



Fig (*Ficus carica* L.) and its bioactive compounds

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Abstract

Figs are one of the fruit species commonly found in countries in subtropical and temperate climates. Its cultivation is as old as human history. Anatolia is known as the gene center of figs. In addition to the taste of figs, it has been determined by studies that figs have numerous health benefits. Phenolic compounds in figs have important effects on health. Figs are also rich in vitamins and minerals. This review describes the history, composition, health effects and bioactive components of figs. Fig leaves, seeds, seed oil and the fig itself have been evaluated in numerous studies. Today, new value-added fig products are being designed and their production continues to increase due to the fact that fig is a fruit with health benefits.

Key words: *Ficus carica*, bioactive compounds, fig, variety of figs.

1. Introduction

For centuries, the fig tree has been believed to be nature's miracle fruit tree. For generations it has always been seen as a symbol of abundance and fertility. In ancient Greek civilization, crowns made of fig leaves were proudly worn as a symbol of fertility. The importance of figs to humans has been so great that sacred sources refer to figs as the fruit of paradise. The Old Testament, which mentions figs frequently, is full of fig-inspired imagery and metaphors. Sitting in the shade of a fig tree or tasting its fruit seems to be synonymous with tasting a serene, peaceful existence. Even today, Jews use figs as a traditional food for Passover celebrations, and in the Bible, figs are described as a tree that grew in the Garden of Eden, and as a sacred fruit, they are a staple of Christmas celebrations. In Islam, the Prophet Muhammad is reported to have said of figs, "If I had a choice, I would want to take a fig tree with me to paradise" [1,2]. Although it is known that figs were also cultivated by the Sumerians and ancient Egyptians, Anatolia is considered the homeland of figs. In 484 BC, the historian Herodotus praised the delicious figs grown in Anatolia. The botanical name of fig, "Ficus Carica", comes from the ancient settlement of 'Caria' in the Aegean region. Later, figs spread from Anatolia to the Middle East,

India and China and became known worldwide [3].

Fig fruit is known to be one of the fruits with the oldest development history among the cultivated fruits dating back to the history of humanity in Anatolia. It has numerous health benefits and the health effects of fig fruit continue to be studied. The fact that fig is a fruit that requires special fertilization and special drying conditions makes the regions where it grows limited. Although fig is a subtropical fruit, it is grown commercially in all coastal regions of our country due to its wide ecological adaptability and there is a significant density in the Büyük and Küçük Menderes basins for dry and fresh fig production [4,5]. Fig genetic collection in Türkiye has got 354 varieties. Of this number, 284 are female figs (Figure 1) and 70 are caprifigs. Türkiye ranks first in the world in terms of fig gene diversity. In this review, the effects of figs on health will be examined and the chemical composition and bioactive composition of figs will be examined.

Bioactive composition, chemical composition and the health effects of figs

Bioactive compounds are secondary metabolites that provide positive health effects by influencing physiological and cellular activities. Bioactive compounds are not essential nutrients for the growth and development of living organisms

such as carbohydrates, proteins and fats, which are known as primary metabolites. However, they are compounds that support the organism's survival and ability to withstand harsh living conditions [6]. In addition to basic nutrition, fruits and vegetables are rich in bioactive phytochemicals that reduce the risk of developing chronic diseases and have beneficial health effects. Recent research suggests that the benefits of bioactive compounds may be greater than currently understood. This is because in vitro and animal experiments show that these compounds have multiple mechanisms of action in addition to antioxidant activity [7]. Although bioactive compounds are usually found in small amounts in foods, they have significant health effects. Na'imâ states in his novel that figs (tîn) are very useful against plague, that figs relieve blood disorders and fever, and that figs are used as a cure [8]. Bioactive compounds are known to have positive effects on inflammation, cancer, cardiovascular diseases, obesity, diabetes, neurological disorders, osteoporosis and immune system regulation [9]. Plant-derived bioactive compounds, also called phytochemicals, are divided into three main groups: terpenes and terpenoids, alkaloids and phenolic compounds [10]. Factors such as changing living conditions, environmental factors, chemical wastes and radiation cause the formation of free radicals in our body. Free radicals are unstable and highly active molecules with one or more unpaired electrons. Antioxidants are substances that can be found in plant and animal tissues and can completely stop or reduce the damage of free radicals. Phenolic compounds are phenolic acids and phenolic acids found in all plant metabolisms to protect them from external factors.



Figure 1. Picture of some fig varieties (original)

Phenolic compounds are divided into two as phenolic acids and flavonoids, which are found in all plant metabolisms to protect them from

external factors. Their functions in terms of human health are important in many aspects such as their effects on taste and odor formation, their participation in color formation and change, antimicrobial and antioxidative effects, causing enzyme inhibition, and being purity control criteria in different foods [11].

Fig, which is rich in bioactive compounds, is one of the first fruits cultivated by humans and one of the most important fruits of Anatolian origin with genetically diverse varieties. There are many different varieties of figs and the two most preferred varieties in our country are Sarılop and Bursa Black, Sarılop is generally consumed dried and Bursa Black is consumed fresh [12,13].

Fig is a fruit rich in minerals, vitamins and fiber, and there are studies in the literature reporting that it also has antibacterial and antioxidant activity due to phytochemicals such as phenolic compounds it contains. Studies conducted in our Institute and other R&D institutions have shown that fig varieties can contain between 40 and 195 mg (gallic acid) of total phenolic substances per hundred grams depending on fruit color [14]. In addition to flavonoids and phenolic acids, anthocyanins and phytosterols were detected in fig varieties. Among flavan-3-ols, catechin and epicatechin are reported to be the main phenolic compounds in figs (although it may vary depending on the variety). In addition, chlorogenic acid from phenolic acids, kemferol and quercetin from flavonols and cyanidin from anthocyanins were also identified in some varieties of figs. Fruits with high phenolic content such as pomegranate and black carrot are known to of 155 to 1052 mg gallic acid equivalent per 100 g. In addition, the amount of flavonoids was found to be 38-97 mg catechin equivalent/100 g in figs and 5-150 mg catechin equivalent/100 g fruit in pomegranate and carrot [15,16]. Phenolic acids consist of two groups: hydroxycinnamic acids and hydroxybenzoic acids. Coumaric acid, ferulic acid and chlorogenic acid are among the hydroxycinnamic acids found in figs. Gallic acid, Siringic acid and Ellagic acid are hydroxybenzoic acids found in figs. Cyanidin-3-glucoside, cyanidin-3-rutinoside and pelargonin-3-glucoside anthocyanins are found in high amounts in dark fig fruits. In addition, quercetin, rutin (quercetin-3-o-rutinozide), campferol-rutinoside are the flavonoids most commonly found in figs. The skin of fig fruit contains high amounts of rutin. Moreover, catechin and epicatechin are proanthocyanins detected in figs. [13,17,18]. Figs are known to inhibit breast, skin,

and stomach cancers under experimental conditions.

The consumption of dried figs, which is one of the evaluation areas of figs, is important for human health due to its rich mineral and vitamin content. As a matter of fact, according to the Food and Nutrition Board of U.S. institute; with the consumption of 100 grams of dried figs, 30% of iron, 15.8% of calcium, 14% of potassium, 7.1% of thiamine and 6.2% of riboflavin that we need daily can be met [19]. In addition, since it does not contain fat, cholesterol and sodium, it can be recommended as a healthy food especially for the middle and older age group. In addition, there are studies showing that value-added products such as black dried figs, fig chips, fig syrup and flour contain 2-3 times more bioactive compounds than traditional production [20]. A comprehensive understanding of secondary metabolites in *F. carica* is essential for its horticultural cultivation, commercial importance and potential health benefits. Furthermore, by focusing on relevant structural genes and transcription factors, figs appear to possess regulatory mechanisms of important secondary metabolites in *F. carica*, including anthocyanins and furanocoumarins. New health benefits of figs, a superfruit, are being identified day by day [21]. For this reason, increasing the consumption of figs both by producing value-added products and in its natural form will make positive contributions to consumer health.

2. Conclusions

Recently, with the increasing demand for healthy products, the tendency for products with high fiber content such as figs is increasing. It is seen that figs are a preferable product with both its composition and phenolic content. In addition, figs in Turkey have a wide variety of fig genetic diversity and figs in colors such as yellow, red, purple are easily accessible and can be preferred by consumers. Coumaric acid, ferulic acid and chlorogenic acid are among the hydroxycinnamic acids found in figs. Gallic acid, Siringic acid and Ellagic acid are hydroxybenzoic acids found in figs. Cyanidin-3-glucoside, cyanidin-3-rutinoside and pelargonin-3-glucoside anthocyanins are found in high amounts in dark fig fruits. In addition, quercetin, rutin (quercetin-3-o-rutinozide), campferol-rutinoside are the flavonoids most commonly found in figs. The skin of fig fruit contains high amounts of rutin. It is inevitable that figs,

which have numerous bioactive components, will be processed into new fig products with added value.

Compliance with Ethics Requirements

Author declares that he respects the journal's ethics requirements. Author declares no conflict of interest.

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