Progress in Nutrition 2021; Vol. 23, N. 2: e2021070 DOI: 10.23751/pn.v23i2.10472

Original article

Comparison of antidiabetic and antioxidant activities of sweet and bitter apricot kernels

Gülşen Kaya[1] *and Merve Keskin*[2]

[1] Scientific and Technological Research Center, Inonu University, Malatya, Turkey
[2] Vocational School of Health Services, Bilecik Seyh Edebali University, Bilecik, Turkey

Abstract. Fruits and their kernels have important phytochemical components for human health and nutrition. The fruits and their kernels have antioxidant effects by their seconder metabolites. Apricot (*Prunus armeniaca L.*) is an important fruit because of its functional properties with both its fruits and kernels. Therefore, in this study, total phenolic, flavonoid content, ferric reducing antioxidant power (FRAP) and inhibition properties of α-amylase enzyme of fruit, sweet and bitter apricot kernels were investigated. Methanol extract of each part of this fruit was prepared respectively. Total phenolic content as 241.83±1.47; 118.15 ± 2.03 and 60.41 ± 0.97 mg GAE/100 g, flavonoid content as 177.05±1.68; 20.08 ± 0.63 and 32.16 ± 0.51 mg QE / 100 g; antioxidant capacity as 0.81±0.02; 0.66 ± 0.01 and 0.27 ± 0.02 mM Fe^{2+}/ mL extract were determined respectively. IC_{50} values for alpha amylase inhibition were calculated as 1.30±0.02; 0.74 ± 0.01 and 3.17 ± 0.01 mg/mL for fruit, sweet and bitter kernel extract respectively. The extracts showed good amylase inhibition properties. It can be concluded that apricot fruit and kernels might be used as a food supplement in Diabetes mellitus.

Keywords: α-amylase; inhibition; phenolic; kernel; Diabetes mellitus

Introduction

Phytotherapy, which means treatment with herbs, finds a wide application area in traditional and complementary medicine practices. Today, natural products are gaining more and more attention, and some researchers are focusing on the beneficial effects of plant-based antioxidants. Natural antioxidants such as vitamins, minerals and carotenoids contribute significantly to the prevention and quenching of free radical species. These antioxidants are highly effective against oxidative damage-related health disorders such as cardiovascular diseases, neurological syndromes, the aging process, cancer, cataract development, immune system weakness and inflammation. Different parts of the fruit in fresh and dry form are a rich source of natural antioxidants, including polyphenols (flavonoids, phenolic acids, lignins, etc.), Carotenoids and vitamins A, C and E, which are reported to control degenerative diseases in humans (1).

Prunus armeniaca L. (apricot) belongs to the Rosaceae family and is grown mainly in the Mediterranean regions (1). Apricot is an important fruit with functional properties such as polyphenols, carotenoids, etc. The phytochemicals in apricot fruit play a key role in the taste, color and nutritional value of apricot, as well as antioxidant, anti-mutagenic, anti-microbial, hepatoprotective, cardioprotective and anti-inflammatory properties. In addition, the use of apricot in the treatment of infertility, eye inflammation, bleeding, spasm, vaginal and skin infections is mainly attributed to the phytochemicals found in its fruit, kernels and leaves (1).

Apricot kernels are rich in oil (50%), unsaturated and saturated fatty acids. The energy of kernels are

575 kcal/100g and it is provided by proteins. Kernels contain 21.0-23.3% protein with eight different essential amino acids. They contain 5.5% of total soluble sugars and 12.2% of the dietary fiber, approximately (2). In addition, they also contain vitamin E and various trace elements. Therefore, apricot kernels have become one of the nutritionally balanced foods in daily diet, due to their rich nutrients and benefits for human health, especially in treating or preventing the diseases like Diabetes mellitus, cough, asthma, cardiovascular and cerebrovascular and weight maintenance (2).

Recently, nutritional properties of the kernels left over after the consumption is stated in the studies reported in literature (1-3). Apricot kernels are called sweet or bitter according to the drying process applied. In this study, the total phenolic content and antioxidant properties of apricot fruit, sweet and bitter kernels were determined and their effect on α-amylase inhibition were investigated.

Materials and Method

Preparation of the extracts

Prunus armeniaca L.,bitter and sweet kernels were purchased from Malatya, Turkey in 2019. 5 g of dried kernels and 10 g of *Prunus armeniaca L.* were grinded and separately put into in a flask with 100 mL methanol (99%) and shaken at room temperature for 24h, then sonicated for 2h. The mixtures were filtered with Whatman no 1 filter paper and condensed in a rotary evaporator (IKA-Werke, Staufen, Germany) at 40 °C. The residues were then resolved one by one with a minimal volume of methanol and kept at 4 °C until used.

Determination of Total Phenolic content

The total phenolic content of extracts were determined according to Folin-Ciocalteu's method (4-5). A calibration graph was drawn using the Gallic acid (GA) standard and the results were expressed as mg GAE per 100 g sample.

Determination of Total Flavonoid Content

Total flavonoid content was determined according to aluminum chloride method (6) Quercetin (QE) as standard. Total flavonoid content was expressed in mg QE per 100 g sample.

Determination of Ferric Reducing Power Antioxidant Activity

Antioxidant capacity of exracts were measured by using ferric reducing antioxidant power (FRAP) (7). The absorbance was recorded at 700 nm. All analyses were performed in triplicate. Results were expressed as mM Fe^{2+}/ mL extract.

Determination of α-amylase Inhibition Properties

The activity of α-amylase was performed according to DNS method described by Bernfield (8) with slight modification. 300 µL of 1% soluble starch and 300 µL of enzyme solution were mixed and incubated at 35 °C for 30 min. Then DNS was added in equal volume and kept in boiling water. After the reaction, the absorbance values were recorded at 550 nm (9). All analyses were performed in triplicate and IC_{50} values were calculated. Acarbose was used as reference inhibitor (10).

Results and Discussion

Sweet and bitter kernel of apricot fruit constitutes approximately 34% of the oils. The oil is rich in phenolics and used in the pharmaceutical and cosmetic industries. It is reported that bitter apricot kernels are rich in dietary proteins, lipids, fiber and deadly cyanogenic glycoside (1). Cyanogenic glycosides, which are very common in plants, are produced as secondary metabolites of nitrogen metabolism by more than 2500 species (11). Due to their potential to form toxic hydrogen cyanide (HCN), cyanogenic glycosides are an important chemical weapon in plants' defense against parasites and herbivores (12-13). Amygdalin (D (-) - mandelonitrile-β-D-gentiobioside) is one of the most

frequently encountered cyanogenic di-glycosides, usually found in plants belonging to the Prunus genus of the Rosaceae family. It is found in the kernels of fruits such as apricots, almonds, cherries, apples, plums, pears and peaches (14). The toxic dose of amygdaline in humans ranges from 0.5-3.5 mg per kg body weight (15-19). Cyanogenic glycosides taken into the body by humans and animals can form HCN with the effect of intestinal microorganisms or plant-based enzymes (20). If the amount of cyanide taken with food is at the level of body weight, cyanide poisoning may develop, so foods rich in amygdalin like bitter apricot kernel should be used carefully. The consumption of the seeds of fruits such as apricots and grapes is increasing day by day because of their health promoting property thanks to secondary metabolites of them. Their use can be supportive in the treatment of certain diseases such as cancer and Diabetes mellitus.

In this study, total phenolic, flavonoid content, antioxidant capacity and inhibition properties of α-amylase enzyme of fruit, sweet and bitter apricot kernels were investigated. Total phenolic and flavonoid content was calculated as 241.83±1.47; 118.15±2.03; 60.41±0.97 mg GAE/100 g and 177.05±1.68; 20.08±0.63; 32.16±0.51 mg QE/100 g for fruit, sweet and bitter apricot kernels respectively. Antioxidant capacity by ferric reducing antioxidant power was determined as 0.81±0.02, 0.66±0.01 and 0.27±0.02 mM Fe^{2+}/mL extract for fruit, sweet and bitter apricot kernels respectively. IC_{50} values for alpha amylase inhibition were found as 1.30±0.02; 0.74±0.01 and 3.17±0.01 mg/mL for fruit, sweet and bitter apricot kernels respectively (Table 1).

It was stated in a study that the total phenolic content of sweet apricot kernels was 59.41±0.54 mg GAE/100 g DW and the total amount of flavonoid content was 32.20 ± 0.39 mg CE/100 g DW (1). It was reported in another study that the total phenolic and flavonoid content of bitter apricot kernels varied between 0.84-1.38 mg/ g and 0.52-2.48 mg/ g, respectively (1). In a study, total phenolic and antioxidant capacities of sweet and bitter apricot kernels were determined. The researchers were found that the total phenolic content of bitter apricot kernels was 0.5 μg GAE/ mL and the phenolic content of sweet apricot kernels was 5.7 μg GAE/ mL (21). In a study, antioxidant activity of bitter and sweet apricot kernel ethanol extracts was reported as 1.309 mg Trolox/ g for sweet kernel and 0.459 mg Trolox/ g of bitter apricot kernel. It was stated that the total phenolic content varied between 1.004 and 0.630 mg GAE/ g and the amount of flavonoid content varied between 0.468 and 8.099 mg QE/ g, respectively (22). Qin et al. (2019) determined the ferric reducing power antioxidant activity of methanol extracts of bitter apricot kernels. IC_{50} value of the ferric reducing power of extract and the control were reported as 3.05±0.78 mg/mL and 5.08±1.88 mg/mL, respectively (23). In a study, a polysaccharide was isolated from the fruit of apricots (*Armeniaca sibirica L. Lam.*) and fragmented by ultrafiltration and Sephadex G-75 gel chromatography. Hypoglycemic activity of the isolate was determined by its in vitro β-glucosidase inhibitory activity with IC_{50} value calculated as 6.06 mg/ mL (24). Apricots have seconder metabolites and they have antioxidant activity because of these metabolites. It was reported that apricots

Table 1. Biochemical characterization of sweet and bitter kernels extracts

	Total Phenolic Content mg GAE/100g	**Total Flavanoid Content mg QE/100g**	**Antioxidant Capacity, FRAP mM Fe^{+2}/mL Extract**	**α-amylase IC_{50} mg/mL**
Fruit	241.83±1.47	177.05±1.68	0.81±0.02	1.30±0.02
Sweet Kernel	118.15±2.03	20.08±0.63	0.66±0.01	0.74±0.01
Bitter Kernel	60.41±0.97	32.16±0.51	0.27±0.02	3.17±0.01
Acarbose				0.27±0.03

(*Prunus armeniaca L.*) has ability to get lower glucose concentration in patients' blood with type 2 diabetes (25). Prunus smoothies were scanned in terms of their polyphenol profiles and the relationship between phenolic contents and antioxidant capacity, α-glucosidase and α-amylase inhibitory effect. The study showed that Prunus smoothie could be important natural sources of phenolic antioxidants with high potential for controlling early stages of postprandial hyperglycemia (26).

In a study, α-glucosidase inhibition and insulin-like activity of Japanese apricot were determined. It was stated that ethanol extract of apricot showed 17.4 % inhibition effect (27).

In a study, antioxidant activity and α-amylase enzyme inhibition properties of peach kernel were determined. Total phenolic content and IC_{50} values for α-amylase enzyme inhibition was reported in the range of 12.7 to 3.8 g/100 g and 1.90 to 19.36 mg of dried seeds respectively (28).

It is clear that the findings of present study for total phenolic, flavonoid content and antioxidant activity are convinent with the literature datas. When the studies in literature were examined, it was seen that there were very few studies showing the in vitro inhibition effect of bitter and sweet apricot kernels on the α-amylase enzyme. Therefore, this study will contribute to the literature.

Conclusion

Apricot (*Prunus armeniaca L.*) is a valuable fruit that plays an important role in nutrition. The kernels of the apricot fruit are consumed as a food supplement. Diabetes mellitus is a chronic disease and nutrition is important in Diabetes mellitus. Therefore, interest in natural products for nutrition is increasing. In this study, ferric reducing antioxidant power and the inhibition effect of sweet and bitter apricot kernels on α-amylase enzyme were investigated. It was determined that apricot kernels could be used as a food supplement for the treatment of Diabetes mellitus. Despite varietal diversity, apricot kernels can be a valuable source for pharmaceutical industry in the production of dietary supplements. These supplements could be used as supportive or preventive agent in chronic non-communicable diseases. However, due to the many controversies related to the toxicity of amygdalin, further research should be carried out to confirm or exclude their health promoting properties, and thus the possibility of using apricot kernels as a source of bioactive compounds.

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Correspondence
e- mail: gulsen.kaya@inonu.edu.tr