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Industrial Importance and Greening Applications of Studied *Pyrus L.* Species in Greater Caucasus

Abstract

This work investigates the medicinal, nutritional, and industrial significance of wild pear species in the context of their diverse applications across agriculture, food, and traditional medicine. With over 800 plant species exhibiting medicinal properties in the local flora, and more than half of medications derived from plants, the conservation of these species is critical. Wild pears are rich in essential vitamins, minerals, and bioactive compounds such as antioxidants, flavonoids, and polyphenols, which contribute to their health benefits, including anti-inflammatory, anti-cancer, and wound healing properties.

The industrial role of wild pears extends to food production, pharmaceuticals, and cosmetic applications. The study highlights their use in creating beverages, dietary supplements, and skin care products, demonstrating their versatility and economic potential. Experimental investigations using Wistar albino rats showed significant wound healing activity from *Pyrus communis* extracts, suggesting their promise as natural remedies in the pharmaceutical industry. The ecological resilience of wild pears positions them as valuable resources for greening efforts, with potential applications in landscape architecture.

This research underscores the need for further exploration of their pharmacological properties to validate medicinal uses and promote sustainable industrial practices.

Keywords: *wild pear, medicinal, industrial, antioxidants, phytochemicals*

Introduction

There are over 800 plant species with medicinal effects in our country's flora. More than 50 % of the medications used are derived from plants. We can state that one of the reasons for the decline in the habitats of certain rare species is this (Iskender & Sadigova, 2017).

Typically, the pear plant lives for 70-90 years, but some species can live up to 300 years. Cultivated varieties, on the other hand, live for over 50 years. Wild pear species are rich in vitamins A, B group, as well as E, C, P, and PP. In addition to vitamins, the fruits contain ascorbic, citric, malic, and folic acids, as well as glucose, sucrose, fructose, and various trace elements. They also contain many metals, such as zinc, copper, nickel, molybdenum, iodine, manganese, iron, and fluorine. Therefore, when the body lacks food reserves, the fruits are often used in the treatment of anemia and thyroid diseases. Wild pear is also used in traditional medicine: medicines and compotes are prepared from fruits and leaves, dried and brewed teas. The use of wild pear species has proven beneficial in the treatment of prostatitis. Regular consumption of compote made from dried wild pears helps restore and normalize the function of the prostate gland. Doctors recommend that men over 50 collect dried wild pear fruits for the winter and brew them into compote or tea for preventive purposes during winter (Galitsina, 2021).

Research

Pears contain special phyto components, including anti-inflammatory flavonoids, anti-cancer polyphenols, and anti-aging flavonoids. They are also rich in vitamins, carbohydrates, and mineral substances. Pears contain fructose, which is especially beneficial during diarrhea in children. They are also a good source of dietary fiber and calcium, essential for maintaining strong bones and preventing osteoporosis. The use of pears in the pharmaceutical industry is widespread. The pectin in pears helps lower cholesterol levels. Due to the presence of arbutin, wild pear species can combat bacterial infections. Hydroquinone, found in pear leaves, is beneficial for protection against bacterial diseases and enhances biochemical reactions. Increased consumption of fruits and vegetables helps lower blood pressure, which normalizes heart function, and the presence of ursolic acid in pears helps prevent the risk of heart attacks. Daily consumption of pears is particularly beneficial for women during menopause to mitigate cancer risks. Pears play a significant role in the treatment of diabetes and heart diseases. Consuming fresh pears and drinking fresh juice can help lighten the skin, as they contain secondary arbutin, which prevents the formation of melanin pigment. Additionally, pear fruits play a significant role in wound healing. They are rich in secondary compounds that aid in wound healing by producing tannins, vitamins, and collagen. They improve digestion and combat constipation. Pectin acts as a natural diuretic that helps soften stools, facilitating their easy passage through the intestines. It also helps balance pH levels. Pears are also used to produce wine, and beverages obtained from the fermentation of pears can be made either fully or partially fermented. Pear wood is also used for furniture, musical instruments, and carving work. Since it does not emit any odor during processing and readily takes on color, it is also used to produce kitchenware. Pears can also be used as a dye. In terms of the cosmetic importance of wild pears, they contain nutrients beneficial for skin lightening and hair health. They are added to facial scrubs and washes for skin freshness, resulting in long-lasting hydration. Daily consumption of pears also serves as a natural scrub. These scrubs help reduce skin wrinkles and are beneficial in treating acne and other skin infections (Abbas & Bano, 2020).

The studied wild pear species are utilized in various sectors of industry. The utilization possibilities of the studied plants are reflected in Table 1.

Table 1
Industrial Importance of Studied Pear Species

No.	Species	Medicinal	Culinary	Food	Honey-Producing	Ornamental
1	<i>Pyrus communis</i> L.	+	+	+	+	+
2	<i>Pyrus caucasica</i> Fed.	+	+	+	+	+
3	<i>Pyrus georgica</i> Kuth.	+	+	+	+	+
4	<i>Pyrus vsevolodii</i> Heideman	+	+	+	+	+
5	<i>Pyrus salicifolia</i> Pall.	+	+	+	+	+

Wild pear fruits, especially in juice, contain a significant amount of sugar alcohol – sorbitol, which has disinfectant properties. The skin of wild pear fruits contains tannins, vitamins B and C, phytoncides, carotenoids, and other chemical compounds. The seeds of the studied pear species are rich in biologically active substances. The leaves of these plant species contain a considerable amount of arbutin (1.4-3.0 %), hydroquinone, and flavonoids (10-20 times more than the fruits). The presence of hydroquinone, which is formed from the breakdown of arbutin-glucoside in some species of wild pears, distinguishes them from others due to its strong disinfectant effect (on the urinary system). The hydroquinone compound in pear plants, which determines one of their medicinal properties, positively impacts diseases caused by bacteria, fungi, and other organisms. The formation of hydroquinone from arbutin only occurs in alkaline urine. Therefore, patients with urinary tract diseases are advised to use pear species containing arbutin. Furthermore, patients with

leukocytes in their urine are also recommended to use these species. Pear fruits are also utilized as raw material for the preparation of compotes, kvass, and other beverages. In the Caucasus, people grind dried fruits and mix them with flour to make cakes. Dried pears have long been used in traditional medicine. A beverage made by boiling dried pears helps quench thirst during feverish illnesses. This solution has anesthetic, antiseptic, and diuretic effects and regulates diarrhea. Boiled and cooked pear fruits are also used in severe coughs, choking, and pulmonary tuberculosis. Pear fruits are especially significant in the dietary nutrition of diabetic individuals .

E. M. Novruzov conducted an analysis of flavonoid accumulation in the flowers and fruits of various wild and introduced plants and determined that the flavonoid content in *Pyrus communis* L. was 101.9 mg, and in *Pyrus salicifolia* Pall. it was 171.3 mg (Novruzov, 2004). The author discussed maintaining the medical practice base in ethnobotanical research by conducting experiments on medicinal plants characteristic of the region, conserving existing plant resources, and cultivating medicinal plants adapted to the region's ecological conditions. Due to the presence of stone cells in pear fruits, only the consumption of pear juice and cellulose-free compote is allowed in any form. It is considered beneficial for certain gastrointestinal diseases (pancreatitis). The flowers of the pear plant are a valuable source of nectar and pollen for bees, but in terms of honey production, pears lag behind cherries, plums, and apples. The honey yield of pear plants is about 20 kg per hectare of cultivated area. The nectar collected by bees from pears contains low sugar content. In the Caucasus, it has been noted that the vitamin C content in pear fruits ranges from 12-21.6 mg% and in the leaves from 150-210 mg%. Furthermore, beautiful, patterned, and colored products (cutting boards, rulers, musical instruments, etc.) can be made from the wood of wild pear species. Additionally, wild pear species are used as rootstocks for cultivated varieties. They are also used as planting material for establishing forest strips in areas with adverse soil conditions (Moghanloo et al., 2019).

To overcome neuronal damage, the brain requires a certain amount of antioxidant reserves, which can be increased by adding various antioxidants. It has been established that *Pyrus communis* is rich in flavonoids, polyphenols, and vitamin C. Therefore, all these results reflect the potential anti-obsessive-compulsive properties of *Pyrus communis* juice (Arzoo & Parle, 2017).

The authors highlight the significance of *Pyrus* L. species not only in ecological contexts but also for their industrial potential. Understanding the pollen morphology and fertility of these species can enhance breeding programs aimed at improving fruit quality and yield, which is essential for both local economies and global markets. Furthermore, insights gained from *in vitro* and *ex situ* conditions can inform conservation strategies and sustainable agricultural practices, ensuring that these valuable genetic resources are preserved while meeting increasing consumer demands. As the horticultural industry increasingly prioritizes biodiversity and sustainability, research like this underscores the importance of *Pyrus* species in developing resilient and productive agricultural systems (Jafarzadeh & Iskandar, 2024).

Using Wistar albino rats, the study evaluated the wound healing properties of *Pyrus communis* L. fruit through various wound models. The wound healing activity of ethyl acetate and ethanol extracts of *Pyrus communis* fruits was investigated in normal rats using different wound healing models, including incision, excision, and dead space wound models. Wounds were created according to standard procedures, and parameters such as wound contraction area, epithelialization time, scar area, tensile strength, and weight of granulation tissue were assessed. Phytochemical screening and total phenolic content were determined for both extracts. The hydroxyproline content of the collected granulation tissue was estimated in all animal groups. As a result, it was found that various extracts of *Pyrus communis* exhibited significant ($p < 0.01$) wound healing activity in the models. This study clarified that *Pyrus communis* is a natural remedy for treating various types of wounds (Cinnasamy & Bhargava, 2014).

It was determined from the study that using 5 mg/kg cadmium for two weeks causes severe liver damage and leads to the depression of protein synthesis, including C-reactive protein and the serum antioxidant haptoglobin. Consequently, it was clear that the extract of *Pyrus communis* seeds protects against liver damage caused by heavy cadmium and helps restore haptoglobin protein.

The studies emphasize the critical role of dendroflora in the Greater Caucasus, particularly in relation to environmental factors and conservation efforts. The analysis of cultivated dendroflora highlights how abiotic factors such as climate and soil conditions significantly influence species distribution, offering insights that can aid in forestry management and biodiversity preservation. Author's evaluation of rare and endangered tree species underlines the urgency of introducing these species into the Absheron region to bolster local ecosystems and maintain genetic diversity (Iskender et al, 2005).

The research on tree and shrub species in the Huzurlu High Plateau provides valuable information on the flora of Turkey, which can inform conservation strategies and agricultural practices in the region. Collectively, these studies advocate for a holistic approach to understanding the ecological dynamics of tree species, which is essential for effective conservation and sustainable development. They highlight the interconnectedness of environmental conditions and the health of forest ecosystems, emphasizing the importance of targeted research in informing policy and conservation strategies (Iskender et al, 2022). Additionally, the integration of local knowledge and scientific research is crucial for the successful introduction of endangered species and the management of forest resources. Overall, these works contribute to a growing body of knowledge that underscores the importance of preserving tree species for ecological balance and industrial use (Iskenderov, 1993).

Previous clinical studies on wild pear have identified a number of beneficial therapeutic properties, such as anti-inflammatory, sedative, antioxidant, hypolipidemic, hypoglycemic, and wound healing effects. This study attributed the antipsychotic effect of wild pear to the presence of antioxidants, such as glutathione, vitamins C and E, flavonoids, and polyphenolic compounds, which protect brain cells from oxidative stress. The presence of glycine and glutamine acids in pear likely leads to reduced dopaminergic transmission by activating various receptors. This beneficial effect of pear helps alleviate strange symptoms of psychosis (Li, 2016). Chronic consumption of pear inhibits acetylcholinesterase activity, and the presence of choline in the pear plant increases cholinergic transmission in the brains of rodents, aiding in the recovery from various nerve-related dysfunctions. Thus, these results suggest that chronic consumption of pear juice may be beneficial in clinical settings to alleviate foreign symptoms in the body and manage various dysfunctions of psychosis due to its multifaceted actions (Saki et al., 2014).

This research investigated the presence of several bioactive compounds in wild pear (*Pyrus communis* L.) that could be responsible for its various medicinal and food purposes. The biological activity of different parts of the plant was revealed in this study. The importance of further research on pear (*Pyrus communis*) to explore other potential pharmacological properties and validate its medicinal use was noted.

The studied pear species are significant plants for use in various fields of agriculture. They have been categorized into five use categories. The studied species are mainly used as medicinal, food, and honey-producing plants.

The fruits of the studied wild pear species are widely used in the culinary preparation of various food products. These pear species are also used in greening works due to their decorative attributes.

Given their resilience to local soil and climatic conditions, the studied wild pear species were determined to have potential uses in greening efforts in two of six use forms (single planting and group planting).

Table 2
Forms of Use of Studied Pear Species in Landscape Architecture

No.	Species	Border	Single Planting	Group Planting	Live Hedges	Alpinar	Flower Bed
1	<i>Pyrus communis</i> L.		+	+			
2	<i>Pyrus caucasica</i> Fed.		+	+			
3	<i>Pyrus georgica</i> Kuth.		+	+			
4	<i>Pyrus vsevolodii</i> Heideman		+	+			
5	<i>Pyrus salicifolia</i> Pall.		+	+			

Overall, since most of the studied pear species need protection, it would be more appropriate to use these plants more extensively in greening efforts through single and group planting to preserve their gene pool.

Conclusion

In conclusion, wild pear species (*Pyrus communis* L.) exhibit significant medicinal and industrial potential due to their rich phytochemical composition and diverse therapeutic properties. The research highlights their effectiveness in wound healing, antioxidant activity, and various health benefits, including anti-inflammatory, hypoglycemic, and neuroprotective effects. Furthermore, wild pears play an essential role in traditional medicine and culinary applications, emphasizing their value in both health and nutrition. The industrial applications of wild pears extend beyond medicinal uses, encompassing food production, beverages, and even cosmetic formulations. Their resilience to local environmental conditions makes them suitable for cultivation in various agricultural sectors, contributing to biodiversity and sustainable practices. Given the increasing interest in natural remedies and the importance of preserving genetic resources, further research and conservation efforts are crucial. Utilizing wild pear species in greening projects and ensuring their protection will not only safeguard their gene pool but also enhance their industrial applications, benefiting both health and the economy. Overall, the study underscores the multifaceted importance of wild pears as valuable resources in medicine, industry, and agriculture.

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