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A review of phytochemical and pharmacological action of *Prunus armeniaca*

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Abstract
Apricots are deciduous stone fruits with a short shelf life that are only cultivated in a few areas of the nation. On the other hand, it has enormous potential to cover a larger market with longer consumption cycles. The implementation of appropriate post-harvest technologies might potentially aid in accomplishing the goal through a range of processed goods. Even while drying the fruit has been supported by several studies, it must still be inspected and processed to account for variations in the final goods. It still lacks engineering inputs for small-scale seed shelling. Furthermore, apricot kernels are used to make benzaldehydes, active carbon, cosmetic items, and food. They are regarded as a great source of high-quality oil. Oil cake and apricot seed oil have both been utilized as organic manure and biofuel. Sugars, polyphenols, fatty acids, sterol derivatives, carotenoids, cyanogenic glucosides, and volatile chemicals are abundant in the plant. There is growing evidence that polyphenols, which are prevalent micronutrients in the human diet, may help prevent degenerative illnesses including cancer and heart disease. The biological properties of *P. armeniaca*, including its antibacterial, antioxidant, hepatoprotective, antinociceptive, anti-inflammatory, antimutagenic, and enzyme-inhibiting properties, have also been studied. Among these, the potential for antibacterial and antioxidant properties has been extensively studied and has demonstrated remarkable efficacy *in vitro*. Value addition mostly deals with the following products: frozen fruit, chutney, instant chutney powder, dehydrated apricots, canned fruit, nectar, pulp juice, jam, baby drinks, etc. It has expanded to include various drying techniques and analyses in addition to the requirement for technical intervention in the post-harvest phase.

Keywords: *P. armeniaca*, seed oil, biological properties, studies, efficacy

Introduction
Since the beginning of time, medicinal plants have been utilized in healthcare. Worldwide research has been done to confirm their effectiveness, and some of the results have prompted the development of plant-based medications. Medicinal plant products have an annual market value of more than $100 billion worldwide. This essay addresses the function, benefits, and utility of medicinal plants in treating diseases that are significant for public health, with a focus on the current strategic approaches to illness prevention. The "whole population" and "high-risk" techniques are contrasted. The benefits of using the common-factor approach to encourage other health advocates to spread the word about the benefits of medicinal plants are emphasized. The five guiding principles of the Primary Health Care (PHC) approach further explore the role of medicinal plants in avoiding common ailments. Medicinal herbs are essential for preventing disease, and all current preventive methods can benefit from their usage and promotion. To effectively discover, recognize, and place medicinal plants in the design and execution of these initiatives, deliberate efforts must be undertaken. These methods provide intriguing and cutting-edge viewpoints in the realm of therapeutic plants. There are suggestions made for planning the future function and positioning of medicinal plants in illness prevention [1].

Plant Profile

Common Name: Apricot, Khubani, Jaradaalu, Sakkare Badami, Chuli, Urumana, Maghz badam Shirin, Malhei [2].

Synonym: *Amygdalus armeniaca, Armeniaca ansu, Armeniaca vulgaris, Prunus ansu, Armeniaca holosericea, Armeniaca armeniaca, Prunus tiliifolia, Prunus xanthocarpos* [3].

Taxonomy
Kingdom: Plantae
Phylum: Tracheophyta
Class: Magnoliopsida
Order: Rosales
Family: Rosaceae
Genus: *Prunus*
Species: *armeniaca* [4].

Description
The apricot tree is a tiny one, growing to a height of 8 to 12 meters. It has a trunk that may reach a diameter of 40 cm and a dense, spreading canopy. The oval-shaped leaves have a pointed tip, rounded base, and finely serrated edge. They are 5–9 cm in length and 4–8 cm in width. The 5-petaled, 2-4.5 cm-diameter blooms are produced singly or in pairs in the early spring, prior to the leaves. The fruit is a drupe that resembles a little peach, with a diameter of 1.5–2.5 cm (bigger in some contemporary varieties), with colors ranging from yellow to orange. The side that receives the greatest sun exposure frequently has a red tint. It typically has a pubescent surface. The one seed is encased in a tough, rocky shell that is sometimes referred to as a "stone." The shell is smooth and grainy except for three ridges that run along one side [2].

Distribution
Currently, the primary growing zones for apricots are a strip that runs from Turkey through Iran, the Hindu Kush, the Himalayas, China, and Japan. Nonetheless, the Mediterranean region provides the majority of the world's apricot crop. Turkey and Iran are the world's biggest producers, contributing 21.6% and 14.7% of global apricot output. These countries are followed by Pakistan, Uzbekistan, Italy, Algeria, Japan, Morocco, Egypt, and Spain. The fruit, which is high in nutrients and health benefits, is also grown in mountainous regions of northeastern Ladakh, Uttar Pradesh and Himachal Pradesh in India [5, 6].

Traditional Uses
Beta carotene is abundant in apricots, which supply 30% of the daily required amount. They are also a good source of fiber, potassium, and vitamin C. As an example, apricot peel, fruit, and kernel all provide a variety of health benefits, such as lowering cholesterol and promoting regular bowel movements. Additionally, apricot kernels and kernel oil have shown benefits in other situations as well, such as Tinnitus and otitis media [7].

Phytochemistry
Apricot contains compounds such as polyphenols, phenolic acids, coumarins, tannins, lignins, phenols, and flavonoids; vitamins, minerals, carbohydrates, fibers, and phytochemicals, such as glycosides, carotenoids, polyphenols, phenolic chemicals, aldehydes, sugars, terpene alcohols, and flavonoids; terpenoid chemicals, geraniol, and nerolidol; cyanogenic glycosides, such as amygdalin, quercetin-3-glucosides, kaempferol-3-rutinoside; neochlorogenic acid, rutin, cynidin-3-glucosides, p-coumaric acids, ferulic acid, epicatechin, epigallocatechin, and Catechin; and terpene chemicals, geraniol and nerolidol. Hexanal, ethanol, hexyl acetate, 1-hexanol, (Z)-3-hexenol, (E)-2-hexenol, and (Z)-3-hexenol-1-ol, catechin, 2-(3,4-dihydroxy phenyl)-3,5,7-trihydroxy-4H-chromen4-one, chlorogenic acid, 3,4,5-trihydroxy benzoic acid, and 3-(3,4 dihydroxy phenyl)-2-propenoic acid, fiber, lipids like sterols and fatty acids, minerals including phosphorus, selenium, magnesium, zinc, iron, potassium, and calcium [8].

Reported Activities
M. Minaiyan *et al*. (2014) [9] investigated apricot kernel oil and extract in rats with ulcerative colitis. Rats were given a 36-hour fast before the experiment. In male Wistar rats, intrarectal injection of 50 mg/kg trinitrobenzene sulfonic acid caused colitis. Six hours after colitis induction, treatments began, and they were administered every 24 hours for five days. Prednisolone (4 mg/kg p.o. or i.p.) was employed as the reference medication, while apricot kernel extract (100, 200, 400 mg/kg p.o. and 100, 400 mg/kg i.p.) and apricot kernel extract/oil (100, 200, 400 mg/kg p.o.) were utilized as experimental treatments. After removing the colon tissue on day six, macroscopic and pathologic characteristics were assessed. The overall colitis index and ulcer index, which are indicators of macroscopic and histologic characteristics, respectively, improved in experimental groups, particularly in those receiving intraperitoneal medication. The outcomes also showed that the oil fraction was unable to enhance the extract's benefits. These findings point to the possibility of using apricot kernel extracts—with or without oil—as a supplementary treatment for inflammatory bowel diseases in future clinical and mechanistic research [9].
Aneta Wojdyło *et al*. (2021) [10] reported principal polyphenolic constituents by LC-ESI-QTOF-MS/MS and screening *in vitro* biological potency as antioxidant capacity (ABTS, online ABTS, FRAP, ORAC), antidiabetic (α-amylase, α-glucosidase), anti-obesity (pancreatic lipase), anti-cholinesterase (AChE and BChE), and anti-inflammatory (COX-1 and COX-2) inhibitory activity of *Prunus armeniaca* Leaf Extract. Caffeoylquinic acid,

Caffeoyl glucoside, 4-Ocaffeoylquinic acid, 3-p-Coumaroylquinic acid, 5-O-Caffeoylquinic acid, p-Coumaroyl glucoside, 3-O-Feruloylquinic acid, Feruloyl glucoside, cis-5-O-Caffeoylquinic acid, 5-p-Coumaroyloquinic acid, 4-O-Feruloylquinic acid, Quercetin-3-O-rutinoside, Quercetin-3-O-rutinoside, Quercetin-3-O-galactoside, Kaempferol-3- O-rutinoside, Polymeric procyanidin were detected which were hydroxycinnamic acid, and flavonol derivatives. The most potent anti-obesity impact of the extract was demonstrated by its inhibition of cyclooxygenase, pancreatic lipase, and antioxidant capacity, notably the capacity to absorb radicals, which was specifically connected with polyphenolic components. Quercetin-3-O-rutinoside > 5-O-caffeoyl quinic acid > 3-O-caffeoylquinic acid, and online ABTS radicals clearly show that these components essentially contribute to antioxidant capacity [10].

Ajab Khan Tareen *et al*. (2021) [11] investigated physical attributes, total phenolics content, total flavonoids content, mineral composition, bioluminescence toxicity assay and antioxidant activity in terms of DPPH, HPS, TAC and FRAP assays in the kernel and pomace samples of apricot cultivars grown in Balochistan, Pakistan. In apricot kernel extracts TFC and TPC were measured using the $AlCl_3$ and Folin-Ciocalteu assays. The results ranged from 1797.5 (Chagali) to 4778.9 (Badoghur) mg QUE/100 g DW and from 1750.0 (Chagali) to 5005.8 (Badoghur) mg GAE/100 g DW. The antioxidant activity of apricot kernels was found to be greater than that of pomace; the IC_{50} values of the antioxidant activity for DPPH, HPS, TAC, and FRAP ranged from 24.88 to 98.61 µg/ml, 334.84 to 516.63 µg/ml, and 22.02 to 110.80 µg/ml, respectively. Compared to the pomace, the apricot kernels had greater TPC, TFC, bioluminescence toxicity to *V. logei*, and antioxidant activity. The correlation analysis showed that flavonoids and polyphenols made significant contributions to antioxidant tests. The levels of K, Na, Ca, Fe, and Mn in the studied samples were mostly determined by the kind of sample; pomace had greater mineral concentrations than kernels. The Badoghur kernels exhibited the strongest inhibition against *V. logei* (IC_{50} = 1.61 mg/ml). The results of the PCA analysis indicated that the flavonoid and phenolic contents significantly contributed to the antioxidant bioluminescence toxicity tests. According to the findings, sardai, badoghur, and shakerpara kernels are excellent producers of secondary metabolites and have strong antioxidant and anti-luminescence properties. They may also be useful in the management and avoidance of long-term health issues [11].

Dongying Wang *et al*. (2020) [12] reported the Incorporation of *Prunus armeniaca* kernel essential oil at 0.5% and 1.0% into chitosan films displaying an antimicrobial effect against *Listeria monocytogenes* and improving quality indices of spiced beef. After being stored in a refrigerator for 24 days at 4 °C, the spiced beef packed in CS films incorporating AKEO at 0.5% and 1.0% showed lower levels of PV and TBA (thiobarbituric acid) at 4.8 and 3.6 meq peroxide/kg and 0.5 and 0.4 mg MDA/kg respectively, compared to the control sample. On the 24th day, the levels of pH and total carbonyls (TC) were also lower, at 5.8 and 5.7 and 0.7 and 0.6 nmol/mg protein, respectively. Additionally, the sensory assessment showed that during the complete storage time, the spiced beef packed in CS films with 1.0% kernel essential oil included had improved sensory features, such as flavor, color, texture, and overall acceptability [12].

Sehgal Jaya *et al*. (2012) [13] reported the antimicrobial activity of ethanolic and aqueous extracts of fruits of *Prunus armeniaca*. Using the disc diffusion technique, these activities were evaluated against human pathogenic bacteria, and the zone of inhibition for each active extract was found. The ethanolic extract exhibited the most antibacterial activity against *Bacillus subtilis* and *Staphylococcus aureus*. It also shown efficacy against *Escherichia coli* and *Proteus vulgaris*. A significant efficacy against *Candida albicans* was also noted. The antibacterial activity of the ethanolic extract was much higher than that of the aqueous extract [13].

Davoud Salarbashi *et al*. (2021) [14] reported the Synthesis, characterization, control release behavior, and evaluation of anticancer and antimicrobial properties of curcumin-loaded *Prunus armeniaca* gum nanoparticles. *Prunus armeniaca* gum exudates (PAGE) and Ca^{2+} ions combine electrostatically to create a novel polysaccharide-based encapsulating system that increases curcumin's biological activity and bioavailability. The effects of varying ion concentrations (1, 3, and 5) and pH levels (6, 7, and 8) on the samples' surface charge and particle diameter were investigated. The majority of the curcumin was successfully encapsulated within the PAGE matrix by the encapsulation approach used in this investigation, as evidenced by the achieved 86.1% encapsulation efficiency in the PAGE-based nanoparticles. The smooth, spherically-shaped surface of the nanoparticles was observed. The production of polyelectrolyte complexation was verified by X-ray investigations and FT-IR. Both free and encapsulated curcumin showed a clear inhibition zone in *Staphylococcus aureus* and *Escherichia coli*. The antimicrobial activity of curcumin has been associated with the hydrogen-bonding and hydrophobic interactions of this phenolic compound with membranal proteins of the bacterial cells that change the permeability of the membrane, and as a result, inhibit the bacterial growth. The 4t1 and A2780 cell lines were evaluated, and both pure curcumin and curcumin-loaded nanoparticles were hazardous. Furthermore, a concentration-dependent cytotoxicity of the tested substances was noted. The nanoparticles containing curcumin exhibited a more potent cytotoxic impact, indicating the combined benefits of curcumin and PAGE [14].

Dulf *et al*. (2017) [15] reported the Phenolic compounds, flavonoids, lipids, and antioxidant potential of *Prunus armeniaca* pomace fermented by two filamentous fungal strains in a solid-state system. During the solid-state fermentation process (SSF) of apricot pomaces with Aspergillus niger and Rhizopus oligosporus, the changes in phenolic contents (measured by colorimetric assays and high-performance liquid chromatography, HPLC–MS) and antioxidant activity (measured by DPPH test) were examined. Using GC–MS, the changes in the fatty acid content of the oils in apricot kernels after SSFs were also examined. According to the findings, total phenolic levels rose by more than 70% in SSF involving *R. oligosporus* and more than 30% in SSF involving *A. niger*. The levels of total flavonoids showed a similar pattern (increases of 38 and 12% were noted for SSF by *R. oligosporus* and *A. niger*, respectively). The ability of methanolic extracts to scavenge free radicals was also significantly improved. Using HPLC-MS, the primary phenolic chemicals found in the fermented apricot press residues were quercetin 3-acetyl-glucoside,

rutin, neochlorogenic acid, and chlorogenic acid. This study also showed that using filamentous fungal strains in the SSF increased the amount of lipid recovered from apricot kernels and produced oils with superior quality characteristics (high linoleic acid content). In conclusion, using the waste apricot by-products from the juice sector might provide additional revenue while also assisting in the resolution of solid waste management issues [15].

Alireza Ostadrahimi *et al*. (2020) [16] evaluated Anti-cholinesterase and Neuroprotective Activities of Sweet and Bitter *Prunus armeniaca* Kernels. Using Ellman's approach, the inhibitory activity of both the sweet and bitter extracts of apricot kernels towards the cholinesterase (ChE) enzymes, butyryl and acetyl, was investigated. Furthermore, the ability of aqueous extracts and amygdalin to prevent H_2O_2-induced cell death in PC12 neurons was studied. The bitter type aqueous extract had the greatest acetylcholinesterase inhibitory activity (IC_{50} = 134.93 ± 2.88 µg/mL) and neuroprotectivity. It came to light that there was no butyrylcholinesterase (BChE) inhibitory activity in any of the extracts [16].

Naveeda Akhter Qureshi *et al*. (2020) [17] reported *In vitro* anti-leishmanial activity of *Prunus armeniaca* fractions on *Leishmania tropica* and molecular docking studies. Using solvents such as n-hexane, ethyl acetate, and methanol, column and thin layer chromatography were used to fractionate and analyze the leaf extract. Twelve fractions of *Leishmania tropica* were separated and tested for cytotoxicity and *in vitro* antileishmanial activity against promastigotes and amastigotes. Of all the fractions that were utilized, fraction (F7) showed the highest level of antileishmanial activity. By using FTIR, UV-Vis, and GC-MS analysis, the bioactive fraction was further studied. The PTR1 active site was identified via in silico docking. Within the safety range of IC_{50} > 100 µg/ml, all generated fractions demonstrated toxicity. With IC_{50} 11.48 ± 0.82 µg/ml for antipromastigotes and IC_{50} 21.03 ± 0.98 µg/ml for antiamastigotes, respectively, the fraction (F7) demonstrated considerably higher antiamastigotes activity than the control, which was 11.60 ± 0.70 and 22.03 ± 1.02 µg/ml, respectively. Six absorption peaks were identified by the UV-Vis spectroscopic study, and chemicals including alkanes, aldehydes, carboxylic acids, thiols, alkynes, and carbonyls were identified by the FTIR spectrum. Nine chemicals were found in the GC-MS chromatogram: α, β dimethyl benzene ethanol; carbazic acid; 3-(1 propyl butylidene)-, ethyl ester; 1, 2-benzene dicarboxylic acid; diisooctyl ester; a-methyl benzene ethanamine; 2-amininononadecane; 2-heptanamine-5-methyl; cyclobutanol; cyclopropyl carbine; and nitric acid, nonyl ester. The 1, 2-benzene dicarboxylic acid diisooctyl ester had the highest affinity for the PTR1 receptor of all the substances. Fraction (F7) had non-cytotoxic findings that were satisfactory. *In vivo* research will be necessary in the future, though [17].

Moujane Soumia *et al*. (2022) [18] investigated the ability of polyphenols identified in *Prunus* armeniaca, to target the HPV16 virus by virtual high-throughput screening and molecular docking, and to evaluate the safety of this plant *in vivo*. Discovery Studio 2021 created the PDB: 4GIZ structure of E6HPV16 as a target in silico. The iGEMDOCK tool was used to virtually screen 47 polyphenols. Potential inhibitors were then assessed using docking affinities derived from the SYBYL-X Surflex-Dock module v2.0, 21. The substances 3-p-Coumaroyl quinic acid, 5-p-Coumaroyloquinic acid, Epicatechin, and Dimethoxyflavone were predicted to have the greatest binding affinity for E6HPV16 out of all the polyphenols examined in this work. Additionally, many interactions with the E6 binding site region were found. Oral administration of an aqueous extract once at a dosage of 2000 mg/kg without causing toxicity symptoms or death. Furthermore, there was no discernible variation in the body weight of the treated and control rats. It was demonstrated, nonetheless, that the LD_{50} value of this plant was more than 2000 mg/kg [18].

Mahmoudi *et al*. (2019) [19] evaluated the expression levels of Bax and c-FLIP mRNAs in total RNA obtained from MCF7 and MDA-MB-231 human breast cancer cells treated with *Prunus armeniaca* extract. Using various medication doses and incubation periods (24, 48, and 72 hours), the impact was assessed using the MTT test. Using the qRT-PCR method, the expression levels of Bax and c-FLIP mRNA were ascertained. The study's findings demonstrated that throughout the whole incubation period, *Prunus armeniaca* considerably reduced cell growth in a concentration-dependent way. Additionally, our results demonstrated that, in both cancer cells, the expression levels of the Bax and c-FLIP genes were consistently higher in the untreated group as compared to the control group. Compared to the untreated group, *Prunus armeniaca* decreased the expression levels of the Bax and c-FLIP genes in cancer cells in a time-dependent manner. This suggests that using the extract may help prevent and cure breast cancer [19].

S. Kalia *et al*. (2017) [20] investigated the Effect of *Prunus armeniaca* seed extract on the health, survivability, antioxidant, blood biochemical, and immune status of broiler chickens at high altitude cold deserts. The extract's high levels of carotenoids, flavonoids, and phenolics have been identified by phytochemical research. A strong protective effect of the extract in chicken peripheral blood lymphocytes was shown by an *in vitro* effectiveness evaluation prior to the *in vivo* trial. An aqueous extract of *P. armeniaca* in drinking water at concentrations of 100, 150, 200, 300, 400, and 800 mg/kg body weight of chicken, respectively, was given to treatment groups T1, T2, T3, T4, T5, and T6 for 42 days in addition to the control group, which was fed the basal diet. In addition, compared to the control group, the chicken in the treatment groups exhibited significantly lower levels of malondialdehyde, interleukin-6, glucose, cholesterol, triglyceride, ALT, and AST and significantly higher levels of total antioxidant capacity, free radical scavenging activity, interleukin-2, total protein, albumin, and globulin.

Findings indicate that *P. armeniaca* extract, at 200 mg/kg body weight of chicken, had a positive impact on the growth performance and survival rate of broilers; as a result, it may be helpful as a phytogenic feed supplement for broiler chickens raised in cold desert high altitudes [20].

Mohamed Eddouks *et al*. (2023) [21] evaluated the effect of the aqueous extract of *Prunus armeniaca* leaves on arterial blood pressure in normotensive and hypertensive rats. The extract (160 and 100 mg/kg) was administered orally to L-NAME-induced hypertensive and normotensive rats for the acute experiment. Blood pressure parameters were also assessed. In the *in vitro* experiment, vascular dilatation was measured after isolated intact thoracic aortic rings were precontracted with KCl (80 mM) and epinephrine (EP) (10

μM). After oral treatment, the extract decreased blood pressure parameters in L-NAME-induced hypertension rats without harming normotensive animals, indicating that PAAE has antihypertensive properties. Furthermore, in thoracic aortic rings precontracted by EP (10 μM), PAAE (0.25-1 mg/mL) had a vasorelaxant effect; this effect was particularly diminished in the presence of glibenclamide or nifedipine. On thoracic aortic rings precontracted by KCl (80 mM), however, PAAE (0.25–1 mg/mL) only slightly reduced vasorelaxant effects. In conclusion, the findings show that the *P. armeniaca* aqueous extract exhibits strong vasorelaxant and antihypertensive properties. Its vasorelaxant effects appear to be mediated via the blockage of L-type calcium channels and the activation of ATP-sensitive K^+ channels [21].

Elie Salem Sokhn *et al*. (2024) [22] evaluated synergistic/antagonistic antibacterial activities of fatty oils from apricot seed oil (ASO), date seed oil (DSO), grape seed oil (GSO), and black seed oil (BSO). The concentrations of linoleic acid, oleic acid, palmitic acid, stearic acid, and linolenic acid were revealed by fatty acid profiles of individual oils and oil mixes. All samples showed linoleic acid as the most prevalent fatty acid, except ASO, where oleic acid predominated. ASO had the lowest total phenolic content, whereas GSO displayed the highest. *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, and *Staphylococcus aureus* were the antibacterial species screened for. All evaluated oils exhibited antibacterial action against S. aureus strains, except ASO. ASO had the strongest antibacterial effect against *P. mirabilis* strains, except *P. aeruginosa*. In summary, seed oil combinations should exhibit encouraging antibacterial properties against certain strains.[22]

Mahmoud, A.M *et al*. (2015) [23] investigated the possible protective effects of *Prunus armeniaca* leaf extract against isoniazid (INH) and rifampicin (RIF)-induced nephrotoxicity in rats. The experimental rats were given 50 mg/kg of INH and RIF, as well as 100 or 200 mg/kg body weight of *Prunus armeniaca* leaf extract, orally for 45 days. Histopathological changes and a significant rise in serum urea, creatinine, and uric acid levels were indicative of nephrotoxicity caused by INH/RIF treatment. Rats intoxicated with INH/RIF showed markedly elevated levels of renal lipid peroxidation and serum tumor necrosis factor-alpha. On the other hand, the kidneys of INH/RIF-induced rats showed a significant decrease in glutathione level as well as diminished activity of glutathione peroxidase and superoxide dismutase. The extract supplementation at either dose concurrently inhibited the biochemical and histological changes brought on by INH/RIF. Thus, this work provides fresh insights into the protective potential of extract from *Prunus armeniaca* leaves against nephrotoxicity caused by anti-tuberculosis medication by increasing the antioxidant defense system, eliminating oxidative stress and inflammation, and protects against INH/RIF-induced kidney damage [23].

Sabry Ali El-Naggar *et al*. (2020) [24] investigated the antitumor efficacy of *Prunus armeniaca* seed extract (PASE) and *Prunus domestica* seed extract (PDSE). Ehrlich ascetic carcinoma (EAC), human breast (MCF-7), hepatic (HepG-2) cancer cell lines, phytochemical analysis, and (GC-MS) profile were employed to assess the anticancer activity. Total anthocyanin, saponin, flavonoids, and phenolic were 1291 μg mL^{-1}, 159 μg mL^{-1}, 16 mg g^{-1}, and 65 μg mL^{-1}, respectively, in PASE. On the other hand, 729 μg mL^{-1}, 63 μg mL^{-1}, 7.6 mg g^{-1}, and 89 μg mL^{-1} was found in PDSE, respectively. According to the GC-MS analysis, octasiloxane-hexadecamethyl (17.04%) and hexadecanoic acid, trimethylsilyl ester (31.92%) had the greatest peak areas (%) in PASE and PDSE, respectively. PASE and PDSE had *in vitro* inhibitory concentrations (IC_{50}) against MCF-7 of 31.5 and 306, respectively. PASE and PDSE had IC_{50} values of 22.8 and 430 μg mL^{-1}, respectively, against HepG–2 [24].

F.A. Masoodi *et al*. (2017) [25] reported the Optimization of antioxidant activity and total polyphenols of *Prunus armeniaca* fruit extracts using response surface methodology. Four independent variables were used to optimize the conditions for antioxidant potential and polyphenols from apricot powder: methanol (20%, 35%, 50%, 65%, and 80%), solvent/sample ratio (10, 15, 20, 25 and 30), temperature (20, 30, 40, 50 and 60 °C), and time (20, 30, 40, 50 and 60 min). Response surface methodology (RSM) was used in this process. The findings demonstrated that the trials' total polyphenol content and antioxidant potential ranged from 8.77 to 12.11 mg GAE/g and 76.15% to 96.68%, respectively. The total polyphenols and antioxidant potential F-values were 4.44 and 0.99, respectively. It came to light that the antioxidant potential and total polyphenols had coefficients of determination (R^2 values) of 0.4799 and 0.8057, respectively. The results for antioxidant potential and total polyphenols were 91.165% and 10.702 mg GAE/g, respectively, under the ideal circumstances of 35% methanol, 15 solvent/sample ratio, 30 °C temperature, and 30 min duration. The current method may be used commercially to extract antioxidants from apricot fruits for use in nutraceuticals and other applications [25].

Sobia Noreen *et al*. (2022) [26] investigated *Prunus armeniaca* Gum-Alginate Polymeric Microspheres to Enhance the Bioavailability of Tramadol Hydrochloride. The ionotropic gelation process was used to create coated and blended microspheres. The impact of varying polymer content on the structural and functional characteristics of microspheres that were formulated was examined. Thermal analysis, XRD, and FTIR were used to characterize the microspheres. The well-formed spherical beads in each formulation ranged in average diameter from 579.23 ± 07.09 to 657.67 ± 08.74 μm. The range of medicines entrapped by microspheres was 65.86 ± 0.26–83.74 ± 0.79%. Compared to blended formulations, coated formulations had a greater pH-dependent swelling index. Tramadol hydrochloride entrapment was verified by FTIR spectra, which also revealed the absence of any drug-polymer interaction. With an R2 value of 0.9803–0.9966, the *in vitro* drug release profile demonstrated sustained release following the Korsmeyer–Peppas kinetic model. Swiss albino mice used in an acute toxicology trial that used the oral route revealed no harm. These findings suggest that by extending the release period, mixing PAG with sodium alginate can increase the stability of alginate microspheres and their drug release profile [26].

Tek Chand Bhalla *et al*. (2016) [27] reported the Purification, Characterization, and Application of Hydroxynitrile Lyase (HNLs) of *Prunus armeniaca* in the Synthesis of Enantiopure Mandelonitrile. The wild apricot Hydroxynitrile lyases were purified 8.1 times and yielded 18.2%, with a specific activity of 141 units mg^{-1} protein.

The enzyme's 40 and 37 kDa subunits were identified by SDS-PAGE. Nonetheless, the holoenzyme's molecular weight was determined to be 360 kDa. At 25°C, the enzyme was most active in a 0.1 M sodium citrate buffer with a pH of 4.75. Thermostability tests indicated that this HNL was active up to 70 °C and reasonably stable up to 50 °C. The predicted activation energy of HNL of wild apricot (ParsHNL) was determined to be 37.83 kJ mol^{-1}. When mandelonitrile is used as the substrate, this enzyme exhibits K_m of 3.76 mM, V max of 188.4 µmol mg^{-1} min^{-1}, and k cat of 1130.4 s^{-1}. In contrast, when benzaldehyde is used as the substrate, K_m of 16.1 mM, V_{max} of 7.21 µmol mg^{-1} min^{-1}, and k cat of 43.3 s^{-1} are seen in the reverse reaction. After employing ParsHNL for the synthesis of mandelonitrile, 8.88 mmole (1.184 g) of the compound was obtained, corresponding to 89% molar conversion and 96% ee for R-mandelonitrile. Mandelonitrile yielded 411 µmol $mg^{-1}h^{-1}$. These findings showed that ParsHNL may be utilized to produce enantiopure cyanohydrins and has a very high potential for cyanohydrin synthesis [27].

Sobia Noreen *et al*. (2023) [28] investigated Preparation and evaluation as a potential candidate for controlled drug delivery of a novel pH-responsive hydrogel system based on *Prunus armeniaca* gum and acrylic acid. A new hydrogel system based on Prunus armeniaca gum (PAG) and acrylic acid (AA) was created via a free radical process, with potassium persulfate (KPS) acting as an initiator and N, N-methylene bis acryl amide (MBA) acting as a cross-linker. The effects of different concentrations of PAG, AA, and MBA were investigated by developing a range of hydrogels. The pH-responsive swelling, drug release, gel content, and porosity of the hydrogels were described. FTIR, XRD, and SEM studies were used to conduct structural study. Thermal stability was evaluated using TGA analysis. *In vivo*, drug release studies and oral acute toxicity studies were conducted on rabbits. Drug release and pH-dependent swelling were demonstrated via hydrogels. As PAG and AA concentration rose, swelling, drug loading and release, and porosity increased; on the other hand, MBA decreased. Increasing all three of the components enhanced the gel content of the formulations. The formation of copolymeric networks and the loading of medication were validated by FTIR measurements. According to XRD investigations, hydrogels were amorphous, and upon loading, the crystalline medication transformed into an amorphous form. The hydrogels were found to be stable up to 600 °C based on TGA data. The nontoxicity of hydrogels in rabbits was confirmed by acute oral toxicity data, up to a dosage of 2 g/kg body weight. In comparison to the drug's oral solution, the pharmacokinetic study showed that hydrogels extended the drug's availability and that the drug's peak plasma concentration was reached in 6 hours. The model medication utilized was tramadol hydrochloride (THC). Therefore, PAG-based hydrogels may be taken into consideration as possible controlled-release polymeric carriers due to their pH-responsive swelling and release, nontoxic nature, and enhanced pharmacokinetics [28].

Eman A. Mazyed *et al*. (2024) [29] reported the Formulation and characterization of quercetin-loaded *Prunus armeniaca* gum nanoparticles with an enhanced anti-bacterial effect. A glycoproteomic analysis of the gum's composition identified components of the arabinogalactan family of polysaccharides. It also revealed the presence of several proteins involved in the plant's defense against environmental stress and the chemical changes of the gum caused by oxidation. The electrostatic interactions of calcium ions with Prunus armeniaca gum exudate (PAGE) served as the basis for the synthesis of quercetin-loaded PAGE-NPs. A 23-factorial design served as the basis for the formulation procedure. F6 was selected as the optimal PAGE-NPs after analyzing the ways in which the independent variables impacted the drug encapsulation efficiency (DEE%) and the percentage of quercetin released after 24 hours (Q24h). Compared to unprocessed quercetin, F6 significantly improved intestinal permeability and stability. The histological characteristics of the PAGE NPs-treated group improved in terms of the antibacterial action. Additionally, this group's survival rate increased and the bacterial burden significantly decreased. Furthermore, IL-1β and IL-6, two inflammatory mediators, significantly decreased in the group treated with PAGE NPs. Thus, PAGE-NPs are effective green nano-drug delivery vehicles for augmenting quercetin's pharmacological action [29].

Tomáš Nečas *et al*. (2021) [30] Reported the Effect of Methyl Jasmonate, Cytokinin, and Lavender Oil on the Antioxidant Enzyme System of *Prunus armeniaca* Fruit. After the fruit was treated, its lipid peroxidation and the activity of the enzymes catalase (CAT), superoxide dismutase (SOD), and ascorbate peroxidase (APX) were examined. The fruit was kept at 0 °C and 90–95% relative humidity for 25 days. The results of the study showed that treating apricot fruit with 5 ppm cytokinin and 1000 ppm lavender oil improved APX and CAT enzyme activity, respectively. Additionally, fruit treated with MeJA + lavender oil showed improved SOD enzyme activity. As a result, it can be emphasized that the product quality of apricot fruit is preserved as both the eco-friendly application of MeJA, cytokinin, and lavender oil separately from each other and the treatment of combinations between these compounds activate the enzymatic antioxidant defense systems of apricot fruit after harvest [30].

A. Derardja *et al*. (2022) [31] reported the Polyphenol oxidase and enzymatic browning in *Prunus armeniaca*. L-PaPPO, a recombinant latent apricot polyphenol oxidase, was the cause of the *in vitro* browning. Significant amounts of the enzyme with both copper ions in the catalytic active site were produced by the successful heterologous expression of PaPPO in *Escherichia coli*. We characterized the expressed L-PaPPO in terms of its molecular mass (56531.3 Da), pH optimum (7.0), SDS activation, and enzyme kinetics. Brown and non-brown apricots' phenolic profiles were compared using LC-MS/MS. Antioxidant capacity and total phenolics (as determined by the DPPH and CUPRAC assays) were significantly reduced by the browning reactions. Browning primarily affected individual phenolics such as epicatechin, B-type procyanidins, and catechins, with chlorogenic and neochlorogenic acids. Because they were oxidized significantly more quickly than the other phenolics that were identified, these phenolics are most likely the primary endogenous substrates of LPaPPO [31].

Nigar Vardi *et al*. (2013) [32] reported the protective effects of *Prunus armeniaca* against methotrexate-induced oxidative damage and apoptosis in rat kidneys. Significant elevations in serum creatinine and urea levels indicate that methotrexate-induced renal failure occurred. Furthermore, the findings demonstrated that methotrexate markedly increased lipid peroxidation and decreased antioxidant

activity in rats. On the other hand, apricot enhanced the levels of glutathione, superoxide dismutase, and catalase while reducing the production of malondialdehyde, so greatly preventing the harmful effects of methotrexate. Furthermore, it was shown that methotrexate exposure causes major histological damage to kidney tissue, including glomerulosclerosis and apoptosis. On the other hand, an apricot diet can reverse these effects. These findings suggest that apricots might help avoid some of the negative consequences of MTX, namely nephrotoxicity [32].

Feral Ozturk *et al*. (2009) [33] evaluated the Protective effect of 10% and 20% containing feed of *Prunus armeniaca* on hepatic steatosis and damage induced by carbon tetrachloride in Wistar rats. Apricot feeding was shown to considerably reduce the area of liver damage. The CCl4 group showed markedly elevated levels of malondialdehyde and total glutathione as well as catalase, superoxide dismutase, and glutathione peroxidase activities, all of which point to enhanced oxidative stress. The histological damage was lessened and the oxidative stress was reduced by apricot eating. It may be concluded that apricot feeding was advantageous for CCl4-induced liver steatosis and damage, most likely because of its strong radical-scavenging ability and antioxidant nutritional contents (beta-carotene and vitamin). Apricot consumption can lower the risk of free radical damage and hepatic steatosis [33].

Murat Y Ugras *et al*. (2015) [14] evaluated the *Prunus armeniaca* protects rat testes from the detrimental effects of low-dose X-rays. The spermatozoa get damaged by low-dose x-ray exposure mostly through late-onset (after three months) oxidative stress. An isoenergetically constructed meal of 20% apricot was added to the standard rat diet. It was established what the two diets' total phenolic content, reducing power, and antioxidant capacity were. Before and after being exposed to X-rays, Sprague-Dawley rats were fed a diet high in apricots. The controls were given regular diets. The rats were put down on the 20th week following their exposure to 0.2 Gy x-rays during the 8th week. Reduced glutathione, superoxide dismutase, catalase, and tissue thiobarbituric acid-reactive compounds were used to measure the oxidative state of the testicles. Leydig and Sertoli cell counts, Johnsen scores, and qualitative and quantitative microscopic investigations were carried out for the histologic examination. There was modest tissue degeneration and considerable testicular oxidative stress in the control diet group. The exposure groups showed a substantial reduction in tubule diameters, Johnsen scores, and Leydig and Sertoli cell numbers. A diet high in apricots considerably reduced oxidative state and stopped damage in tubular histology. When the diet was started after exposure, the protective effects were only partially protected, but they were still noticeable when the diet was followed for the entire duration. Apricot's inherent antioxidant properties help testis tissue recover from the long-term negative effects of low-dose radiation. Additional research is required due to the apricot's high overall antioxidant capacity [34].

Siwei Tan *et al*. (2016) [35] reported Apricot Kernel Oil Ameliorates Cyclophosphamide-Associated Immunosuppression in Rats. Rats were given cyclophosphamide intraperitoneally to suppress their immune systems, and for four weeks, they were either given normal saline (NS) or apricot kernel oil (AKO) intraperitoneally. Hepatocytes' anti-inflammatory and lymphocytes' antimicrobial components were found using enzyme-linked immunosorbent tests. The spleen, liver, and thymus were histopathologically analyzed after hematoxylin and eosin staining. There were notable distinctions seen in the immune systems of the AKO group, the normal saline group, and the healthy control group. The lymphocytes extracted from rats fed AKO exhibited a considerable improvement in the levels of immunoglobulin (Ig)A, IgM, IgG, interleukin (IL)-2, IL-12, and tumor necrosis factor-α (TNF-α) as compared to the normal saline-treated group. Rats given AKO had decreased oxidative stress as evidenced by lower levels of malondialdehyde in their liver tissue and lowered activities of glutathione peroxidase and superoxide dismutase. Rat growth was significantly impacted by dietary AKO, which also prevented organ deterioration linked to cyclophosphamide. These findings showed that AKO may strengthen the immune system in living things. The immune system's critical involvement of metabolites of intermediate oleic and linoleic acid may be reflected in these effects, and the presence of α-tocopherol in AKO may amplify these phenomena. This suggests that AKO may be used as a dietary supplement to lessen immunosuppression brought on by chemotherapy [35].

Conclusion

Apricot (*Prunus armeniaca*), sometimes referred to as stone fruit, which is enjoyed globally due to its many health and nutritional advantages. Bioactive substances including carotenoids, flavonoids, phenolics, and antioxidants are present in it. The fruit has a unique flavor and aroma. It may be consumed raw or added to jams, jellies, and preserves. While the seed from the seed kernel is utilized in pharmacological and cosmetic applications, it is also used in wine. Apricot oil's many advantages make it a popular ingredient in skincare, hair care, and cosmetic products. It has unsaturated fatty acids, antioxidants, vitamin K, vitamin E, and vitamin C. This combination of antioxidants and nutrients can help calm and repair the skin. It has a range of beneficial properties, including those that are sedative, antipyretic, antispasmodic, antiseptic, laxative, expectorant, emollient, emetic, ophthalmic, antioxidant, cardioprotective, anti-inflammatory, and hepatoprotective activities.

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