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Biological activities and phytochemistry of apricot (*Prunus armeniace L.*) grown in Balochistan (A Review)

SYED ZAHOOR AHMED
M.Phil. Scholar, Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
MUHAMMAD ANWAR PANEZAI
Professor, Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
JAHANGIR KHAN ACHAKZAI
Department of Natural and Basic Sciences, University of Turbat, Turbat, Pakistan
ABDUL MANAN KAKAR
Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
NAZIMA YOUSAF KHAN
Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
AJAB KHAN TAREEN
Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
SHABANA TAREEN
M.Phil. Scholar, Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
BUSHRA HABIBULLAH
M.Phil. Scholar, Institute of Biochemistry, University of Balochistan, Quetta, Pakistan
NAJMA GUL KHAN
M.Phil. Scholar, Institute of Biochemistry, University of Balochistan, Quetta, Pakistan

Abstract

Medicinal plants have long been used to cure a variety of ailments, including infectious disorders, and hundreds of thousands of plant species have been examined for their medicinal characteristics in recent years. The phytochemicals present in Apricot (Prunus armeniace L.) exhibited significant biological activities such as anti-inflammatory, hepatoprotective, antibacterial, antifungal, antioxidant, antimutagenic, antimicrobial, and cardioprotective as well as important role in nutrient contents, color and flavor, Bleeding, spasm, infertility, eye inflammation, Vaginal and skin infections. The phytochemicals present in Apricot are polyphenols, phenolic acids, coumarins, tannins, lignins, lignants, phenols and flavonoids, vitamins, minerals, carbohydrates, fibres and phytochemicals for instance glycosides, carotenoids, polyphenols, phenolic chemicals, aldehydes, sugars, terpene alcohols, and flavonoids, terpenoid chemicals geraniol and nerolidol, cyanogenic glycoside such as amygdalin, quercetin-3-glucosides, kaempferol-3-rutinoside, neochlorogenic acid, rutin, cynidin-3- glucosides, p-coumaric acids, ferulic acid, epicatechin, epigallocatechin and Catechin, acids, acetates, alcohols, aldehydes esters and terpenes. Hexanal, ethanol, hexyl acetate, (Z)-3-hexenyl acetate, (E)-2-hexenyl acetate, 1-hexanol, (Z)-3-hexenol, and (E)-2-hexen-1-ol, chlorogenic acid, 3,4,5-trihydroxybenzoic acid, 2-(3,4-dihydroxyphenyl)-3,5,7-trihydroxy-4H-chromen-4-one, catechin and 3-(3,4-dihydroxyphenyl)-2-propenoic acid, minerals for instance phosphorus, selenium, magnesium, zinc, iron, potassium and calcium and fiber, lipids such as sterols and fatty acids, essential oil

Keywords: Apricot (Prunus armeniace L.), Biological activities, Phytochemistry

INTRODUCTION

Natural resource exploitation for the discovery of novel anti-infective medicines has sparked increased attention in recent years. Medicinal plants have long been used to cure a variety of ailments, including infectious disorders, and hundreds of thousands of plant species have been examined for their medicinal characteristics in recent years (Górniak et al., 2019). More than 80% of the world's population relied on medicinal plants and compounds for primary care in 2008. Fruit and vegetable consumption is critical in human nutrition. They provide beneficial biological activities with nutrients and non-nutritive elements, resulting in a well-balanced diet and a reduced risk of disease. Nutritionists feel that increasing fruit and vegetable consumption is one of the best methods to reduce the burden of many chronic diseases, based on scientific evidence (Boeing et al., 2012). Phenolic chemicals are one of the most prevalent categories of secondary metabolites produced by plants. Over 800 different types of phenolic chemicals can be found in plants (Cvejić, Krstonošić, Bursać, & Miljić, 2017).

Phenolic chemicals can operate as microbicides through a variety of methods. These chemicals can inhibit a variety of microbial virulence factors, e.g., Toxin neutralization, inhibition of biofilm development and silencing of host ligand interaction, start reducing hydrophilicity, undermine nucleic acid synthesis and metabolic functions, and quash bacterial cell wall synthesis (Górniak et al., 2019; Quideau et al., 2011). One of the most important health issues today is the emergence of numerous forms of resistant microorganisms as a result of the antibiotic overuse, which has resulted in a decrease in their potency (Fadli et al., 2016). In reality, the growth of multidrug-resistant microbes is posing a problem for infection therapy (Yap et al., 2014). As a result, new techniques to combating these diseases are urgently needed (Brooks & Brooks, 2014).

Apricot belongs to the genus Prunus, family Rosacea, bearing stone fruits and is firm deciduous. This fruit is originated in Japan, China and Korea (Lim, 2012). Five thousand years ago, apricot was domesticated in Afghanistan, Western China, Iran, Middle Asia and Turkey (Hacıseferoğulları, 2007). The apricot tree, *Prunus armeniaca* L., belongs to the Rosaceae family of flowering fruit trees. It is a native of the East, specifically China and Japan (Lee et al., 2014), with a global production of around 2.6 million tons, it is regarded one of the most important temperate fruit trees (Gatti et al., 2009). Apricot seeds, for instance, are used to treat hemorrhages, wheezing, asthma, fertility problems, and eye inflammation in traditional medicine (Bensky, 2014),. Furthermore, apricots have antibacterial properties, specifically against skin illnesses like acne vulgaris, as well as antidandruff properties (Kamel, 2018).

Pakistan produces 0.991 million tons of total fruits per year from a land area of 0.239 million hectares. Balochistan accounts for 32.6 percent of the country's area and 17.4 percent of its production. Balochistan is a Pakistani province that lies on the Iranian Plateau's eastern edge. Its coordinates are 30.12°N 67.01°E. The province is famous for its diverse nature of climate and is Pakistan's top fruit producer, earning it the moniker "Fruit Basket of Pakistan." The province's diverse climates are ideal for cultivating a wide range of fruit crops, from temperate to sub-tropical to tropical and yields 90% of almonds, grapes, and cherries, 60% of apricot, pomegranate, and peach, 34% of apple, and 70% of dates. (FAO, 1993).

Recent reports concerning the phytochemical quantifications, antioxidant activities, bioluminescent toxicity testing and mineral composition of six varieties of apricot kernel and pomace belonging from Balochistan is available in the literature (Tareen et al., 2021), but no information is available regarding the *in vitro* antimicrobial, GC-MS analysis and antifungal activities of apricot pomace and the lack of research relating the antifungal and antibacterial activity of the apricot fruits have initiated the current study.

BACKGROUND OF STUDY

Balochistan has a unique environment for the production of a wide range of high-quality fruits, thanks to its four agro-ecological zones. The province is regarded as the country's fruit basket, producing 90% of grapes, cherries, and almonds, 60% of peach, pomegranate, and apricot, 34% of apple, and 70% of date. The province produces a variety of fruit crops due to its varying climates, which range from temperate to sub-tropical to tropical. Grape, olive, pistachio, and pomegranate are high delta fruits, while apple, apricot, cherry, and peach are low delta fruits. Despite these facts, we believe that, to the author's knowledge, the antibacterial and antifungal aspects of apricot fruit grown in the province is limited and obscure. Since, higher plants, in fact, are highly effective against human bacterial and fungal diseases. Fruit's health advantages are a hot topic among scientists all around the world. The purpose of this study is to assess the potential health benefits of different varieties of apricot fruits grown in the province in terms of antibacterial and antifungal activities. For this purpose selected varieties of apricot fruits will be assessed for their antifungal and antibacterial attributes.

LITERATURE REVIEW

There are several chemical substances with medicinal properties found in the plant world. The use of medicinal plants as flavors, odour, colour, preservatives, and a variety of traditional and folklore medicines is the outcome of this. The fact that one of the most "lifesaving pharmaceuticals" (antibiotics) can only be obtained by plants serves as a reminder of the value of natural treatments. According to reports, even though synthetic substances and microbiological agents contribute significantly to the pharmaceutical industries, the usage of phytodrugs has grown recently. Approximately 25% of prescribed medications are made from plants.

In recent years, according to Sinha (2012) the utilization of plants as a source of new compounds to fight microbial illnesses has grown in popularity. Using *in vitro* antibacterial screening methodologies, the study evaluated the phytochemical content of Moringa olehifera extracts biological effects. At concentrations of 5 mg/ml, the antibacterial methanol extract of this plant's leaves, flowers, barks, seeds, and fruits shown antibacterial activity against *Shigella flexneri, Shigella Dysenteriae, Pseudomonas aeruginosa, Bacillus subtilis and Escherichia coli*.

Fruits had mystical or spiritual properties in the past (Unnisa, 2012). The phenolic compounds which are present in fruits and exhibit significant biological activities are phenolic acids, coumarins, tannins, lignins, lignants, phenols and flavonoids (Cong-Cong, 2017). Complex chemical compositions of fruits are the resounding proof for their health benefits (Oliveira, 2009). Polyphenol compounds are abundantly present in variety of fruits which exhibit biological activities (Blumberg, 2013). Stress is reduced by secondary metabolites such as polyphenols in fruits (Asensi, 2011). Various long term diseases are cured by variety of fruits containing secondary metabolites (Sochor, 2010). Nutritionally important minerals for instance phosphorus, selenium, magnesium, zinc, iron, potassium and calcium and fiber are present in Apricot fruit (Lichou, 2003).

Regarding nutritive values (vitamins, minerals, carbohydrates, fibres and phytochemicals for instance glycosides, carotenoids, polyphenols), apricot is considered a product of interest (Wani, 2017). Apricot consists of polyphenols such as quercetin-3-glucosides, kaempferol-3-rutinoside, neochlorogenic acid, rutin, cynidin-3- glucosides, p-coumaric acids, ferulic acid, epicatechin, epigallocatechin and Catechin (Campbell, 2013). Apricot is a good source of secondary metabolites for instance carotenoids and lipids such as sterols and fatty acids as well as minerals (Zaghdoudi, 2015; Dragovic-Uzelac, 2005; Hegedüs, 2011). The phytochemicals present in Apricot exhibited significant biological activities such as anti-inflammatory, hepatoprotective, antimutagenic, antimicrobial, and cardioprotective as well as important role in nutrient contents, color and flavor (Erdogan-Orhan, 2011).

Bleeding, spasm, infertility and eye inflammation are treated by the phytochemicals present in bark, kernels, leaves and fruits of apricot (Wani, 2017). Vaginal and skin infections are treated the phytochemicals present in apricot (Yiğit, Yiğit, & Mavi, 2009). The toxic cyanogenic glycoside such as amygdalin is found in the kernels of apricot (Gómez, Burgos, Soriano, & Marín, 1998).

Lee et al., (2014), discussed the phytochemical composition and antibacterial activity of the apricot seed essential oil. The hydro distillation-isolated essential oil was examined using gas chromatography-mass spectroscopy. The antibacterial effectiveness against 16 bacteria and two yeast species was assessed using the disc diffusion, agar dilution, and gaseous contact methods. According to their study, The lowest inhibitory concentrations for yeast strains, Gram-positive bacteria, and Gram-negative bacteria, respectively, varied from 250 to 4000, 500 to 2000, and 250 to 1000 g/mL, whereas, For yeast strains, gram-positive bacteria, and gram-negative bacteria, the minimal inhibitory doses by gaseous contact ranged from 12.5 to 50, 12.5 to 50, and 3.13 to 12.5 mg/L air, respectively. The main compounds identified were Benzaldehyde, mandelonitrile and benzoic acid.

In a comparitive study, Nafis et al., (2020), used essential oils from the leaves of apricot and *Laurus nobilis* L. from Morroco were assessed for the first time to see if they would have synergistic *in vitro* antibacterial and antifungal effects with some common antimicrobial medications, including, ciprofloxacin, fluconazole and vancomycin. By using GC-MS, samples were further assessed for their chemical composition. The primary volatile substances found in apricot were benzaldehyde (7.25%), nonacosane (8.76%), pentacosane (15.11%) and (Z)-phytol (27.18%), while in *L. nobilis* were methyl eugenol (8.72%) α-terpinyl acetate (12.64%)and eucalyptol (40.85%). Pertaining to the antimicrobial activity, the essential oils from *L. nobilis* showed the higher activity with minimal inhibitory concentrations varying from 2.77 and 5.55 mg/mL for yeasts and from 1.39 to 22.2 mg/mL for bacteria. In fact, out of the 32 associations that were investigated, 23 (71.87%) showed complete synergistic effect and 9 (28.12%) showed partial synergism.

A study based on the effect of extraction efficiency, Cheaib et al., (2018), studied the, antioxidant, antiradical and antimicrobial activity of phenolic compounds extracted from apricot pomace and kernels by using infrared (IR) and solid–liquid (S/L) technology . According to their results, The highest levels of flavonoid (6.3 mg CE/g DM), tannin (3.6 mg/L), and polyphenolic content (10.8 mg GAE/g DM) were found in IR pomace extract and consequently had the greatest inhibitory effect on all of the gram-positive bacteria and one gram-negative bacterial strain tested (Escherichia coli) and showed strong activity of ABTS and DPPH activity. The High-performance liquid chromatography (HPLC) analysis showed that caffeic and gallic acid were predominant phenolic compounds in apricot kernels and rutin, catechin, and epicatechin were in apricot pomace. The results demonstrated that IR technology outperformed S/L ones in terms of extraction effectiveness and biological activity of the extracts.

A study described the *in vitro* antioxidant and antimicrobial activities of water and methanol extracts of bitter and sweet *Prunus armeniaca* L. kernels were investigated by Yiğit, D., Yiğit, N., & Mavi, A. (2009). They concluded that both the water and methanol extracts of sweet kernel extracts exhibited higher antioxidant activities i.e., total phenolic content (7.9 ± 0.2 μg/mL) and the highest percent inhibition of lipid peroxidation (69%) were seen in the water extract of the same cultivar and the methanol extract of sweet kernels (Hasanbey), respectively. Whereas, the most potent antibacterial activity against the Gram-positive bacteria *Staphylococcus aureus* was seen in the methanol and water extracts of bitter kernels and in the methanol extract of sweet kernels. Furthermore*, Escherichia coli*, a Gram-negative bacterium, was particularly sensitive to the methanol extracts of the bitter kernels with MIC value: 0.312 mg/mL).

Using the solid phase micro extraction (SPME) coupled with GC-MS technology, the aroma components of the eight Malatya apricot cultivars, six cultivars bred under identical conditions from various sites, and one hybrid cultivar were investigated by Gokbulut, I., & Karabulut, I. (2012). It was discovered that the total concentration of fragrance components ranged between 514 and 6232 g/kg fresh weight. The primary volatiles found in apricot varieties were acids, acetates, alcohols, aldehydes esters and terpenes. Hexanal, ethanol, hexyl acetate, (Z)-3-hexenyl acetate, (E)-2-hexenyl acetate, 1-hexanol, (Z)-3-hexenol, and (E)-2-hexen-1-ol were all found in some concentrations in all of the cultivars examined.

According to Vorobyova, V. I., Skiba, M. I., & Trus, I. M. (2019) the apricot pomace extract (APE) has demonstrated significant antioxidant and anticorrosion capabilities, making it a potential multifunctional inhibitor material. In their work, by using GC-MS analysis, determined the elements that are present in the ethanol APE. To characterize the antioxidant activity of the extract, a number of experimental models, such as iron (III) reducing capacity, total antioxidant capacity, and DPPH radical scavenging activity, were applied. Fourier transform infrared (FTIR), potentiodynamic polarisation, and weight loss analysis were employed to evaluate the corrosion inhibition. Additionally, the protective coating was characterised using atomic force microscopy and scanning electron microscopy. The GC- MS findings revealed that the principal APE chemicals are chlorogenic acid, 3,4,5-trihydroxybenzoic acid, 2-(3,4-dihydroxyphenyl)-3,5,7-trihydroxy-4H-chromen-4-one, catechin and 3-(3,4-dihydroxyphenyl)-2-propenoic acid. Research work shed light on the chemical reactivity, active sites, and potential mechanisms of interaction between inhibitor chemicals and mild steel surfaces.

To investigate how specific nonpolar solvents affect *Prunus armeniaca* L.'s phytochemical makeup and antioxidant potential was conducted by Shakun et al., (2020) in a dry apricot cake acquired through food industry processing. The apricot variety used in their study was “Favorit,” harvested from two geographical regions of Ukraine (Nikolaev and Kherson). Silicone, ethanol and mixtures propan-2-ol with silicone and ethanol silicone was used for extraction. GC-MS was used for component composition, Infrared Spectrometry for functional group identification, UV Spectrometry for identification of the compounds, Total Antioxidant Assay, Ferric-Reducing Ability Power (FRAP), Scavenging of DPPH Radicals, ABTS•+ Radical Cation Scavenging assays were applied to investigate antioxidant activity. GC-MS analysis revealed there were 50 distinct chemical structural components in all. A significant amount of phenolic chemicals, aldehydes, sugars, terpene alcohols, and flavonoids are present in the ethanol-derived extract. There are 38 different components in the dried apricot cake extract propan-2-ol that have a higher terpene alcohol content. The composition of the silicone (D5) extract from apricot waste was studied, and it was discovered that it has various quantitative amounts of the same components as propan-2-ol extract. All of the components of the ethanol and silicone extract were present in the extract that was produced using a combination of the two solvents. The extract had the highest concentration of the terpenoid chemicals geraniol and nerolidol, according to GC-MS analysis whereas, UV-spectrum indicated the frequency of substances belonging to the class of terpenoids and fatty acids. Furthermore, parallel to the mechanism of reaction, various extracts displayed varying levels of antioxidant activity in various test methods.

In a recent study conducted by Tareen et al., (2021), investigated the kernel and pomace samples of six apricot cultivars grown in Balochistan, Pakistan, for total flavonoid content, mineral composition, bioluminescence toxicity assay, and antioxidant activity as measured by DPPH, HPS, TAC, and FRAP assays. According to their results, Comparing the TPC, TFC, bioluminescence toxicity to *V. logei*, and antioxidant activity, the apricot kernels outperformed the pomace. However, the Pomace contained more minerals than kernels. The correlation study showed that polyphenols and flavonoids significantly contributed to antioxidant tests. Remarkably, the Badoghur kernels were reported to have the strongest inhibition against V. logei (IC50 = 1.61 mg/ml).

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