elaeagnus angustifolia L. Extract are considered important for drug development, because they are reported to have Pharmacological activity in the Asia, Middle East especially China and India. For a long time 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. Traditionally, different parts of Elaeagnus angustifolia plant especially fruits and flowers have been used in treating some common problems such as nausea, cough, asthma, fever, jaundice, and diarrhea. The use of fruit powder and extract of E. angustifolia have shown to be effective in alleviating pain in patients with rheumatoid arthritis and also reducing the healing time of the wounded area. In addition, some recent reports have indicated the anti-oxidant, anti-inflammatory, antimicrobial, anticancer activities of oleaster plant. The other important property of this plant is 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 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.

**Keywords:** Gastrointestinal Healing; Muscle Relaxant Activity; Anti-Tumor Activity; Memory Improvement

## 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]. The E. angustifolia is a deciduous tree or large shrub which is commonly called Russian olive since its appearance resembles olive tree with small reddish-brown, elliptic shaped fruits [3].

The Elaeagnus angustifolia is a long lived tree (80-100years) which grows rapidly up to 10m in height and 30cm in diameter and start to fruit after 5-6 years [4]. Elaeagnus angustifolia 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 oleaster tree have been used for medicinal purposes, in perfume industries and also in wood-work and musical instruments production [4].

The E. angustifolia fruits have high nutritional values and are consumed fresh or mostly in dried form [6]. The fruits contain sugar, proteins, vitamins A,B,C,K, potassium and phosphorus salts [7, 3]. The flowers are small, yellowish white color, fragrant, and used as a flavoring agent in liqueur production and a source of nectars for honey bees [3, 4]. In traditional medicine the flowers have been used to treat tetanus [6].

The decoction and infusion of the fruit, flower, leaf and bark of E. angustifolia have been used traditionally to treat a variety of illnesses and their symptoms. The raw or boiled fruit is consumed for the treatment of sore throat, cough, flu, cold, fever, nausea, vomiting, jaundice, asthma, diarrhea and some other diseases [5,8,9]. In Iranian folk medicine the fruit is been used in relieving pain and inflammation in patients with rheumatoid arthritis and also in assisting the wound healing process in injured area [1]. Recent pharmacological studies have shown that E. angustifolia has anti-inflammatory, anti-oxidant and some other health benefits which can be used for treating a number of distresses [6].

## Composition

The fruits of Elaeagnus angustifolia have been traditionally consumed fresh or dried as a rich source of vitamins such as tocopherol, carotene, vitamin C, thiamine B1, and minerals like calcium, magnesium, potassium, iron and manganese [10]. The different parts of E. angustifolia also contain different concentrations of the 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 fruit is potassium (8504mg/ kg) followed by sodium (1731mg/kg) and phosphorus (635mg/kg) [12].

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Phytochemical studies of Elaeagnus angustifolia L. fruit extract have shown the presence of flavonoid compounds, polysaccharides, sitosteroles, cardiac glycosides, terpenoids, coumarines, phenol carboxylic acids, amino acids, saponins, carotenoids, vitamins, and tannins [8,13,14]. Recent studies suggest that flavonoids and sitosteroles are responsible for anti-inflammatory and analgesic effects of the plant [8].

The flavonoids are mainly present in fruits and vegetables and due to their phenolic hydroxyl groups are able to chelate metals, reduce lipid peroxidation, and have demonstrated a high antioxidant and free radical scavenging activities [13]. There is a group of flavonoids such as 4(+)-catechin, (-)-epicatechin, (+)-gallocatechin, (-)-epigallocatechin,Kaempferol, quercetin, luteolin, isorhamnetin and isorhamnetin-3-0-β- D-galactopyranoside which have been isolated and identified from this plant [13].

In E. angustifolia, the most abundant phenolic compounds are known to be 4- hydroxybenzoic acid from the benzoic group (45.8mg/100g dry wt.) and caffeic acid from the cinnamic group (32mg/100g dry wt.). 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 fruit along with phenolic compounds [15]. Elaeagnus angustifolia, contain high amount of condensed tannins [16]. In many studies, the health benefits of condensed tannins which are present in teas, red wines and some fruits and vegetables have been proven. These phytochemicals have shown to have anti-cholesterol, anti-inflammatory, anti-cancer, cardioprotective and chemopreventive effects in our body and in addition they increase the angiogenesis activities in wounded area of skin tissues which assist to lessen the healing time. 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 leaves and annual branches [16]. In conclusion, Elaeagnus angustifolia fruit is a rich source of some nutrients, minerals, and chemical compounds such as antioxidants [12].

## Wound healing

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 steps 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 infectious micro-organisms and release of the healing factors to the wounded area for facilitating the migration and division of cells for the proliferative phase. It is important that inflammatory response to be short since the continual of inflammation phase can stop the healing process [8].

In a study, Elaeagnus angustifolia fruit extract significantly reduced the process of inflammation in rats. In this study hydroxyproline content of the skin which has an important role in making collagen, was increased in the extract treated wounds [8]. The finding of a study also shows that the fruit extract of angustifolia could reduce the pain and inflammation in addition to accelerating the wound healing process [8]. Another study suggests that the effectiveness of this plant in wound healing process might be due to the increase of re-epithelization and collagen deposition in wound after applying the fruit extract [17].

In Iranian traditional medicine, dried powdered leaves of oleaster (Persian; Senjed) have been used as a remedy to control bleeding and accelerate the wound healing process [8, 18]. A study shows that the application of the oleaster leaves extract (OLE) decreases the area of wound significantly and highly increases the number of capillary buds and fibroblasts in treated group compared to the control group. Fibroblasts are the adhering cells in skin connective tissue and play an important role in the wound healing process [18].

Elaeagnus angustifolia extract contain antioxidants and flavonoids which are important factors in wound healing process. Antioxidants have an essential role in protecting tissues from oxidative damages and significantly promote DNA synthesis in wound healing progression. Flavonoids are known for their antimicrobial activities which help to increase the speed of wound closure and regeneration of epidermis in the skin. Further phytochemical studies can determine and isolate the active components and mechanism of action responsible for the pharmacological properties of this plant which could be used as a therapeutic agent for wound healing in the future [8].

## Gastrointestinal healing

The preparations of oleaster fruits are widely used in some part of Europe and Central Asia, since they increase the speed of the formation of wound healing tissue in peptic ulcer patients [19]. In a study the carotenoid fraction of the fruit oil proved to have a protective effect against gastro-intestinal ulcers [19].

The result of a study after applying the methanolic fruit extract of E. angustifolia on the ethanol induced ulcer in rats showed that the extract has a strong gastroprotective effect after histopathological examination and ulcer index determination in the tissue. The report initiated another study on the effect of the leaf and flower extract of E. angustifolia on the activity of gastrointestinal smooth muscle [20]. The results demonstrated that the activities of some isolated smooth muscle cells were inhibited by the E. angustifolia extract which may be a reason for the beneficial effects of E. angustifolia in the treatment of nausea, vomiting, and flatulence. Although these symptoms are motor related functions and could be under the control of nervous system, it is difficult to figure out whether the beneficial effects of E. angustifolia to treat these diseases is due to the direct effect on the contraction of smooth muscle cells or by the neural control of gastrointestinal motor functions [20].

A drug from Armenia, called pshatin which is made from E. angustifolia and a concentration of the fruit polyphenolic compounds is being used for the treatment of colitis and other GI tract diseases [14]. Further studies on the pharmacological effects of E. angustifolia extract on neurons, vascular and respiratory smooth muscle cells and the mechanisms of action of the extract in the inhibition of SMC (smooth muscle cells) activity

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are needed. In addition advanced phytochemical studies would facilitate and determine the major substances incorporated in variety of biological activities of this plant [20].

## Muscle relaxant activity

The extracts of fruit, leaf and flower of E. angustifolia (oleaster) have been used traditionally for the treatment of a variety of ailments. An infusion of the oleaster fruit in Iranian folk medicine has been used for relieving pain in patients suffering from rheumatoid arthritis. In addition the use of the oleaster flower in the treatment of tetanus can be an indication of the muscle relaxant activity of this plant [21].

In a study, the muscle relaxant activity of aqueous and ethanol extracts of the E. angustifolia fruit seeds was examined in mice, using traction test. The result showed that with the increased dosages of the extracts the muscle relaxant property of the tissue also increased. In higher dosages, the effectiveness of the aqueous and ethanol extracts was similar to diazepam (2mg/kg) [21].

The muscle relaxant activity of E. angustifolia might be due to some flavonoids or flavones components such as chrysin which have partial agonistic effect on benzodiazepine receptors. More studies are needed to explain the mechanism of interaction between the active components of the plant extracts and the receptors [21].

## Epilepsy

Epilepsy is a neurological disorder in which a person experiences repeated convulsions or seizure over a period of time. In an experiment, the effect of Elaeagnus angustifolia leave extracts was evaluated on a (Pentylenetetrazol) PTZ-induced seizure in male mice. The result showed that the administration of 200-400 mg/kg of E. angustifolia leaves extracts increased the seizure threshold significantly. Then the anticonvulsant effects of hydro- ethanolic extract of E. angustifolia can be due to the relation between the inhibitory and excitatory system, antioxidant mechanisms and the inhibition of ion channel [22].

## Antioxidant activity

The toxic and dangerous side effects of many synthetic antioxidants and the tremendous benefit of natural antioxidants and phenolic compounds found in fruits, vegetables and dietary antioxidants, in improving the quality of life and reducing the risk of some diseases have raised the interest of many people toward the consumption of more natural antioxidants in their diets [23].

The active compounds of natural sources such as phenolic and flavonoids compounds which can be found in the fruit, flower, seeds and leaves of many plants have shown to have antioxidant activities due to their ability to release the electrons and scavenge the free radicals [23]. Many factors such as climate, soil and ecological conditions are involved in the amount of these plants secondary metabolites [23].

The extracts of leaves and flowers of E. angustifolia contain phenolic and flavonoid compounds which have antioxidant properties and protect cells from oxidative damages and delays or reduce the risk of many degenerative diseases [2]. The studies have shown that the amounts of phenolic and flavonoid compounds are higher in leaves than flower of the oleaster plant. The explanation might be due to the process of photosynthesis which occurs in the leaves and also the existence of high amount of flavonoid biosynthetic pathway precursors in the leaves than any other organs [23].

As the studies have shown Elaeagnus angustifolia L., is consist of various chemical compounds including amino acids, flavonoids, phenolic compounds, polysaccharides and some other essential elements. The polysaccharides are important component of E. angustifolia with anti-radiation, antioxidant and immune regulatory activities. To examine the characterization and antioxidant activity of the polysaccharides of E. angustifolia, two polysaccharides (Elaeagnus angustifolia L. polysaccharide-1 (PEA-1) and (PEA-2)) were prepared and studied from the fruits of this plant. The result of this study demonstrated the strong antioxidant activity of PEA-1 and PEA-2 in vitro with moderate scavenging properties and lipid peroxidation inhibition effect. Further studies are required to evaluate the safety and potential usage of this plant for the development of some new natural remedies [24].

## Cardioprotective activity

Heart attack or acute myocardial infarction (MI) is one of the top causes of death among cardiovascular diseases. Sometimes a partial or complete blockage of the heart arteries can cause the decrease of blood flow to the heart muscle which is called myocardial or cardiac ischemia. This can damage the heart muscle, reducing its ability to pump efficiently and decrease the heart's oxygen supply. The most effective way to reduce the heart injury is the quick return of the blood supply to the heart. Strangely enough, the return of blood supply to the tissue after a period of time can also do harm to the heart by causing inflammation and oxidative stress damage to the tissue, called myocardial ischemia-reperfusion (I/R) injury. A range of studies have shown that some antioxidants, such as vitamin E, catalase (CAT), melatonin, and superoxide dismutase (SOD) can have protective effect against I/R injury [25].

In a study the effectiveness of aqueous extract of the E. angustifolia leaves and its cardioprotective activity in induced ischemia/reperfusion (I/R) was demonstrated in isolated rat heart. The result showed that EA at the dosages of 0.5mg/mL and1.0mg/mL significantly improved the restoration of the cardiac function and myocardial biochemical values toward the normal amount [25]. This result can indicate that the extract leaves of Elaeagnus angustifolia has a protective effects on myocardial ischemia reperfusion injury which can be connected to the increase of antioxidant activity by the extract in the myocardial tissue [25].

## Antinociceptive & anti-inflammatory effects

In search for new analgesic drugs, it is logical to look into the medicinal plants which have been used traditionally for the relief of pain. Oleaster (Elaeagnus angustifolia) has been used

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in Iranian folk medicine for its analgesic and anti-inflammatory activities. The phytochemical studies of E. angustifolia fruit extract indicates that flavonoids and terpenoids are considered to be the main components for the analgesic and anti- inflammatory effects of E. angustifolia fruit extract [20].

Many studies have shown that the use of aqueous extract of E. angustifolia fruit is effective in reducing the pain and inflammation in animal models and also in patients with atherosclerosis. The extract has the ability to inhibit the activity of cyclooxygenase type1 and type2 enzymes and it seems to be a right candidate for becoming a good anti- inflammatory drug [26].

The report of a study shows that the effectiveness of extract of E. angustifolia to reduce the chronic pain and inflammation caused by formalin injection is comparable to the chemical drugs such as indomethacin, a nonsteroidal anti-inflammatory drug (NSAIDs) and dexamethasone which is a steroid medication used as an anti-inflammatory and immunosuppressant drug [26]. Indomethacin act through the inhibition of cyclooxygenase type 1 and 2 enzymes and dexamethasone play a role in inhibiting the phospholipase A2 enzyme activities. The result of in vitro study indicates that extract of E. angustifolia also has an inhibiting effect on cyclooxygenase type 1 and 2 enzymes which is comparable to indomethacin and since the result did not show any harsh effect on mucous membrane of the gastrointestinal tract, it seems this could be a good candidate for a natural anti- inflammatory drug in the relief of chronic pain in humans [26].

Oral lichen planus (OLP) is a chronic inflammatory rash-like disease which appears in various clinical forms on the mucous membrane of the mouth. Although the use of topical or systemic corticosteroids can have therapeutic effects in treating the disease but there are some side effects such as fungal infections, adrenal suppression, malignancy and headache with the use of these medications. Due to these adverse reactions, the search for new kind of treatment and substitute with minimum side effects has always been in consideration [7].

The study on the use of Elaeagnus angustifolia in the patients with the oral lichen planus disease has shown that the topical use of 19% aqueous gel of E. angustifolia has a pain relieving, inflammation reducing and healing effect on oral lichen planus symptoms [7]. Although the exact mechanism of action is not clear, the studies of the fruit and seed extract of E. angustifolia have shown that the extract has anti-inflammatory and antinociceptive effects in rats [26].

There have been many biological studies associated with the finding of a safer and more effective way in reducing and relieving the pain in many patients. The report shows that in addition to the relative high cost of some of these pain medications, there are many side effects with taking these drugs such as digestive system's problems, delayed wound healings, increased risk of infections, dependency and tolerance to the drugs [26].

## Osteoarth

painful chronic joint disorder which in many patients progresses with the age. To relieve the pain and discomfort, nonsteroidal anti-inflammatory drug analgesics (NSAIDs), selective cyclooxygenase-2 (COX-2) inhibitors and intra-articular therapies have been commonly used which the study shows some adverse reaction associated with the use of these drugs. The use of alternative therapy such as herbal medicine in treating chronic pain disorders have shown to be beneficial in patients suffering from the diseases. There are some reported beneficial effects related to the relief of pain and inflammation for ginger extract and E. angustifolia extract and also in a newer trial the combination of ginger and E. angustifolia was studied. The report shows that patients after eight weeks of taking 200 mg of E. angustifolia and ginger extracts had more improvement in their pain intensity and the pain was reduced significantly [27]. The result of this study suggests that the combination of ginger and Russian olive extracts are safe and can be effective in reducing pain in patients suffering from osteoarthritis. Further studies in the effect of different dosages and duration are suggested [27].

Traditionally in Iran, Russian olive is brewed and used as an analgesic agent to relief pain in rheumatoid arthritis patients [2]. The studies have shown that the flavonoid components have antinociceptive and anti-inflammatory activities. The addition of muscle relaxation activity of the extract also makes it a proper treatment for some musculoskeletal disorders [28].

## Respiratory disorders

Many people around the world suffer from chronic inflammatory diseases of respiratory tract such as asthma and bronchitis which is characterized by coughing, wheezing and breathing difficulties. In Traditional Chinese Medicine, Elaeagnus pungens thumb from Elaeagnacea family has been used as a remedy for the treatment of chronic inflammatory diseases such as severe asthma, bronchitis and other respiratory disorders [29].

After administration of leaf powder of Elaeagnus pungens to the patients with asthma for two weeks, the frequency of asthma occurrences significantly decreased [29]. In another study, the injection of purified extract of Elaeagnus pungens leaf to the patients with chronic bronchitis raised the effective treatment rate up to 92.1% which is the indication of E. pungens on the treatment of asthma and chronic bronchitis [29].

## Anti-tumor activity

There is several species of Elaeagnus family which are known for their cytotoxic activities against cancer cells such as E. angustifolia, E. umbellate, E. pungens and E. glabra. There are some bioactive components like triterpenoid, flavonoid, lignanoid and bezenoid isolated from these species which could be responsible for their antitumor activities [30].

In an experiment the antioxidant and anti-tumor activity of different fractions of acetic ether of Elaeagnus angustifolia L. was studied. With the increase of concentration and polarity level of each sample the antioxidant and radical scavenging activities increased relatively. The study shows that there is a significant inhibitory effect on the proliferation of Hela cells in vitro with the use of higher concentration of E. angustifolia extract [31].

In traditional medicine of Taiwan, Elaeagnus oldhamii Maxim has been used for treating lung and pulmonary problems such

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as cough and asthma. To study the anti-lung cancer activity of this plant, the effect of the leaf extract of E. oldhamii plant on the growth of non-small cell lung cancer A549 cells was studied. The in vitro study showed that soluble fractions of the leaf extract of E. oldhamii Maxim had the best cytotoxic activity against the A549 cell lines. Advanced studies are required to determine the active components and mechanisms of actions responsible for cytotoxic activity of this plant [30].

The fruit, leaves and roots of Elaeagnus multiflora (cherry silverberry) has been used traditionally for relieving itch, diarrhea, cough and some other symptoms. The studies have shown that this plant have anti-oxidant, anti-inflammatory and anti-proliferative activities [32]. In a report, the seed and flesh extracts of silverberry inhibited the cell growth and induced apoptosis in HT-29 colon cancer cells. The results suggest that the extract of cherry silverberry might be able to suppress cancer through their anti-inflammatory and antiproliferative activities [32]. The investigation of another study shows that the bark extract of Elaeagnus glabra has a dose dependant inhibitory effect on the invasion of human fibrosarcoma cell lines HT1080 [33].

## Antimicrobial activity

During the recent years, due to the increased rate of illnesses caused by antibiotic- resistant microorganisms, the importance of using better alternatives such as medicinal plants with their natural antimicrobial activity has grown significantly [34].

Some medicinal plants and their components can potentially be a good source to be used as an anti-microbial agent. The first step toward the development of these plant- based antimicrobial agents would be the screening of the plants for their antimicrobial activities in vitro. The study of Elaeagnus angustifolia showed that the MCI (minimum inhibitory concentration) value of the fruit extract which indicates the antimicrobial activity against the targeted culture ranged from 7.5 mg/mL to 0.1 mg/mL. Above all, strong antimicrobial activity with MIC of 1.62 mg/mL against E. coli was shown in this study [34]. The report signifies the presence of promising antimicrobial agents in the E. angustifolia fruit extracts. Further studies are needed for finding the compounds responsible for the antimicrobial activity of the extract in targeted cultures [34].

The antimicrobial activity of methanol extract of E. angustifolia leaves was evaluated in vitro against some microorganisms and the result of the study showed that the extract was highly effective against the growth of some of the Gram positive and negative bacteria such as Bacillus subtilis RSKK 245, Staphylococcus aureus RSKK 2392, Salmonella typhimurium RSKK19 and specially Yersinia enterocolitica NCTC 11174. In these studies the antimicrobial activity was evaluated with the standard antibiotics [35]. In another study, the leave extract of E. angustifolia has shown to have a 42% positive inhibitory effect on Salmonella typhimurium TA 100 [13].

## Memory

Alzheimer's disease is characterized by the impairment of cognitive and memory functions which are usually caused by the decreased activity of the cholinergic system. In a study by Morris water test the effect of water extract of E. angustifolia was examined in rats which their memory and learning were temporarily impaired by the scopolamine injection. The result showed that with the increased intake of the E. angustifolia water extract, the spatial learning and memory of the scopolamine induced rats improved dose dependently [35].

## Bio-monitor activity

For many years, the pollution of water with harmful wastes and heavy metals produced by a different range of industries has been a major concern due to their toxic effects on the wellbeing of humans, environment, and agriculture. Since most of the heavy metals such as Ni, Cd, Hg, Zn, Pb and Cr are not biodegradable and are toxic, they accumulate over time in living organisms causing a number of illnesses and disorders [36].

The deposition, accumulation and distribution of metal pollution have been detected by some plant materials such as fungi, lichens, mosses and also some plant leaves. In a past few decades mostly higher plant leaves have been used for bio-monitoring of the heavy metals pollution in the environment [37].

Since Elaeagnus angustifolia can survive in wide range of geographical and environmental conditions and is able to differentiate between the airborne and soil borne heavy metals and is also easy to sample and simply identifies the pollutants then it can be a good candidate to be used as a bio-monitor agent for screening the heavy metals [37]. Besides the growing number of industries and the environmental concern about the pollution of water resources by heavy metals, bio-monitoring and removing the toxins from the water are critical. Most of the methods such as ion exchange, coagulation, adsorption and electrochemical deposition are very costly. The more affordable way to eliminate these contaminants from the aqueous solutions is by bio-absorption method or the use of agricultural waste materials such as rice straw, sawdust, tobacco dust, orange, apple, or carrot residues, coconut shell powder, castor leaves powder, and etc. In adsorption method the molecules of adsorbate are attracted to the surface of adsorbent until the balance is achieved between adsorbent and adsorbed molecules [36].

In an experiment the adsorption potential of Cr (VI), Cd (II) and Ni (II) by Elaeagnus angustifolia fruit powder in aqueous solution was studied and the result suggested that this natural Bio-absorbent was effective in removing the pollutants and depended on PH, absorbent dosage and contact time [36].

In the Elaeagnus angustifolia fruit powder aqueous solution, the best possible pH for adsorption of Cd (II) and Ni (II) ions found to be 6.0 and for Cr (VI) was 2.0. The rate of adsorption was rapid for all three metal ions. The chromium, cadmium and nickel ions attained equilibrium in 150 min, 120 min and 70 min, respectively [36].

## Nitrogen fixation (Bio-fertilizer) activity

Planting nitrogen-fixing tree species on the distressed lands or inter-planting them with some other crops is a common way

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to increase the nutrient supplies and bring the productivity back to the region [38].

Elaeagnus angustifolia L. which is a salt-tolerant and native to the Central Asia has been used for a long time for many purposes such as fruit, firewood, nectar and honey production, and also for medicinal purposes. E. angustifolia is able to cultivate and spread in wide range of climatic and soil conditions especially in distressed areas [38].

In an experiment, the nitrogen-fixation property of Elaeagnus angustifolia L. in a mixed plantation with a few non-fixing plants was studied in saline and phosphorous-deficient soil conditions. The result showed that with each growing season the amount of N, organic C and plant-available P increased in the soil significantly. This improvement in the soil fertility is the indication of suitability of the species for the process of afforestation in some distressed lands [38].

## Side effects

Based on a study, no harmful side effects such as growth delayed or induction of abnormalities were observed even with the use of high dosages of extracts [39]. A report of a study on the pollen of E. angustifolia shows that the inhalation of these allergens may cause nasal symptoms in some sensitized patients [40].

## Conclusion

The reports of many studies about Elaeagnus angustifolia plant and its extracts have provided a scientific validation for the traditional use of this plant as a remedy for the relief and treatment of many common symptoms and diseases as well as some other more serious problems. The plant extract have shown to have an anti-oxidant antimicrobial and antimutagenic activities. Further investigation on the bioactive elements of E. angustifolia, their properties, the effectiveness and safety of this plant is useful and might be considered in the development of pharmaceutical and food products in the future.

## Conflict of Interest

Authors declare no conflict of interest.

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