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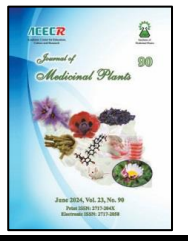

Review Article

A comprehensive review of the pharmacological properties and medicinal uses of *Allium jesdianum* Boiss. & Buhse

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ABSTRACT

Background: *Allium jesdianum* Boiss. & Buhse is a native herb from the *Amaryllidaceae* family found in Middle East regions. Due to its numerous medicinal and biological properties, it is used for the treatment of many diseases, including colds, infections, kidney stones, etc. **Objective**: In this review, we investigated the medicinal uses, phytochemical properties, and pharmacological properties of *A. jesdianum*. **Methods:** The medicinal uses and phytochemical and pharmacological properties of *A. jesdianum*, were searched databases such as Google Scholar, PubMed, Scopus, and the Web of Science using keywords such as *A. jesdianum*, biological activity, phytochemical compounds, pharmacological effects, medicinal plants. **Results**: Studies have shown that *A. jesdianum* contains various chemical compounds such as flavonoids, polyphenols, and Sulphur compounds. Moreover, the antioxidant, anticancer, analgesic, antidepressant, antifungal, antibacterial, kidney protective, liver protective, immune system enhancing, radioprotective, and hematopoietic effects of this plant have been demonstrated. Furthermore, *A. jesdianum* can be used as a natural preservative to improve the oxidative stability of foods rich in unsaturated fatty acids, control the growth of microorganisms, and enhance the immunity of foods. **Conclusion**: Based on the results obtained, *A. jesdianum* can be considered an herbal compound with anti-inflammatory and anti-oxidative, which can be useful as a protective agent against chemical toxicity and overuse of drugs. However, further studies are needed to investigate the clinical effects of this extract on human health.

Abbreviations: ALT, Alanine Aminotransferase; AST, Aspartate Aminotransferase; Bax, Bcl-2-associated X protein; Bcl-2, B-cell lymphoma 2; B-CPAP, thyroid cancer cell line; CCL4, Carbon Tetrachloride; Caspase-3, cysteine-aspartic acid protease 3; CAT, catalase, COX-1, Cyclooxygenase-1; COX-2, Cyclooxygenase-2; CTGF, Connective Tissue Growth Factor; ESWL, Extracorporeal Shock Wave Lithotripsy; GABA, Gamma-aminobutyric acid; GBM, glioblastoma; HT-29, colon cancer cell line; IFN-γ, Interferon-gamma; IL-1β, Interleukin-1 Beta; IL-4, Interleukin-4; LDH lactate dehydrogenase; MDA Malondialdehyde; mg/kg, Milligrams per kilogram; MLKL, mixed lineage kinase domain-like protein; MMP-2, matrix metalloproteinase 2; MMP-9, matrix metalloproteinase 9; µg/ml, micrograms per milliliter; NO, Nitric oxide; NSAID, Non-steroidal anti-inflammatory drug; p53, tumor protein p53; RAGE, Receptor For Advanced Glycation End Products; RIPK1, receptor-interacting serine/threonine-protein kinase 1; SOD, Superoxide Dismutase; Thr.C1.PI33, thyroid cancer cell line; TNF-α, Tumor Necrosis Factor Alpha

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1. Introduction

In recent years, the focus on plant foods and medicinal plants due to their potential impact on health has increased. There has been a global rise in the use of herbal medicines as supplements or alternatives to chemical medicines, primarily because of their lower cost and minimal side effects. Extensive studies have been conducted to investigate the bioactive compounds present in plants and their effects on improving health [1, 2].

The genus *Allium* is a diverse group of *Amaryllidaceae* family that comprises over 850 species, including 121 species found in Iran. This genus includes important horticultural products such as garlic, shallots, onions, leeks, and other species with unknown medicinal, spice, vegetable, or ornamental properties. Due to their beneficial effects on human health, numerous scientific research studies have examined the chemical and biological properties of *Allium* genus. The medical use of *Allium* genus dates back to the Ebers Codex book in Egypt around 1500 BC. Throughout history, notable figures like Hippocrates, Herodotus, Pasteur, and Albert Schweitzer have mentioned the use of *Allium* genus for medicinal purposes. Initially, they were likely used as protective agents against febrile diseases, including plague and other infectious diseases. In Europe during the Middle Ages, monks cultivated garlic to prevent and treat infectious diseases. In the 19th century, Pasteur described the antibacterial properties of garlic extract. During the First World War, garlic extract was used topically to prevent gangrene, and in the Second World War, it was referred to as Russian Penicillin. This effect is primarily attributed to two main categories of compounds: sulfur compounds and saponins. All types of *Allium* genus contain more than 200 components, including vitamins, sulfur-containing compounds, amino acids, proteins, and lipids, rare elements such as selenium, flavonoids, and antioxidants [3, 4].

One of the remarkable species within the *Allium* genus is *Allium jesdianum* Boiss. & Buhse, locally named Bowser, Sarpa, or Bon-Sorkh in different cities of Iran due to the red color of its onion. *A. jesdianum* found in Middle East regions, growing wild at altitudes of 1800-2600 meters in the western region of Iran. It is an herbaceous, perennial plant that grows from a bulbous rootstock. It produces a cluster of grass-like leaves, and a flowering scape that reaches a height of around 75-90cm (Figure 1).

Fig. 1. *Allium jesdianum*

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Local people have a long-standing tradition of gathering the *A. jesdianum* plant during the early spring and selling it in markets. This plant holds culinary value as it is commonly cooked and enjoyed alongside rice or used as an ingredient in soups. However, the distressing reality is that due to rampant illegal harvesting practices in recent years, the *A. jesdianum* plant has been designated as an endangered species.

Furthermore, the aerial parts of *A. jesdianum* have been deeply rooted in traditional medicine practices. They have been employed for centuries to alleviate various ailments such as abdominal pain, rheumatism, vomiting, kidney stones, and colds. The plant's medicinal properties have made it a valuable resource within local communities, where it has been relied upon as a natural remedy [5-7]. In light of the distinctive characteristics exhibited by this indigenous plant, our research endeavors led us to conduct a comprehensive review article aimed at exploring its pharmacological effects and potential applications. By shedding light on the scientific evidence surrounding this native plant and its different extracts, our review article seeks to contribute to the existing knowledge base. This work provides a solid foundation for further scientific exploration and facilitates the investigation of its potential for various therapeutic interventions.

2. Method

The scientific databases including Scopus, Web of Science, Google Scholar, and PubMed were searched to access all relevant books and papers in English and Persian until 2024. The keywords used in the search were A. jesdianum, biological activity, phytochemical compounds, pharmacological effects, and protective effects.

3. Results

3.1. Phytochemical compounds

Several studies on the essential oil and extract composition of *A. jesdianum* have highlighted notable variability in chemical constituents, influenced by factors such as ecotype, growth stage, and environmental conditions. For instance, analyses utilizing GC and GC/MS technologies revealed the presence of a range of key compounds. Key components identified in the essential oil include dimethyl trisulfide, hexadecanoic acid, and various terpenes. Specifically, one study found dimethyl trisulfide to comprise 22.34 % of the oil, while hexadecanoic acid accounted for 19.03 %. Other significant compounds included phytol, caryophyllene oxide, and curzerene. The essential oil features significant phytochemicals such as Trisulfide dimethyl and Hexadecanoic acid, both recognized for their bioactive properties. Other notable compounds include Disulfide methyl-1-(methylthio) ethyl and Beta-Ionone, which contribute to the oil's antioxidant, antimicrobial, and anti-inflammatory effects. The oil demonstrates strong antioxidant properties, characterized by a phenol content of 85 ± 3.2 mg GA/100 g and impressive free radical scavenging ability. These findings underscore the therapeutic potential of *A. jesdianum* essential oil, particularly in mitigating oxidative stress [8, 9].

In samples collected from different regions, such as Kohgiluyeh and Boyer-Ahmad province, hexadecanoic acid was frequently noted as the most abundant component. Studies analyzing the essential oil of *A. jesdianum* revealed that sulfide and sesquiterpene compounds, including allicin, diallyl disulfide, diallyl trisulfide, Curzerene, and Curzerenone, are key components of the oil.

Research on dried flower extracts has also revealed a diverse profile of monoterpenes,

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sesquiterpenes, and non-terpene compounds, with analyses identifying numerous constituents such as thymol, linalool, and nonanal among the major components. Additionally, comparative studies between wild and cultivated ecotypes demonstrated that cultivated plants generally yielded higher quantities and qualities of essential oils and other metabolites, suggesting that organic cultivation practices could enhance the chemical composition and nutrient content of the plant [10].

Phytochemical analyses of the fresh bulbs of *A. jesdianum* identified multiple steroidal glycosides, further contributing to the plant's bioactive potential. These compounds include newly identified compounds such as jesidin, jesdoside, and jesdioside [11]. Additionally, computational methods have been applied to assess the corrosion resistance of certain phytochemicals found in *A. jesdianum* flowers. Notably, α-linolenic acid, palmitic acid, and 1-ecosanol displayed effective corrosion-resistant properties for metals such as iron, aluminum, and copper [12]. Furthermore, *A. jesdianum* contains phenols and flavonoids among its chemical compounds [13, 14].

3.2. Pharmacological effects

A list of pharmacological effects of *A. jesdianum* extract reported in the literature has been mentioned in Table 1.

Table 1. Pharmacological effects of *A. jesdianum* extract reported in the literature

Anticancer effects	**Model**	**Concentration (µg/ml)**	**Result**	**Ref**
Methanolic extract	HeLa, K562	>2 (µg/ml)	Inhibitory effects on cell growth	[15]
Hydroalcoholic extract	GBM	250 (µg/ml)	Decreased cell survival, hindered cell migration, reduced cell invasion and adhesion	[16]
Hydroalcoholic extract	HT-29	25, 50, and 100 (*µ*g/mL)	Decreased number of colon cancer cells, increased MDA levels, stimulated ROS production, reduced antioxidants, initiated necrosis, upregulated RIPK1, RIPK3, and MLKL	[17]
Hydroalcoholic extract	B-CPAP, Thr.C1.PI33	200 (g/ml)	Decreased cell growth, increased cytotoxicity, release of LDH, Induction of apoptotic cell death, downregulation of Bcl-2, upregulation of Bax, p53, and Caspase-3	[18]
Renal protective effects				
Hydroalcoholic extract	Mice	250 and 500 (mg/kg)	Reduced cell destruction, mitigated nephrotoxicity, exhibited antioxidant activity	[24]
Aqueous extract	Wistar rats	250 and 500 (mg/kg)	Reduced kidney stone formation, decreased concentration of urea, creatinine, and uric acid in blood	[6]
Hydroalcoholic extract	Rat	250 and 500 (mg/kg)	Reduced symptoms of diabetic nephropathy, reduced expression of CTGF and RAGE genes, improved oxidative stress conditions	[21]
Hydroalcoholic Extract	Human	250 (mg/kg) Twice Per Day	Improved symptoms, increased rate of stone passage, enhanced kidney function, reduced pain and other symptoms associated with kidney stones	[25]

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Table 1. Pharmacological effects of *A. jesdianum* extract reported in the literature (Continued)

Radio protective effects	Model	Concentration (µg/ml)	Result	Ref
Hydroalcoholic Extract	NMRI mice	500, 1,000, and 2,000 (mg/kg)	Reduced cell destruction, mitigated nephrotoxicity, exhibited antioxidant activity	[23]
Hepatoprotective effects				
Hydroalcoholic Extract	NMRI mice	50 and 100 (mg/kg)	Improvement in the hepatic function and histopathological changes	[25]
Hydroalcoholic Extract	Rat	200 (mg/kg)	Increased antioxidant activity, Improved liver biochemical parameters, Reduced blood lipid levels	[26]
Hydroalcoholic Extract	Rat	200 and 400 (mg/kg)	Increased antioxidant enzymes activity, Reduced peroxidative enzyme levels, Decreased in inflammatory markers and liver fat deposition	[27]
Hydroalcoholic Extract	Rat	250 and 500 (mg/kg)	Improved liver markers, Decreased levels of inflammatory cytokines, Reduced oxidative damage, and mitigated apoptotic	[28]
Antioxidant activity				
Ethanolic Extract	DPPH assay	8 to 500 (µg/ml)	Scavenged free radical	[31]
Ethanolic Extract	DPPH assay	0.1, 0.5, 1, and (2 mg/ml)	Scavenged free radical	[32]
Methanol Extract Aqueous Extract	DPPH and ABTS radical scavenging activity	50,100, 200 mg/ml	Exhibited higher antioxidant activity	[35]
Neuroprotective effects				
Aqueous Extract	Rat	50, 100, 200, and 400 (mg/kg)	Anxiolytic and anti-depressant activity	[30]
Hydroalcoholic Extract	Rat	100, 200, and 400 t (mg/kg/day)	Downregulation of Bax gene expression and upregulation of miR-330, miR-132, and Bcl-2 gene expression Reversed mitochondrial toxicity parameters	[37]
Analgesic Effects				
Hydroalcoholic Extract	Human fresh blood	0.5 to 6 mg/ml	Reduced the activity of the COX-1 enhanced the activity of the COX-2	[39]
Essential oil		0 to 100 (mg/ml)	Enhanced the activity of COX-1 but had no effect on COX-2	
Hydroalcoholic Extract	Rat		Increased Tail Flick and Hot Plate latencies	[40]
Blood Effects				
Hydroalcoholic Extract	Human fresh blood	0.5 to 6 (mg/ml)	Inhibit platelet aggregation	[39]
Essential oil		0 to 100 (mg/ml)		
Methanolic Extract	Human fresh blood	?	Decreased in platelet aggregation	[41]

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Table 1. Pharmacological effects of *A. jesdianum* extract reported in the literature (Continued)

Immune protective effects	Model	Concentration (µg/ml)	Result	Ref
Ethanolic Extract	Mice	50,100, 200 mg/kg	Increased number of lymphocytes and elevated levels of antibodies	[45]
Aqueous Extract	Rat (bone stem cells)	500 and 1000 (µg /ml)	Reduced IFN-γ and IL-17 Increased IL-4	[46]
Aqueous Extract	Mouse peritoneal macrophages	(0.5, 1, 5 and 10 mg/mL)	Increased NO production at non-toxic concentrations.	[47]
Non-medical Use				
-	Mild Steel in Acidic Media	200 ppm	Enhanced the corrosion resistance	[52]
Palmitic acid a-Linolenic acid 1-Ecosanol	Electron Density Functional Method	-	Prevented corrosion in metals	[12]
Aqueous Extract	As the nano-catalyst for electrocatalytic oxidation	200 mg/liter	Exhibited exceptional electrochemical activity	[53]
Alcoholic Extract	Shelf life of white fish fillets	(0.5%, 1%, 1.5%)	improved the shelf life of white fish fillets dose dependently	[54]
Antibacterial activity				
Aqueous Extract	Pathogenic bacteria resistant to antibiotics	230 (mg/ml)	Inhibition of bacterial growth	[7]
Methanol Extract		130 (mg/ml)		
Bacterial extract derived from the endophyte of the *A. jesdianum*	Gram-positive bacteria	100 mg/ml	Decrease in the growth of pathogenic bacteria and fungi	[34]
Methanol Extract Aqueous Extract	*P. aeruginosa, E. coli, E. aerogenes, L. innocua, and S. pyogenes*	50,100, 200 mg/ml	Treatment for antibiotic-resistant bacteria	[35]
Antifungal activity				
Methanol Extract Ethanolic Extract	Trichophyton mentagrophytes	50 and 100 mg/ml	Decrease keratinase activity	[50]
Methanol Extract Ethanolic Extract	Human vaginal *Candida glabrata* isolates		Antifungal efficacy	[49]
Hydroalcoholic Extract	*Candida* albicans	(0.5, 1, 5 and 10 mg/mL)	Anticandidal activity.	[42]

3.2.1. Anticancer effects

Zarabi et al., (2017) found that concentrations higher than 2 µg/ml of the methanolic extract derived from the *A. jesdianum* plant exhibited significant inhibitory effects on cell growth in both HeLa and K562 cell lines. The presence of chemical compounds such as phenols, flavonoids, and anthocyanins in the plant strongly indicates their potential contribution to its anticancer activity [15]. The findings of Rashidi et al., (2022) study showed that the *A. jesdianum* extract (250 µg/ml) cause a

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concentration- and time-dependent decrease in cell survival by hindering cell migration, reducing cell invasion and adhesion, and downregulating the expression of matrix metalloproteinase 2 and 9 (MMP-2 & 9) in glioblastoma (GBM) cells [16]. In another study the hydroalcoholic extract of *A. jesdianum* exposure led to a reduction in the number of colon cancer cells (HT-29) by elevating the levels of MDA, stimulating the production of reactive oxygen species (ROS), decreasing antioxidants, initiating necrosis, and upregulating receptor-interacting serine/threonine-protein kinase 1 (RIPK1), RIPK3, and mixed lineage kinase domain-like protein (MLKL) [17]. Moreover, exposure to the hydroalcoholic extract of *A. jesdianum* (200 mg/ml) resulted in decreased cell growth, increased cytotoxicity, the release of lactate dehydrogenase (LDH), and induction of apoptotic cell death in thyroid cancer cells (B-CPAP and Thr.C1.PI33). These effects were accompanied by downregulation of B-cell lymphoma 2 (Bcl-2) expression and upregulation of Bcl-2-associated X protein (Bax), tumor protein p53 (p53), and cysteine-aspartic acid protease 3 (Caspase-3) expression [18]. Further in our recent publication, the hydroalcoholic extract of *A. jesdianum* has shown significant cytotoxic effects on human melanoma cell lines [19]. Based on these findings, it may be concluded that *A. jesdianum* possesses anticancer properties, stimulates apoptosis, and may serve as a natural source for further experimental and clinical study for the development of anticancer drugs.

3.2.2. Renal protective effects

In a study conducted by Kalantari et al. (2018), the hydroalcoholic extract of *A. jesdianum* (250 and 500 mg/kg) was investigated for its protective effects against carbon tetrachloride (CCl4) -induced nephrotoxicity in mice. The results demonstrated that *A. jesdianum* extract reduced cell destruction, mitigated nephrotoxicity, and exhibited antioxidant activity [20]. Another study examined the effect of the aqueous extract of *A. jesdianum* (250 and 500 mg/kg) on kidney stones induced by ethylene glycol in male Wistar rats. The findings revealed that the consumption of *A. jesdianum* extract at a dose of 500 mg/kg by rats significantly reduced kidney stone formation and decreased blood level of urea, creatinine, and uric acid [6].

In another study, the hydroalcoholic extract of *A. jesdianum* at doses of 250 and 500 mg/kg reduced diabetic nephropathy symptoms and lowered the expression of connective tissue growth factor (CTGF) and receptor for advanced glycation end products (RAGE) genes. The extract also improved oxidative stress by reducing MDA levels and increasing superoxide dismutase (SOD) activity [21]. The study demonstrated that the combination of tamsulosin and *A. jesdianum* extract improved symptoms, increased stone passage rate, enhanced kidney function, and reduced pain and other related symptoms compared to tamsulosin alone [22].

In general, the research results indicate that *A. jesdianum* is an effective herbal compound with increased antioxidant activity, which can serve as an adjunctive treatment in reducing symptoms associated with kidney disorders such as diabetic nephropathy, kidney stones, and risks caused by toxin exposure.

3.2.3. Protective effects against radiation

The study conducted by RoshanKhah et al. (2021) indicates that *A. jesdianum* extract (250 and 500 mg) has protective effects against gamma radiation-induced damage in the pancreas. The extract was found to decrease the expression of apoptotic proteins Caspase-3 and 9, increase the antioxidant activity of SOD and

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catalase (CAT), and reduce the levels of inflammatory markers tumor necrosis factor alpha (TNF-α) and interleukin-1 beta (IL-1β) in the pancreas of mice. These findings suggest that *A. jesdianum* extract has potential as a radioprotective agent [23].

3.2.4. Hepatoprotective effects

The liver is a vital metabolic organ involved in drug and chemical metabolism and is susceptible to damage from toxins. Liver damage is associated with systemic oxidative stress, leading to cell necrosis, fibrosis, tissue lipid peroxidation, and reduced glutathione levels. As reliable hepatoprotective drugs are lacking in modern medicine, compounds derived from plants represent a significant option [24]. Research suggests *A. jesdianum* may have hepatoprotective properties. According to the study by Sohrabinjad et al. (2019), mice that received alcoholic extract of *A. jesdianum* (50 and 100 mg/kg) experienced improvements in hepatotoxicity induced by acetaminophen [25]. Another study by Kalantari et al. in 2018 showed that the hydroalcoholic extract of *A. jesdianum* (200 mg/kg) reduced bromobenzene-induced hepatotoxicity in rats through increased antioxidant activity and decreased oxidative stress in the liver. Additionally, the extract significantly improved liver biochemical parameters such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), and reduced blood lipid levels [26]. In another study by the same authors, consumption of *A. jesdianum* extract (200 and 400 mg/kg) against hepatotoxicity induced by CCl4 increased the activity of antioxidant enzymes, reduced peroxidative enzyme levels, inflammatory markers and liver fat deposition [27]. Furthermore, the use of *A. jesdianum* extract at both doses of 250 and 500 mg/kg improved liver markers, decreased levels of inflammatory cytokines, reduced oxidative damage, and mitigated apoptotic changes in the livers of rats exposed to mercury chloride [28]. Based on the obtained results, it can be concluded that *A. jesdianum* may serve as a hepatoprotective substance against chemical toxicity and drug overdose by reducing inflammatory cytokines, oxidative damage, and apoptotic changes. However, further studies are required to investigate the clinical effects of this extract on human liver health.

3.2.5. Antioxidant activity

Oxidative stress arises when there is an imbalance between the generation and accumulation of ROS within cells and tissues and the body's ability to eliminate them. ROS are produced as a natural byproduct of oxygen metabolism, but various environmental stressors, such as UV radiation, ionizing radiation, pollutants, heavy metals, and anticancer drugs, can greatly increase ROS production, resulting in damage to cells and tissues. In recent years, there has been increasing interest in investigating the potential of medicinal plants and their compounds, particularly flavonoids and polyphenols, as a means of combating oxidative stress [29, 30]. In Ghasemi et al., (2019), various extracts of onion and leaves from different populations of *A. jesdianum* were found to exhibit significant antioxidant activity [31]. Furthermore, Ahmadzadeh et al.'s research in 2014 showed that the ethanolic extract of *A. jesdianum* leaves exhibited significant antioxidant activity across all tested concentrations (0.1, 0.5, 1, and 2 mg/ml) in a dose-dependent manner [32-34]. In 2021, Hojjati et al. conducted a study to investigate the antioxidant properties of *A. jesdianum* extracts using two extraction methods: aqueous and

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methanolic. The results indicated that the methanolic extract (200 mg/l) exhibited higher antioxidant activity compared to the aqueous extract. As a result, both methanolic and aqueous extracts of *A. jesdianum* could serve as natural preservatives, enhancing the oxidative stability of food products rich in unsaturated fatty acids and improving the safety of food products [35].

3.2.6. Neuroprotective effects

Plants in the *Allium* genus, such as garlic and onions, contain bioactive compounds like allicin, known for their protective effects on the nervous system. Allicin offers antioxidant and anti-inflammatory properties, helping to combat oxidative stress and reduce inflammation. This has led to growing interest in *Allium* genus, particularly *A. jesdianum* as potential natural therapies for supporting neurological health and preventing neurodegenerative diseases [36].

The results of Mousavi et al., (2013) study showed that administering the aqueous extract of the *A. jesdianum* plant (50, 100, 200, and 400 mg/kg) significantly reduced anxiety and depression behaviors in rats. Furthermore, changes in the expression of genes related to anxiety and depression were observed in the rats' brains after the extract was administered. These findings suggest that the *A. jesdianum* extract holds promise as a natural agent with the potential to alleviate anxiety and depression in humans by affecting the Gamma-aminobutyric acid (GABA) receptor system and serotonin system in the brain [33]. Kamranfar et al., (2023) evaluated the protective effects of a hydroalcoholic extract of *A. jesdianum* in a mouse model of Alzheimer's disease. Extracted from *A. jesdianum* markedly reduced cognitive dysfunction and mitochondrial toxicity induced by intracerebroventricular streptozotocin (icv-STZ) administration. After STZ injection, there was upregulation of Bax gene expression and downregulation of miR-330, miR-132, and Bcl-2 gene expression. Treatment with *A. jesdianum* extract led to a reversal of the expression of these microRNAs and genes, suggesting its potential in ameliorating Alzheimer and reducing neuronal apoptosis. This study demonstrates the neuroprotective ability of *A. jesdianum* against STZ-induced oxidative stress and cognitive impairment in mice, highlighting its therapeutic potential in the management of Alzheimer [37].

3.2.7. Analgesic Effects

Pain and sensitivity often result from inflammation caused by tissue injuries and infections, which stimulate nerves and release substances like prostaglandins that promote pain. Due to the side effects of long-term synthetic drugs for pain relief, many studies have investigated the analgesic and anti-inflammatory properties of plant extracts as natural alternatives to alleviate pain without the adverse effects of synthetic medications [38]. In Khaksarian et al., (2016) study, the effects of *A. jesdianum* extract doses ranging from 0.5 to 6 mg/ml and essential oil doses ranging from 0 to 100 mg/ml extracted were investigated on the activity of Cyclooxygenase-1 (COX-1) and Cyclooxygenase-2 (COX-2) enzymes. The study revealed that the *A. jesdianum* extract reduced the activity of the COX-1 enzyme while enhancing the activity of the COX-2 enzyme. On the other hand, the essential oil from the plant enhanced the activity of COX-1 but had no effect on COX-2 [39]. Another study using hydroalcoholic extract from *A. jesdianum* leaves demonstrated significant analgesic properties, indicating that these effects are mediated by various brain regions and the opioid system [40]. Overall, the results suggest that *A. jesdianum* can serve as a medicinal resource with anti-

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inflammatory and pain-relieving properties. Phenolic compounds, alkaloids, and saccharides present in the extract have been proposed as potentially effective substances contributing to these analgesic properties. However, further studies are needed to fully understand the precise analgesic mechanisms of *A. jesdianum*.

3.2.8. Blood Effects

In 2017, Khaksarian and his colleagues showed that, in addition to its anti-inflammatory and pain-relieving properties, *A. jesdianum* is able to inhibit platelet aggregation in a dose-dependent fashion. This effect is also observed in drugs such as aspirin, which is a useful non-steroidal anti-inflammatory drug (NSAID) in cardiovascular diseases [39]. Additionally, a 2015 study by Lorigooini et al. evaluated the anti-platelet aggregation effect of different species from the *Allium* genus. The extract of *A. jesdianum*, administered at a dose of 200 micrograms, caused a significant decrease in platelet aggregation [41]. Therefore, this plant, as an herbal composition, can be used as an alternative treatment for diseases associated with blood clot formation. Immune protective effects.

3.2.9. Immune System Effects

The immune system protects the body from pathogens and cancers, and even small declines in its function can increase disease risk. While there are various methods to boost immunity, some may be costly with limited effects. In contrast, many herbal medicines are cost-effective, have good immunomodulatory properties, and cause fewer side effects, making them suitable as adjuncts or alternatives to conventional treatments [42]. *Allium* plants, which are found extensively around the globe, have the potential to enhance immune responses to different diseases through their ability to modulate immunity. This has led to significant interest in exploring the potential of A *A. jesdianum* as a natural immunomodulatory [43, 44].

The study by Rahimi and Madani in 2015 demonstrated the potential beneficial effects of the ethanolic extract of *A. jesdianum* on the humoral response of mice infected with bacteria but also highlighted the importance of finding the appropriate dosage to avoid any adverse effects [45]. In another study, Radjabian et al. (2021) showed that the aqueous extract of *A. jesdianum* acts as an immunomodulatory agent by positively influencing the response of spinal cord stem cells in terms of the production of Interleukin-4 (IL-4) cytokine and reducing the production of Interferon-gamma (IFN-γ) and Interleukin-17 (IL-17) cytokines [46]. Furthermore, the aqueous extract of *A. jesdianum* has shown the ability to stimulate macrophage cells to increase Nitric oxide (NO) production at non-toxic concentrations [47]. Our recent study seems that *A. jesdianum* improves various factors of the immune system. Its effects include increasing the proliferation of spleen lymphocytes, delayed proliferative response, and antibody production. In general, *A. jesdianum* was able to strengthen various immune responses, including humoral immunity and cellular immunity [13]. Consequently, the use of *A. jesdianum*, at appropriate doses, may be considered a natural and harmless method to modulate the immune response. According to our latest unpublished research *A. jesdianum* exerts protective effects on the immune system of cyclophosphamide -treated animals by boosting both cellular and humoral immunity, with no observed hepatoxicity [48].

3.2.10. Antibacterial Effects

The antibacterial effects of both aqueous and methanolic extracts of *A. jesdianum* were

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evaluated against several pathogenic bacteria resistant to antibiotics, such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Klebsiella pneumoniae*. The results revealed that the methanolic extract of *A. jesdianum* exhibited better inhibition of bacterial growth compared to the aqueous extract. Notably, at a concentration of 500 µg/ml, the methanolic extract completely inhibited the growth of the tested bacteria [7]. Esmaeili et al. (2021) demonstrated the potential of the bacterial extract from *A. jesdianum* endophytes as a novel source for inhibiting the growth of gram-positive bacteria. The results indicated that using a dose of 100 mg/ml extract led to a significant decrease in the growth of pathogenic bacteria and fungi [34]. Based on Hojjati et al. (2021) findings, the methanolic extract of *A. jesdianum* demonstrated greater antimicrobial activity compared to the aqueous extract. Therefore, the *A. jesdianum* may potentially serve as an alternative treatment for antibiotic-resistant bacteria [35].

3.2.11. Antifungal Effects:

Recent studies have demonstrated the significant antifungal activity of aqueous extract, hydroalcoholic extract, and *A. jesdianum* essential oil against *Candida Albicans* in laboratory conditions [34]. For instance, Shahrokh et al. 2017 investigated the antifungal effects of the water-alcoholic extract of *A. jesdianum* at doses of 250, 500, 1000, and 2000 µg/ml on fluconazole-resistant and sensitive *Candida Glabrata* isolates obtained from the human female genital tract. The results indicated that the *A. jesdianum* extract exhibited a substantial antifungal effect on both fluconazole-sensitive and resistant isolates [49]. In another study, it was found that the alcoholic extract of *A. jesdianum* at a dose of 200 µg/ml exhibited the greatest effect in reducing the keratinase activity of the fungus [50]. Similarly, Khezezlo et al.'s study in 2017 revealed that the ethanolic extract of the *A. jesdianum* plant (640 µg/ml) displayed strong antifungal effects against *T. Mentagrophytes* isolates [51]. These findings suggest that the hydroalcoholic extract of *A. jesdianum* possesses potent antifungal properties may potentially serve as a rich source of antifungal compounds.

3.4. Non-medical Use

In a 2021 study conducted by Kahkesh, the potential of *A. jesdianum* extract as a green corrosion inhibitor for mild steel in hydrochloric acid solutions was highlighted. The results of the study revealed that the plant extract not only inhibits corrosion but also has a positive impact on the surface integrity of the metal. Further research and development in this area could lead to the development of more environmentally friendly corrosion protection methods for metal materials [52]. In another study, researchers investigated the effect of phytochemical components of *A. jesdianum* flower in preventing corrosion of three metals - iron, aluminum, and copper - using the electron density functional method (DFT). The findings showed that utilizing these phytochemical components could be a cost-effective and straightforward method to prevent corrosion in these metals. This research provides valuable scientific insights into the potential use of *A. jesdianum* extract as a corrosion prevention technique [12]. In Sheikh Mohseni's study, the water extract of *A. jesdianum* (200 mg/liter) was utilized for the synthesis of a Ni/Montmorillonite Nano catalyst. This method yielded a product with excellent electrochemical properties, suitable for use in the electrochemical oxidation reaction of methane. The results demonstrated that the prepared nanocomposite containing nickel catalyst

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exhibited exceptional electrochemical activity in the electrochemical oxidation reaction of methane [53]. In another study, the effect of the alcoholic extract of *A. jesdianum* plant (0.5 %, 1 %, and 1.5 %) on the shelf life of white fish fillets was investigated [55]. The results revealed that the use of *A. jesdianum* extract at a dose of 1 % significantly improved the shelf life of white fish fillets. However, doses higher than 1 % had a negative effect on the shelf life of fish fillets [49]. Furthermore, Akrami et al. (2021) indicated that bio nanocomposite films containing nanoliposomes of *A. jesdianum* extract could be used as food packaging with effective antibacterial properties [54].

Conclusion

Based on the findings of this review, *A. jesdianum* can be regarded as an herbal compound that possesses anticancer, renal protective, radioprotective, hepatoprotective, neuroprotective, analgesic, anti-inflammatory, antioxidant, immune protective, antifungal, and antibacterial effects. This suggests that the extract may serve as a valuable protective agent against drug and chemical toxicity, potentially offering significant benefits for human health. However, additional research is essential to understand its efficacy and safety fully. Such studies could explore the extract's mechanisms of action, optimal dosages, and long-term effects, ultimately paving the way for its clinical application and integration into therapeutic strategies.

Author contributions

Research conception and design: KSH and ZSH. Data collection: KSH and ZSH. Review and editing: KSH. All authors contributed to the article and approved the submitted version.

Conflicts of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

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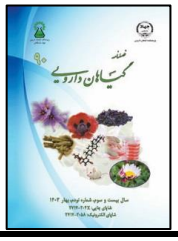

مقاله مروری

مروری بر خواص دارویی و کاربردهای درمانی گیاه پیاز یزدی (*Allium jesdianum* Boiss. & Buhse)

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اطلاعات مقاله

گل‌واژگان:

Allium jesdianum

فعالیت بیولوژیکی

ترکیبات فیتوشیمیایی

اثرات دارویی

گیاهان دارویی

چکیده

مقدمه: *Allium jesdianum* Boiss. & Buhse یک گیاه بومی از خانواده *Amaryllidaceae* است که در مناطق خاورمیانه یافت می‌شود. به دلیل خواص دارویی و بیولوژیکی متعدد آن، از این گیاه برای درمان بسیاری از بیماری‌ها، از جمله سرماخوردگی، عفونت‌ها و سنگ کلیه استفاده می‌شود. **هدف:** در این مرور، ما به بررسی کاربردهای دارویی، خواص فیتوشیمیایی و خواص دارویی *A. jesdianum* پرداختیم. **روش بررسی:** کاربردهای دارویی و خواص فیتوشیمیایی و دارویی *A. jesdianum*، با استفاده از پایگاه‌های داده‌ای چون Google Scholar، PubMed، Scopus و Web of Science با استفاده از کلیدواژه‌هایی نظیر *A. jesdianum*، فعالیت بیولوژیکی، ترکیبات فیتوشیمیایی، اثرات دارویی، گیاهان دارویی مورد جستجو قرار گرفت. **نتایج:** مطالعات نشان داده‌اند که *A. jesdianum* حاوی ترکیبات شیمیایی مختلفی از جمله فلاونوئیدها، پلی‌فنول‌ها و ترکیبات گوگردی است. علاوه بر این، اثرات آنتی‌اکسیدانی، ضدسرطانی، مسکن، ضدافسردگی، ضدقارچی، ضدباکتری، محافظ کلیه، محافظ کبد، تقویت‌کننده سیستم ایمنی، محافظت در برابر اشعه و اثرات هماتولوژیکی این گیاه نیز مورد تأکید قرار گرفته است. همچنین، *A. jesdianum* می‌تواند به عنوان یک نگهدارنده طبیعی برای بهبود پایداری اکسیداتیو غذاهای غنی از اسیدهای چرب غیراشباع، کنترل رشد میکروارگانیسم‌ها و تقویت ایمنی غذاها استفاده شود. **نتیجه‌گیری:** بر اساس نتایج به‌دست‌آمده، *A. jesdianum* را می‌توان به عنوان یک ترکیب گیاهی با خواص ضد التهابی و آنتی‌اکسیدانی در نظر گرفت که می‌تواند به عنوان یک عامل محافظ در برابر سموم شیمیایی و استفاده مفرط از داروها مفید باشد. با این حال، مطالعات بیشتری برای بررسی اثرات بالینی این عصاره بر سلامت انسان مورد نیاز است.

مخففف‌ها: ALT، آلانین آمینوترانسفراز؛ AST، آسپارتات آمینوترانسفراز؛ Bax، پروتئین مرتبط با Bcl-2؛ Bcl-2 -بیماری لنفومای T B; Bcl-2 B-CPAP، سلولی سرطان تیروئید؛ CCL4، کربن تتراکلراید؛ Caspase-3، کاسپاز۳؛ CAT، کاتالاز؛ COX-1، سیکلوکسیژناز-۱؛ COX-2 ، سیکلوکسیژناز-۲؛ CTGF، فاکتور رشد بافت همبند؛ ESWL، لیتوتریپسی با شوک موج خارج از بدن؛ GABA، اسید گاما-آمینوبوتیریک؛GBM ، گلیوبلاستوما؛ HT-29، رده سلولی سرطان کولون؛ IFN-γ، اینترون فرون گاما؛ IL-1β، اینترلوکین-۱؛ IL-4 -، اینترلوکین-۴؛LDH ، لاکتات دهیدروژناز؛ MDA، مالون دی آلدهید؛ mg/kg، میلی‌گرم به ازای کیلوگرم؛ MLKL، پروتئین شبیه کیناز خط میکس؛MMP-2 ، ماتریکس متالوپروتئیناز ۲؛ MMP-9، ماتریکس متالوپروتئیناز ۹؛ µg/ml، میکروگرم در میلی‌لیتر؛ NO، نیتریک اکسید؛ NSAID، داروی ضد التهاب غیر استروئیدی؛ p53، پروتئین توموری p53؛ RAGE، گیرنده محصولات پیشرفته گلیکاسیون؛ RIPK1، کیناز پروتئینی سرین/ترئونین؛ SOD، سوپر اکسید دیسموتاز؛ Thr.C1.PI33، خط سلولی سرطان تیروئید؛ TNF-α، فاکتور نکروز توموری آلفا

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