

An Overview of Fig Nutritional Composition and Phytochemistry

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Abstract

The fig belongs to the Mulberry family, which is said to be one of the oldest known fruit plants in human civilisation. Figs are a delectable fruit that is also high in minerals such as iron, calcium, copper, potassium, and magnesium. Traditionally fig plant was used as medicine to treat many health diseases. In this article, we want to describe about the botanical feature, history, production of the fig and its use to cure different health issues. Phytochemical studies of fig fruits and leaves have revealed the high composition of volatile compounds, phenol and organic acids in them. The important medicinal properties involve anticancer, antimicrobial, hepatoprotective, and hypoglycemic activities. This article is to gather information about component of fig, history, production and their medical benefits.

Keywords – Mulberry family, Phytochemical, Volatile compound, therapeutic effects.

1. Introduction

The common Fig is a moderate size deciduous plant/shrub belonging Moraceae or mulberry family, with tiny twisted stock and crowned with uneven splits. Moraceae, sometimes known as the mulberry family, is among the biggest angiosperm genera in the tropical and subtropical zones of the earth comprising around 800 woody plant, epiphytes, and shrubs species (Badgujar et al., 2014; Vora et al., 2017). The *F. Carica* L. tree typically grows to a height of 15 to 20 feet, has a trunk that is more over 7 feet in diameter and several spreading branches. The enormous, single, alternating, bright green leaves are enormous. They can grow up to one foot in length. There can be 30 to 1600 seeds per fruit, which can be tiny, huge, medium-sized, or any combination of these. If not pollinated, the seeds are usually hollow and delicious (Badgujar et al., 2014). Fresh figs are highly perishable. Some of the unripe fruits are gathered to be taken

far off warehouses and markets/mandis. Mature fruits are collected either by plucking directly from the plant by necking or cutting the stem end, or gathered after they have fallen. According to the color, figs are divided into 5 groups - 1) Green figs, 2) Yellow figs, 3) Purple figs, 4) Black figs and 5) Brown figs, which are spread in Indian oceanic countries mostly in Somalia, South Egypt, Nepal and Peninsula India (Khan et al., 2011). In India, it's generally scatter from the plains in northwestern India to an altitude of 1550 m above water level within the Himalayas and largest cluster within the low and warm regions of south and south-west Himachal Pradesh, Punjab, Uttarakhand, Uttar Pradesh and nearly all parts of Rajasthan state (Tiwari et al., 2014).

Figs can be found in pairs or alone, axillary on leafy branchlets, and are typically shaped like pears. The reproductive systems and fruit (fig) of species in the genus *Ficus* are mutually undivided (Gafoor et al., 2019). The interesting thing about the Fig fruit (synconium) and other species of genus *Ficus* is the exclusiveness of their reproductive system which is pollinated only by the associated agaonoid wasps i.e. Hymenoptera: Chalcoidea: Agaonidae. The wasp in turn laid eggs in the fruits associated only to them (Mawa et al., 2013). Figs are often eaten fresh and can be taken as dried or canned, and often utilized in making of jams. Figs are very nutritious edible fruits with the highest protein and calcium (more than milk), iron and fiber content. The nutrient index of apples, raisins and dates is 9, 8 and 6 respectively, while the nutrient index of figs is 11 (Gani et al., 2018; Singh et al., 2015). The leaves, pulp, rind, seeds, and latex of *F. carica* are among the many portions of the plant that have uses (Palmeira et al., 2019). In general, the prime production, processing, manufacturing, distribution, sales, and final utilization of figs could produce potential functional food components (Comunian et al., 2021). Fig is also utilized in making of anti-inflammatory and antispasmodic drug (Duke et al., 2002).

2. History

Prior to the domestication of fig, it grew as a wild crop in geographical area and at that time for cultivation purpose humans pick prime diversity. De candolle says: " In our time the fig grows in an exceedingly wild or semi wild state over a wide area that has its centre in Syria (and the land of isreal), that's to mention, fro, Persia and Afghanistan everywhere the Canary Island".

Other explorers believe that it originated with in the mountains of Yemen in the Arabian Peninsula. Origin from Mediterranean basin is also postulated in some theories. But the most accepted view, regarding origin of fig, is in somewhere western Asia and from there Mediterranean basin through migration.

2.1 Pre-biblical era

Pre-biblical era also speaks of the famous Sinuhe Papyrus (1800 BC) or the Canaan' blessed Land and figs of its. Leningrad Papyrus (1115) 1800 B.C. a sailor's story, rescued from a shipwreck in the Red Sea

off the coast of Sinai: "I was thrown by a wave on the shore of an island, where I used to be constrained for 3 days and upon which I found figs and vines." and other shrubs and plants were also found " (W. Golenichef—"Réqueil des Travaux"). The products brought from "Syria" in the third and second centuries B.C. were enumerated by Poierus of Zenon (59012) as dried figs, oil, olives, nuts, honey, and pomegranates. Egyptian chronicles show that pagans sacrificed vine and figs throughout the region, giving both fruits a special sanctity (Goor, 1965).

2.2 The Biblical era (1200-445 B.C.)

The plant vine and therefore the fig are linked to the Bible, as they were actually seeded cheek by jowl, the vine sometimes mount over fig. According to biblical times the fig may be an emblem of peace: the more it absolute was seeded, the more the optimism for eternal life, affluence and prosperity (Goor, 1965).

3. Classification and Nutritional composition

The typical fig i.e *Ficus carica* L. is associate to the family named Moraceae, encompasses 1000 plus species dispersed all through the earth (Table 1).

Table 1. Classification of fig

Kingdom (highest)	Plantae
Division	Magnoliophyta
Class	Magnolipsida
Order	Rosales
Family	Moraceae
Genus	Ficus
Species (smallest unit)	F. Carica

Figs and brebas are nutritious fruits that are high in iron (30%, w/w), potassium (14%), calcium (15.8%), and fibre (5.8%, w/w), among other nutrients, furthermore freed from sodium, fat together with cholesterol. The fig fruit has a higher nutritional index (11), compared to the apple (9), resin (8), and date (6) (Gani et al., 2018).

Table 2. Nutritional composition of fig (Singh et al., 2015)

Nutrients	Fresh fig	Dried fig
Moisture	88.1g	23.0g
Fat	0.2g	1.3g
Fiber	2.2g	5.6g

Protein	1.3g	4.3g
Carbohydrate	7.6g	6.9g
Mineral	0.6g	2.4g
Vitamin A	80IU	100IU
Vitamin C	2 mg	2 mg
Total sugar	16g	52g
Iron	0.6mg	4mg
Phosphorus	22mg	77mg

Including this vitamins, amino acids minerals and phenolic compounds are also present sufficiently in them. Indeed due to the existence of huge consolidation of polyphenols, especially in dry figs, a lot of studies have recorded about the health promoting potentiality of brebas as well as figs (Vallejo et al., 2012).

A fruit high in carbohydrates and dietary fibre is the fig. Approximately 92% of the carbohydrates in figs are sugars (Gani et al., 2018). The amount of proteins in figs is among the lowest of all consumable fruits (Table 2). Fig could be low in ascorbic acid yet high in sugar penultimate to dates. The fig's latex contain (ficin) rennin has 3 to 100x milk clotting capability in comparison to animal rennin obtained from calf stomach mucosa. Fig leaves generally utilized as medicinal purpose because of diuretic, demulcent, emollient and antihelmintic attributes.

4. Production

Figs are cultivated everywhere on the globe, originating West Asia then spreading to the Mediterranean. The genus *Ficus* can be enormous; comprising around 1000 plus species, nearly 65 of these species are located in Indian sub-continent. The land covered by figs' farming in the world is 4, 15,780 hectares, with a harvest of 10, 47,230 metric tons (Anonymous, 2015).

Egypt is the major producer of figs, followed by Turkey, Algeria, Morocco and Iran. Maharashtra, Gujarat, Karnataka, Tamil Nadu, Punjab and Uttar Pradesh are major fig cultivated states of Indian sub-continent. The total land portion covered by figs' farming in Indian Territory is about 3575 hectares along with a harvest of about 14,645 metric tons, where by Maharashtra is the largest producer state while Karnataka is the second largest (Anonymous, 2015). Signs of the Prophet Muhammad could be adopted for the plantation of figs. He said, "If I could wish for the fruit brought to heaven it would certainly have been a fig".

The fig tree less prone to diseases as well as pests and got fruiting phase in short duration nearly 7-8 months. The fruits are harvested manually at an interval of 2-3 days. Fruits should be harvested when they are soft and wither at the neck. Milky latex is released when the fruit is plucked before maturity. 20-30 kg

of figs and around 550-1050 fruits can be obtained from an individual plant, which are being sold at Rs. 50-60/kg. There are 400 plants can be seeded per acre and bearing cost per seedling is Rs. 12 then the actual cost come out to be Rs. 5000 per acre. While the wholesale price of the same is at least Rs 20/kg, one could easily get 1.60 lakh per acre. Growers of plants in 4 hectares of land could easily get an ordinary income of Rs. 15 lakhs for one crop. Hence, fig plantation can raise the socio-economic dignity of marginal as well as small landholders having acreage up to one acre or less in arid and semi-arid regions. The fig has hitherto been considered to be insignificant commercial fruit crop reason being that the financial prospects of its plantation have been ill-addressed and is underutilized species in a few areas (Kumari et al., 2019).

According to the Food and Agricultural Organization (FAO), fig fruit production is strong all over the world. Over 289,818 hectares of fig trees are cultivated worldwide, with an approximate value of 1,315,588 tonnes (FAOSTAT. 2019). With 310,000 tonnes produced in 2019, Turkey leads the world, followed by Egypt, Morocco, Iran, Algeria, and Spain. As a result, the Mediterranean region and its neighbouring East remain crucial for fig farming (FAOSTAT. 2019). Spain is Europe's leading producer of figs (51,600 tonnes), accompanied by Greece (19,730 tonnes) and Italy (11,830 tonnes) (FAOSTAT. 2019), Extremadura is the leading producer in Spain (37,382 t), following Catalonia (5834 t) and Comunidad Valenciana (2932 t). Because of its extreme resistance to salt and active calcium, the fig tree is well adapted to marginal areas such as south-eastern Spain (Sánchez et al., 2003). In regards to production, productivity, and size, the primary cultivars grown in Spain are "banana" and "brown turkey" (Pereira et al., 2017).

"Poona" is the most cultivated variety grown in India for consumption as a fresh fruit. Plant and fruit morphology of fig cultivated in Mangalore, Bellary, Coimbatore, Daulatabad, Ganjam, Lucknow and Saharanpur is resembled as Poona fig variety. Lately, 'Dinkar' - an enhanced fig variety of 'Daulatabad'- is gaining marketable significance for its impressive yield and fruit quality. A few California hybrid variety of fig outperformed 'Poona' figs in Mangalore (Jadhav and Gurav, 2018).

5. Most consumed form

Figs have a complex texture that adds to the chewiness of their flesh, smoothness of their skin, and crunchiness of their seeds. They are also seductively sweet. Because the fresh figs' fruits are so delicate and perishable, they are quite uncommon, which contributes to some of their mystery. Because of this, the majority of figs are dried, either naturally or mechanically, making them a tasty and nutritious fruit that may be consumed all year round (Neal, 1965). The most popular uses for them are in jams and preserved fruits, while they can also be found in numerous sweets and baked goods, cans, and well-kept savory and

meat dishes. Since the dawn of civilization, people have regularly ingested fresh and dry fig fruit as a dietary food material (Khare, 2007).

6. Phytochemistry

Photochemical or secondary metabolites are the compounds bring forth by plants which are non nutritive and crucial for plant survival, appropriate growth and replication. The fig is known to contain more than 100 bioactive substances, including arabinose, amyryns, carotenes, glycosides, setosterols, and xanthotoxol. The foremost prominent of these are triterpenoids traced to latex, roots and leaves. Metallothionein, a protein that contains sulphur, is key component for usual function of brain, because it is produced in limited volume within the brain of humans and animals (Slatner et al., 2011). Numerous beneficial components, including insoluble carbohydrates, cyanidin-3-O-glucoside, cyanidin-3-Orhamnoglucoside, calcium, cholesterol, salt, protein, vitamin A, saturated fat, vitamin C, and iron, are present in fruits (Rahmani and Adelbasi, 2017).

Table 3. Phytochemical present in fig

Phytochemical	Example	Plant part
Monoterpenes	Linalool (Trad et al., 2012), Epoxylinool (Santosh et al., 2014)	Fruit
Sesquiterpenes	α -cubenene, α - guaiene, α -ylangene, copaene, β -bourbonene, β -elemene, α -gurjunene, β -caryophyllene, β -cubebene, aromadendrene, α -caryophyllene, τ -muurolene, τ -cadinene, α -muurolene, germacrene D, and (+)-ledene (Oliveira et al., 2010).	Leaves
Alcohols	1-penten-3-ol, 3-methyl-1-butanol, 2-methylbutanol, heptanol, benzyl alcohol, (E)-2-nonen-1-ol, and phenylethyl alcohol (Mawa et al., 2013).	Fruits and leaves
Ketone	5-hepten-2-one, 3-hydroxy-2-butanone (acetoin), 3-pentanone 6-methyl- (Mawa et al., 2013).	Fruit and leaves
Organic acid	malic, oxalic, fumaric, and citric acids, quinic acid (Oliveira et al., 2009).	Fruit and Leaves
Phytosterols	β -sitosterol, 24-methylenecycloartanol, triterpenoids methyl maslinate, lupeol taraxasterol, oleanolic acid, w-taraxasterol ester, , lupeol acetate. calotropenyl acetate, bauerenol (Shiraishi et al., 1996).	Leaves
Fatty acid	Myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid (Oliveira et al., 2010).	Fruit
Phenolic acids,	3-O-caffeoylquinic acids and 5-O-caffeoylquinic acids, ferulic acid,	Leaves ,

	and quercetin Quercetin 3-O-glucoside Psoralen, bergapten, pyrogallic, 3-O-rutinoside, 3-5-dimethoxy, pinocembrine, chysin, galangin, protocetchol, vinallin, cinnamic, quercetin, pinostrobin, pyrogallol, quinol, p-coumaric, phenolptethlin, p-hydroxybenzoic acid, caffeic acid, gallic acid, ellagic acid, quercetin, rosmarinic acid, ligstroside, and kampherol, syringic, chlorogenic, gallic, ellagic Scopolamine, 1,2,2'-triferuloylgentiobiose, and hydroxycaffeic acid 3-feruloylquinic \sacid, Vanillic deoxyhexoside, vanillic di-deoxyhexoside, and p-coumaric Vanillic acid and 5-p-coumaroylquinic malonyl di-deoxyhexoside (Ammar et al., 2015; El Abdel-Aziz et al., 2020; Pande & Akoh, 2010)	Fruit
Flavonoids	epicatechin, luteolin, rutin, cyanidin 3-rutinoside dimer, Pg 3-glucoside, (epi) catechin-(4-8)-cyanidin 3-glucoside, cyanidin 3, Catechin, 5-diglucoside, (epi) catechin-(4-8)-cyanidin 3-rutinoside, (epi)catechin-(4-8)-Pg 3-rutinoside, (epi)catechin-(4-8)-cyanidin 3-rutinoside, Carboxypyranocyanidin 3-rutinoside, cyanidin 3-malonylglucosyl-5-glucoside, cyanidin 3-glucoside, cyanidin 3-rutinoside, apigenin rutinoside, kaempferol rutinoside, luteolin-7-O-glucoside, (epi)catechin-(4-8)-Pg 3-rutinoside, apigenin,luteolin-6C-hexose-8C-pentose, Pg 3-rutinoside, Pn 3-rutinoside, quercetin-O-hexoside-O-acetylhexoside, quercetin-3-O-rutinoside, quercetin-O-acetylhexoside, quercetin glucoside, apigenin-C-hexoside-C-pentoside,taxifolin-O-hexoside, epicatechin kaempferol-O-deoxyhexosyl-hexoside, cyanidin 3-malonylglucoside, apigenin-C-hexoside-C-pentoside, apigenin-2'' -O- rhamnose-C-acetylhexoside, luteolin-6C-hexose-8C-pentose, quercetin rutinoside,quercetin glucoside, quercetin acetilglucosid, Quercetin, luteolin, biochanin-A, kaempferol rutinoside, quercetin rutinoside, quercetin acetilglucoside, catechin, (Palmeira et al., 2019; Pande & Akoh, 2010)	Leaves , Fruit
Coumarins	Hydroxypsoralen hexoside, dihydroxycoumarin, angelicin (isopsoralen), umbelliferone (7-hydroxycoumarin), marmesin, furocoumarins hydroxypsoralen, 4',5'-dihydroxypsoralen, and prenyl-7-	

	hydroxycoumarin.furocoumarins psoralen, phellodenoc A, 6-carboxyl-umbelliferone, hydroxycoumarins esculetin hexoside bergapten (5-methoxypsoralen), murrayacarpin B, isopentenoxypsoralen, oxypeucedanin, psoralic acid glucoside, (Marwat et al., 2011)	
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The figs' phenolics, anthocyanins, fructose, glucose, and sucrose, as well as reports that fruit contains phytosterols, are the other beneficial elements (Rahmani and Adelbasi, 2017). Some phytoconstituents of *Ficus carica* are utilized as coloring agents and as a constituent in sunscreens. Apart from these, fig tree also possesses remarkable medicinal properties like cytotoxic, antioxidant, anti-inflammatory, anticancer, and hypolipidemic activities. The presence of specific bioactive compounds, such as volatile organic compounds, phytosterols, phenol acids, triterpenoids, flavonoids, fatty acids, and coumarins, as well as other strata of phytochemicals, was discovered through research on the phytochemical composition of *F. carica*'s raw materials, such as its fruits and leaves (Table 3).

7. Pharmacological Impact

F. carica's fruits and leaves have great significance in conventional medicine. Figs have been traditionally used as treatment against several medical conditions like CVD, antispasmodic, respiratory, and anti-inflammatory (Salem et al., 2013). Fig fruit is utilized medicinally in a variety of ways with its rind, fruit, leaves, roots, and latex. In addition, Fig is ingested alongside other medicinal plants including the Lauraceae plant *Laurus nobilis* Linn, also well known as Paathri, and natural foods include honey and milk (Idolo et al., 2010; Manjula et al., 2011). *Carica* extracts have been evaluated and confirmed, and in most cases bioassay-guided fractionation has allowed the assignment of chemical structures causative for biological effects, considering some of its folklore applications (Ahmad et al., 2013) (Barolo et al., 2014).

7.1 Antioxidant activity

Tocopherols, flavonoids, and phenolic compound are the principal antioxidants found in fig extracts, which can be employed to increase the antioxidant activity of figs (Konyaltoglu et al., 2008). A few of them are also conducive to human health for behave like antioxidant in various ways: reducing agents, hydrogen donors, antioxidants that fight free radicals, singlet oxygen quenchers, and other substances. Antioxidant capacity, a fruit have, is exhibited by the levels of polyphenols, flavonoids, and anthocyanins- higher the levels of polyphenols, and anthocyanins results higher will be the antioxidant activity (Caliskan and Polat, 2011). NMR data confirmed that the primary anthocyanin in every fig fruits was cyanidin-3-O-rutinoside (C3R).Color form of the fig extract is directly related with the content of total polyphenols, anthocyanins, and antioxidant properties. Additionally, fruits with the excessive

concentrations of polyphenols and anthocyanins showed the greatest antioxidant capability. The C3R imparted 92% of the anthocyanin fraction's total antioxidant activity (Solomon et al., 2006).

7.2 Antispasmodic and antiplatelet

Ex vivo human platelet models were used to explore *Ficus carica*'s antispasmodic and antiplatelet properties and isolated rabbit jejunum preparations. The study found that the mature dried fruit of *Ficus carica* had both spasmolytic and antiplatelet activity, providing pharmacological support for usage in inflammatory and gastrointestinal motility disorders (Gani et al., 2018).

7.3 Antidiabetic, hypocholesterolaemic, and hypolipidemic activities

A study showed that figs are rich in potassium which reduces the amount of sugar in the blood. In diabetic rats produced by streptozotocin, a strong hypoglycemia effect and a reduction in total cholesterol and total cholesterol/HDL cholesterol ratio were seen after oral or intraperitoneal administration of aqueous leaves extract in comparison to the control group (Romano, 2019). The antidiabetic action of fig extracts is mediated by a variety of mechanisms: 1) reducing intestinal glucose absorption by blocking glucosidase and amylase, and 2) Glucose Transporter Type 4 (GLUT4) - phosphatidylinositol-3 kinase (PI3K), a serine/threonine protein kinase, which increases glucose absorption; and 3) managing glucose homeostasis by activating protein kinase (AMPK) (Deepa et al., 2018).

7.4 Anticancer activity

The latex of Fig was used to extract bioactive substances such 6-O-acyl-b-D-glucosyl-b-sitosterols, or AGS (acyl moiety: palmitoyl, linoleyl, stearyl, and oleyl). The palmitoyl derivative of AGS functions as the prohibitor as contrast to linolyl, stearyl and oleyl derivatives for various cancer cell types (Rubnov et al., 2001). Coumarins have also been used to treat prostate cancer. In order to determine the in vitro biological actions of fig latex treatment for cervical tumours, Ghanbari et al., 2019 carried out a research investigation. In comparison to *F. salicifolia*, *F. carica* leaf latex had a more cytotoxic effect and entailed distinct molecular modes of action when tested on breast cancer cells (MDA-MB-231) (AIGhalban et al., 2021). Furthermore, when *F. carica* leaves extract was applied to cells, another study found that the expression of Bcl-2, TP53, and cyclin-dependent kinases (CDK1, CDL5, CDK9, and CDK10) was down regulated (Mustafa et al., 2021).

7.5 Hepatoprotective activity

In vitro tests showed that upon application of fig extracts, some changes were induced, attributing increased hepatoprotective activity (Gond and Khadabadi, 2008). A substantial reversion of biochemical, histological and functional changes in oral rifampicin (50 mg/kg) was showed by petroleum ether leaf extract which results hepatotoxicity in rats (Mawa et al., 2013).

7.6 Hypoglycemic activity

An experiment was conducted in 2005 using the colorimetric method to compare the phenol content in dried and fresh figs, and examined which dried figs contained the highest number of phenolic antioxidants. Large portions of dried figs should be served as dietary supplements because they contain high amounts of phenol antioxidants and fiber (Vinson et al., 2005).

7.7 Skin treatment

Researchers have exhibit that the plants are exercised in curing the skin maladies like eczema as well as warts. Of these figs, a 2014 study by Tabassum and Hamdani showed that figs are utilised in the treatment of skin warts, pimples and scabies (Tabassum & Hamdani, 2014). Another study also results the validity of this treatment by this latex containing enzymes that act on warts and healing of warts (Bohlooli et al., 2007).

7.8 Prevent constipation

A study found that the presence of fibre in figs helps to ensure a smooth digestive process (Lee et al., 2012). The purpose of the study by Pourmasoumi et. al., 2018 was to investigate the advantages of fig in the treatment of irritable bowel syndrome with a predominance of constipation. It is established that the fig is utilised to relieve constipation (Baek et.al, 2016) .

8. Conclusion

The Holy Quran also makes reference to the fig tree. Since the dawn of time, people have consumed fig fruits and leaves for food and for a variety of therapeutic purposes. The fruit of *Ficus carica* is a dietary supplement that includes important amino acids, vitamins A, C, thiamine, dietary fibre, and carbohydrates that are linked to healthy body development and function. On the basis of fig phytochemical studies, specific groups of plant metabolites have been identified. The majority of the phytochemical processes in *F. carica*'s leaves and fruit have been used, although little is known about the phenolic profiles of the stem and root. Additionally, figs have been used as a medicine to cure a number of illnesses, including constipation, cancer, diabetes, and inflammation. Although *F. carica* has a wide range of known medicinal benefits, there is still much room for its phytochemical investigation employing bioassay-guided isolation.

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