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Review

Ficus carica L. (Moraceae): An ancient source of food and health

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ABSTRACT

Since early in the man history, common fig was appreciated as food and for its medicinal properties. This review explores some aspects about the importance of *Ficus carica* L., an amazing and ancient source of medicines and food. Topics regarding chemistry, biological activity, ethno-pharmacological uses, and its nutritional value are discussed, as well as the potential of the species as a source of new and different chemical scaffolds. Very important in the past, appreciated in our time and extremely promising in the future, *F. carica* represents an interesting example of healthy foods and bioproducts.

Contents

1. Introduction

Plants have been used by man for the betterment of his life from the very first day of his emergence on the earth. Ethno-botany deals with traditional uses of plants by the ancient and indigenous people as food, shelter, medicine, clothing, hunting, and in spiritual ceremonies (Abbasi, Khan, Khan, & Shah, 2013). Food and medicinal uses of these plants have been two of the most relevant and reliable reasons for popular plant management, even in cultures that are increasingly losing their close relationship with nature (Hadjichambis et al., 2008). Regardless of agricultural societies, the practice of consuming wild plants has not completely disappeared, their nutritional role and health benefits being reported in many surveys worldwide (Pardo-de-Santayana et al., 2007).

Moraceae is an angiosperm plant family very rich in edible species characterised by milky latex in all parenchymatous tissue, unisexual flowers, anatropous ovules, and aggregated drupes or

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Fig. 1. *F. carica* in Rosario, Argentina in January. Note the immature figs within healthy leaves (Photo: N. Ruiz Mostacero).

achenes. Moraceae are divided in five tribes, between them Ficeae are monotypic with a pantropical distribution and ~750 species (Datwyler & Weiblen, 2004). *Ficus* is one of the thirty-seven genera of this family, and its distribution in America consists of over 100 species divided into two subgenera: *Ficus* subg. *Urostigma* (Gasparrini) Miq. sect. *Americana* Miq. and *Ficus* subg. *Pharmacosycea* (Miq.) Miq. sect. *Pharmacosycea* (Ribeiro, 2011). *Ficus* spp. represents an ancient source of food and health; its importance is as remarkable as to be named in several chapters of Christian sacred texts, the Gospels (Raya, 2006).

The fig species of greatest commercial importance is *Ficus carica* L. (syn. *Ficus kopetdagensis* Pachom.), also known as common fig, which consists of numerous varieties with significant genetic diversity (Salhi-Hannachi et al., 2006; Tropicos.org, 2014) (Fig. 1). Common fig tree, originated in the Middle East, is one of the first plants that was cultivated by humans and is an important crop worldwide for dry and fresh consumption (Dueñas, Pérez-Alonso, Santos-Buelga, & Escribano-Bailón, 2008). Most of the world's fig production occurs nowadays in the Mediterranean basin (Sadder & Ateyyeh, 2006). Nevertheless, a number of *Ficus* spp. are used as food and for medicinal properties in ayurvedic and traditional Chinese medicine especially amongst people who live where these species grow (Lansky, Paavilainen, Pawlus, & Newman, 2008). The plants are shrubs or small trees; the foliage is single, alternate and large, deeply lobed with three or seven lobes, rough and hairy on the upper surface and soft, hairy on the underside; the bark is smooth and grey. The common fig fruit of *F. carica* have been named of several manners along the centuries; names such as Greek *sykon* or *syke agria* are only some examples. On the same way, the *F. carica* tree may be indicated by *syke* or *sykea* (Lansky et al., 2008).

Various biological activities, such as antibacterial (Lazreg-Aref, Mars, Fekih, Aouni, & Said, 2012), antiviral and antioxidant, have been evaluated and confirmed on *F. carica* organic extracts, and the bioassay guided fractionation in most cases allowed to assign the chemical structures responsible of such biological effects, thereby ratifying some of its folkloric uses (Solomon et al., 2006). The modern pharmaceutical industry is paying more attention to medicinal plants as scientists rediscover that plant life is an almost infinite resource for medicine development (Cavero, Akerreta, & Calvo, 2013). Thus, *F. carica* has been included in occidental Pharmacopoeias (i.e. Spanish Pharmacopoeia, British Pharmacopoeia) and in therapeutic guides of herbal medicines, as important as the PDR for Herbal Medicines (2000).

As a part of our programme, devoted to explore natural sources of new bioactive chemical scaffolds, this review was focused on the ethno-pharmacologically relevant plant *F. carica*, because it represents an amazing and ancient source of medicines and food, in the human culture. Topics regarding chemistry, biological activity, ethno pharmacological uses and nutritional value were revised and discussed, as well as the potential of fig tree as a source of new chemical diverse scaffolds. Very important in the past, appreciated now and extremely promising in the future, *F. carica* illustrates an interesting example of healthy foods and bioproducts.

2. Chemistry

In this section was performed a summary of secondary metabolites that have been isolated from different parts of *F. carica* (leaves, fruits, roots, latex), and their biosynthetic origins. Chemical composition of latex and essential oils is discussed separately, because of the distinctive nature of these materials. In addition, proteins with protease activity were included due to their importance to understanding some biological effects, especially of latex. Nevertheless, a generalisation can be made as follows: flavonoids have been isolated mostly from fruits and leaves, coumarins from leaves and roots, sterols from leaves and triterpenoids from latex (mainly as steryl derivatives) and roots, (Fig. 2, Tables 1 and 2). The majority of compounds characterised and reported in essential oils are monoterpenes and sesquiterpenoids showing different oxidation patterns. No reports were found about isolation of alkaloids from *F. carica*, with exception of indole (Mawa, Husain, & Jantan, 2013).

2.1. Shikimate pathway

Mostly coumarins and some esters of phenylpropanoidic acids have been reported both from leaves and roots; on the other hand polyphenols were reported from fruits (Dueñas et al., 2008; Solomon et al., 2006).

2.2. Combined biosynthetic pathways

The contents of total anthocyanins and flavonoids in skin and pulp from commercial varieties of figs with different colour (black, red, yellow and green) have been analysed by Solomon et al. (2006) and then by Dueñas et al. (2008), which characterised qualitative and quantitative pigment composition of different Iberian commercial fig varieties, both in skin and in pulp. They detected fifteen anthocyanin pigments, most of them containing cyanidin as aglycone and also pelargonidin derivatives were found. Rutinose and glucose were present as substituting sugars, as well as acylation with malonic acid. Minor levels of peonidin 3-rutinose in pulp were also detected. In addition, they reported the detection of 5-carboxypyranocyanidin-3-rutinoside, a cyanidin 3-rutinose dimer and five condensed pigments containing C–C linked anthocyanins and flavanol (catechin and epicatechin) residues (Dueñas et al., 2008) (Table 1, Fig. 2).

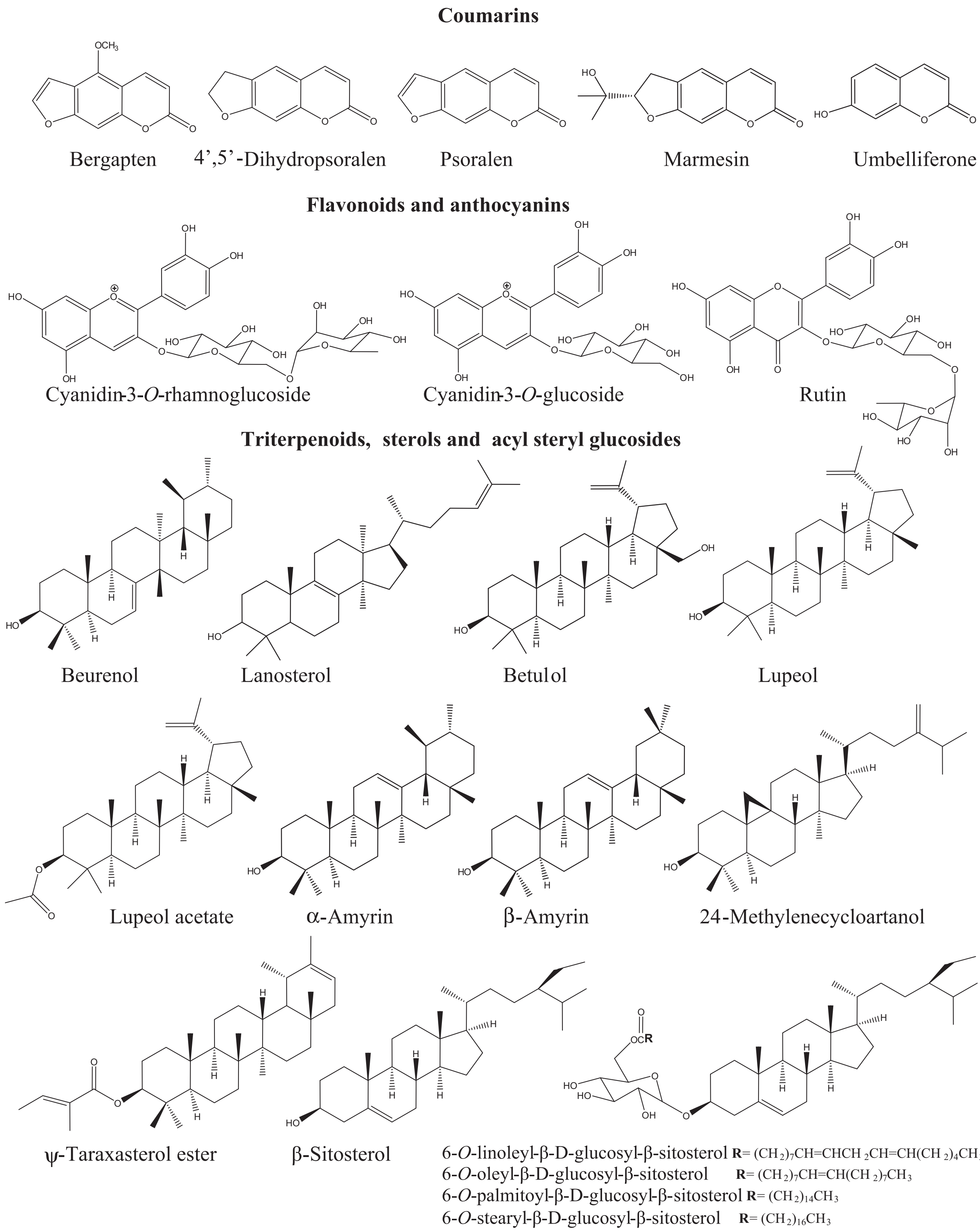

Fig. 2. Structures of the major compounds identified from *F. carica*. Coumarins: Bergapten, 4′,5′-Dihydropsoralen, Marmesin, Umbelliferone, Psoralen. Flavonoids and anthocyanins: Rutin, Cyanidin-3-*O*-glucoside, Cyanidin-3-*O*-rhamnoglucoside. Triterpenoids, sterols and acyl steryl glucosides: Baurenol, Lupeol, 24-Methylenecycloartanol, ψ-Taraxasterol ester, β-Sitosterol, 6-*O*-linoleyl-β-D-glucosyl-β-sitosterol, 6-*O*-oleyl-β-D-glucosyl-β-sitosterol, 6-*O*-palmitoyl-β-D-glucosyl-β-sitosterol, 6-*O*-stearyl-β-D-glucosyl-β-sitosterol, Betulol, Lanosterol, Lupeol acetate, α-Amyrin and β-Amyrin.

Table 1
Compounds identified in *F. carica*.

Plant part	Class	Compound name	References
Fruits	Anthocyanin	(epi)catechin-(4–8)-Cy-3-glucoside, (epi) catechin-(4–8)-Cy-3-rutinoside, Cy-3,5-diglucoside, (epi)catechin-(4–8)-Cy-3-rutinoside, (epi)catechin-(4–8)-Pg-3-rutinoside, (epi)catechin-(4–8)-Pg-3-rutinoside, 5-carboxypyranocyanidin-3-rutinoside, cy-3-malonylglicosyl-5-glucoside, cy-3-glucoside, cy-3-rutinoside, pg-3-glucoside, pg-3-rutinoside, pn-3-rutinoside, cy-3-malonylglucoside	Dueñas et al. (2008)
	Flavonol	Kaempferolrutinoside, quercetineacetilglucoside, quercetinrutinoside, quercetineglucoside	Vallejo, Marín and Tomás-Barberán (2012)
	Flavones	Luteolin 6C-hexose-8C-pentose, apigeninrutinoside	
	Phenolic acid	Chlorogenic acid	
	Volatile		
	Aldehydes	3-Methyl-butanal, 2-methyl-butanal, 2-methyl-2-butanal, (E)-2-pentenal, hexanal, (E)-2-hexenal, heptanal, (Z)-2-heptanal, benzaldehyde, (E, E)-2,4-heptadienal, octanal, (E)-2-octenal, nonanal, (E, Z)-2,6-nonadienal	Oliveira, Silva, de Pinho, et al. (2010)
	Alcohols	1-Penten-3-ol, (Z)-3-hexen-1-ol, 3-methyl-1-butanol, benzyl alcohol, (E)-2-nonen-1-ol, phenylethyl alcohol	
	Ketones	6-Methyl-5-hepten-2-one	
	Esters	Methyl hexanoate, methyl salicylate, ethyl salicylate	
	Monoterpenes	α-Pinene, β-pinene, limonene, eucalyptol, linalool, epoxylinalool, menthol	
	Sesquiterpenes	α-Cubenene, copaene, β-caryophyllene, (E)-α-bergamotene, τ-muurolene, germacrene D, τ-cadinene	
	Norisoprenoids	β-Cyclocitral	
	Miscellaneous compound	Eugenol	
Leaves	Coumarin	Bergapten, 4′,5′-dihydropsoralen, marmesin, umbelliferone	Innocenti et al. (1982)
	Flavonoid	Rutin	el-Kholy and Shaban (1966)
	Sterol	Baurenol, 24-methylenecycloartanol, lupeol, ψ-taraxasterol ester	Ahmed et al. (1988), Saeed and Sabir (2002), el-Kholy and Shaban (1966)
	Volatile		
	Aldehydes	3-Methyl-butanal, 2-methyl-butanal, (E)-2-pentenal, hexanal, (E)-2-hexenal	Oliveira, Silva, de Pinho, et al. (2010)
	Alcohols	1-Penten-3-ol, 3-methyl-1-butanol, 2-methyl-1-butanol, 1-heptanol, benzyl alcohol, (E)-2-nonen-1-ol, phenylethyl alcohol	
	Ketones	3-Pentanone	
	Esters	Methyl butanoate, methyl hexanoate, hexyl acetate, ethyl benzoate, methyl salicylate	
	Monoterpenes	Limonene, menthol	
	Sesquiterpenes	α-Cubenene, α-guaiene, α-ylangene, copaene, β-bourbonene, β-elemene, α-gurjunene, β-caryophyllene, β-cubebene, alloaromadendrene, α-caryophyllene, τ-muurolene, germacrene D, (+)-ledene, τ-elemene, τ-cadinene, α-muurolene	
	Norisoprenoid	β-Cyclocitral	
	Miscellaneous compounds	τ-Nonalactone, psoralen	
Leaves and roots	Coumarin	Psoralen	Innocenti et al. (1982)
	Sterol	β-Sitosterol	el-Kholy and Shaban (1966)

Table 2
Chemical components described in *F. carica* latex.

Volatile		References
Aldehydes	Pentanal, hexanal, heptanal, benzaldehyde	Oliveira, Silva, Ferreres, et al. (2010)
Alcohols	1-Butanol-3-methyl, 1-butanol-2-methyl, 1-pentanol, 1-hexanol, 1-heptanol, phenylethyl alcohol, phenylpropyl alcohol	Oliveira, Silva, Ferreres, et al. (2010)
Ketones	6-methyl-5-hepten-2-one	Oliveira, Silva, Ferreres, et al. (2010)
Monoterpenes	α-Thujene, α-pinene, β-pinene, limonene, eucalyptol, terpinolene, *cis*-linalool oxide, linalool, epoxylinalol	Oliveira, Silva, Ferreres, et al. (2010)
Sesquiterpenes	α-Guaiene, α-bourbonene, β-caryophyllene, trans-α-bergamotene, α-caryophyllene, τ-muurolene, germacrene D, cadinene, α-calacorene	Oliveira, Silva, Ferreres, et al. (2010)
Miscellaneous	Methyl salicylate, quinoline, psoralene	Oliveira, Silva, Ferreres, et al. (2010)
Non volatile		
Organic acids	Oxalic, citric, malic, quinic, shikimic, fumaric	Oliveira, Silva, Ferreres, et al. (2010)
Fatty acids	Myristic, pentadecanoic, palmitic, heptadecanoic, *cis*-10-heptadecenoic, stearic, oleic, elaidic, linoleic, arachidic, heneicosanoic, behenic, tricosanoic, lignoceric	Oliveira, Silva, Andrade, et al. (2010)
Steroids	Betulol, lupeol, lanosterol, lupeol acetate, β-amyrin, β-sitosterol, α-amyrin, 6-O-palmitoyl-β-D-glucosyl-β-sitosterol, 6-O-linoleyl-β-D-glucosyl-β-sitosterol, 6-O-stearyl-β-D-glucosyl-β-sitosterol, 6-O-oleyl-β-D-glucosyl-β-sitosterol	Oliveira, Silva, Andrade, et al. (2010)
Amino acids	Leucine, tryptophan, phenylalanine, lysine, histidine, asparagines, alanine, glutamine, serine, glycine, ornithine, tyrosine, cysteine	Oliveira, Silva, Andrade, et al. (2010)

2.3. Terpenoids

Sterols (actually modified triterpenes) and triterpenoids have been reported from leaves and roots. A comprehensive revision of previous literature about the phytochemistry of *Ficus* spp. was performed by Lansky et al. (2008) where describes ten terpenoidic structures for *F. carica.* Interestingly, acyl steryl glucosides were reported only from latex (Rubnov, Kashman, Rabinowitz, Schlesinger, & Mechoulam, 2001).

2.4. Volatile compounds

Regarding volatile profiling of *F. carica* varieties, Oliveira, Silva, de Pinho, et al. (2010) performed a work on fresh fruits (pulp and peel) and leaves of some European varieties: Portuguese *F. carica* white ("Pingo de Mel" and "Branca Tradicional") and dark ("Borrasota Tradicional", "Verbera Preta" and "Preta Tradicional"), which were characterised by Head space-Solid-phase micro extraction coupled with gas chromatography–ion trap mass spectrometry (GC–ITMS). They found fifty-nine different compounds, including aldehydes, alcohols, ketones, esters, monoterpenes, sesquiterpenes, one norisoprenoid and three miscellaneous compounds, which were distributed mostly in leaves followed by pulps and peels. Leaves were the material with higher quantities of all classes of compounds, except for aldehydes and monoterpenes. These classes were found in highest amounts in peels and pulps. Germacrene D, β-caryophyllene and τ-elemene were the major sesquiterpenes detected in leaves of all varieties analysed (Table 1).

2.5. Latex

All *Ficus* spp. possess latex-like material within their vasculatures, affording protection and self-healing from physical assaults (Lansky et al., 2008). Latex consists of a cytoplasmatic fluid of laticiferous tissues that contains the usual organelles of plant cells, such as nuclei, mitochondria, vacuoles and ribosomes, among others (Kim, Park, Lee, Cerbo, Lee, & Ryu, 2008). It is an aqueous suspension of a complex mixture of molecules found in specialised secretory cells of plants, known as laticifers, which synthesise and store diverse secondary metabolites in appreciable amounts, namely, terpenoids, alkaloids, tannins, sterols and proteins (Agrawal & Konno, 2009). Table 2 summarises organic compounds described in *F. carica* latex.

2.5.1. Phytosterols and fatty acids

Phytosterols are found in most plant foods, with the highest concentrations occurring in vegetable oils. Oliveira, Silva, Andrade, et al. (2010) performed a comprehensive study of the phytosterol content in latex samples by GC–ITMS, and identified several phytosterols not described previously in *F. carica* latex. Besides the most abundant β-sitosterol, they reported betulol, lupeol, lanosterol, lupeol acetate, β-amyrin and α-amyrin. Regarding fatty acid composition of latex, fourteen acids were reported. In that study palmitic, arachidic, and behenic acids were the major fatty acids of total fatty acid content (Oliveira, Silva, Andrade, et al. (2010)). Latex is essentially constituted by saturated fatty acids (ca. 86.4% of total fatty acids), whilst dried and fresh fruits show predominantly polyunsaturated fatty acids (ca. 84% and 69% of total fatty acids, respectively) (Jeong & Lachance, 2001; Pande & Akoh, 2010). With respect to monounsaturated fatty acids, oleic acid (C18:1*n*9) is presented as the most abundant one in latex (Oliveira, Silva, Andrade, et al., 2010), which is in agreement with data found for *F. carica* fruit (Jeong & Lachance, 2001; Pande & Akoh, 2010). Concerning polyunsaturated fatty acids, linoleic acid was the only compound identified (ca. 9.9% of total fatty acids) (Oliveira, Silva, Andrade, et al., 2010), which was already described in dried and fresh fig fruits (Jeong & Lachance, 2001; Pande & Akoh, 2010).

2.5.2. Proteins

Although *F. carica* latex presents reduced amino acid content, the extraction and preconcentration of this matrix may render an interesting material to be used topically or orally in formulations for health promotion. A total of thirteen amino acids, essential and non-essential were described for this matrix (Oliveira, Silva, Andrade, et al., 2010). Regarding protein composition in latex fluid, it is known that lattices of *F. carica* contain multiple forms of proteolytic enzymes (Liener & Friedenson, 1970). It is a distinctive characteristic if comparing with species that accumulates secondary metabolites in latex, for example vindoline in *Catharanthus roseus* (Apocynaceae) or morphine in *Papaver somniferum* (Papaveraceae) (Hagel, Yeung, & Facchini, 2008). Ficin (EC:3.4.22.3) or ficain is a nonspecific sulfhydryl protease similar to papain and classified as cysteine endopeptidase enzyme belonging to peptidase family C1. Its molecular weight is approximately 25,000 Da, its pH range is 6.5–8.5 (www.brenda-enzymes.org), and is registered at Chemical Abstract Service (CAS) with the number 9001-33-6. Protein databases report at least 5 isoforms of ficin, named as A, B, C, D and S (Azarkan et al., 2011; Devaraj, Kumar, & Prakash, 2008; Richter, Schwarz, Dorner, & Turecek, 2002). Nowadays it is possible to buy purified preparations of ficin as laboratory reagents, in solution, fine powder or immobilized onto agarose resin, commercialised by vanguard enterprises, such as Sigma Aldrich® (2013) (www.sigmaaldrich.com) or Thermo Scientific® (2013) (www.piercenet.com/product/immobilized-ficin).

All the chemical components described in *F. carica* latex, including volatile and non volatile, are summarised in Table 2. It is interesting to note that despite the huge information about the chemical composition of fruits, leaves, essential oils and latex of many varieties of common fig, no data were found about stems and little information about roots.

3. Ethno pharmacological uses and biological activities

Traditional phytotherapy is a skill experienced by elder people whose experiential familiarity is appreciated by everyone (Parveen, Upadhyay, Shikha, & Ashwani, 2007). Even today this area holds much more concealed treasure, as almost 80% of the human populace in developing countries is dependent on plant wealth for healthcare (Farnsworth, Akerele, & Bingel, 1985). The use of foods and medicinal plants to improve health is nearly as old as humanity. Among such, none may be older than the fig, which recent investigations have indicated it has been cultivated for over 11,000 years, possibly predating cereal grains (Kislev, Hartmann, & Bar-Yosef, 2006). Besides, people from different cultures have also reported it to cure ailments, for example fruits are appreciated by lesser Himalayan people to cure eye vision problems in association with seeds of *Amaranthus viridis* and as laxative (Abbasi et al., 2013). The importance of *F. carica* as an alternative to cure some illnesses has been recognised through the centuries, and nowadays it is included in several pharmacopoeias and books dedicated to herbal medicines. French Pharmacopoeia (2007) includes mother tincture of fresh, young, leafy branch of *F. carica* L. for homoeopathic preparations, while British Pharmacopoeia (2012) treats fig under Herbal Drugs and Herbal Drug Preparations Section, defining it as "the sun-dried succulent fruit of *Ficus carica* L.". The PDR for Herbal Medicines (2000) cites *F. carica* to treat constipation, as laxative, to treat dysentery and enteritis, many of this information extracted from Chinese medi-

Table 3
Main documented ethno pharmacological uses of *F. carica*.

Plant part	Uses	Preparation	Place	References
Fig	Eye vision problems	In association with *A. viridis*	Asia	Abbasi et al. (2013)
	Laxative	Unspecified	Asia	Abbasi et al. (2013)
	Laxative, to treat constipation	Fig preparations	Unspecified	PDR for Herbal Medicines (2000)
	Anti-dysenteric, to treat enteritis	Fruit	Asia	PDR Herbal Medicine (2000)
	Maturation of skin pustules, furuncles	Heated dried fruit	South America	Martínez (2008)
Latex	Treatment of warts	Direct application	South America	Martínez (2008)
Leafy branches	Homoeopathic preparations	Mother tincture	Europe	French Pharmacopoeia (2007)
Fruit, leaves, roots	Colic treatment, indigestion, loss of appetite, diarrhoea	Unspecified	Unspecified	Gilani et al. (2008)

cine. In South America, the common fig is mainly recognised as food, extremely appreciated in the preparation of sweets, jams, which can be eaten fresh or included in the preparation of delicious cakes and delicatessens, but also its curative properties had has appreciated. A recent revision performed with plants used as medicines at the central region of Córdoba province in Argentina reported that heated dried fruits of the '*higuera*' are used to facilitate maturation of skin pustules and furuncles by direct application on. In addition, latex is usually applied locally to treat warts (Martínez, 2008). Nevertheless, Argentinean Pharmacopoeia never included *F. carica* L. hitherto. Table 3 summarises the main documented ethno pharmacological uses for *F. carica* grouped by plant part.

Some biological activities of *F. carica*, namely, antioxidant, acetyl cholinesterase inhibition (Oliveira, Silva, Ferreres, et al., 2010), antifungal, anti-helminthic (Amorin, Borba, Carauta, Lopes, & Kaplan, 1999; Mavlonov, Ubaidullaeva, Rakhmanov, Abdurakhmonov, & Abdukarimov, 2008), and anticarcinogenic (Lansky et al., 2008; Rubnov et al., 2001; Wang et al., 2008), have been reported. Parts (fruits leaves, twigs) of *F. carica* and *Ficus sycomorus* are reported, either fresh or dry, for treatment of tumors and inflammatory syndromes; also ashes of fig tree as well as wine made from the fruits were used (Lansky et al., 2008). Fruits, leaves and latex of *F. carica* were reported as antioxidants in diabetic rats (Pérez, Canal, & Torres, 2003), as inhibitors of LDL oxidation in humans (Mawa et al., 2013), to treat papillomatosis on bovine teats (Hemmatzadeh, Fatemi, & Amini, 2003) and as inhibitors of proliferation of several cancer cell lines (Rubnov et al., 2001). Also, skin contact with latex may produce allergic reactions like dermatitis, asthma and anaphylaxis (Bohlooli et al., 2007). Decoctions of leaves were stated as effective in ameliorating post-prandial hyperglycaemia in Type 1 diabetes mellitus (Pérez et al., 2003), while leaves mixed with animal feed are used as a digestive in veterinary medicine (De Feo, Aquino, Menghini, Ramundo, & Senatore, 1992).

As was previously exposed in Section 2, leaves of *F. carica* accumulate germacrene D. This sesquiterpene was found as an important factor for insect behaviour (Buttery, Flath, Mon, & Ling, 1986) and as an antimicrobial agent (Steliopoulos, Wüst, Adam, & Mosandl, 2002) such as the β-caryophyllene and the τ-elemene (Kim et al., 2008). β and α-caryophyllene could be related to the response of fig to attack of insects (Loughrin, Manukian, Heath, Turlings, & Tumlinson, 1994). The existence of higher contents of monoterpenes in figs may be related with their important role in the attraction of specific pollinators, namely in the fig/wasp relationship (Grison-Pigé, Hossaert-McKey, Greeff, & Bessière, 2002). Despite some poorly documented evidences, no health hazards are known in conjunction with the proper administration of designated therapeutic dosages, consequently all available data shown that common fig is a secure natural remedy (PDR for Herbal Medicines, 2000). Although latex is not ingested *per se*, some precautions regarding the direct use are needed, because this material is known to have keratolytic and corrosive properties (Hemmatzadeh et al., 2003).

Table 4
Nutrients found in dried figs (extracted from Vinson, 1999).

Dietary component	Amount per 100 g serving	Daily value (%)
Total calories	283	–
Calories from fat	4.7	–
Total fat	0.52 g	0
Saturated fat	0.0 g	0
Cholesterol	0.0 mg	0
Sodium	12.26 mg	0
Potassium	609 mg	7
Calcium	133.0 mg	6
Iron	3.07 mg	6
Total carbohydrate	66.16 g	9
Total dietary fibre	12.21 g	
Insoluble	8.47 g	20
Soluble	3.47 g	
Sugars	49.0 g	–
Protein	3.14 g	–
Vitamin A	9.76 IU	<2
Vitamin C	0.68 mg	<2

4. Nutritional value

As one of the oldest known human foods, figs as a fruit have a very high safety profile. Leaves, fruits and latex of *F. carica* have been used to treat hungry and besides on to improve health conditions. Various reports concerning the nutrient composition of dried figs have indicated that it has the best nutrient score among the dried fruits, being an important source of minerals and vitamins (USDA/ARS, 2002). Dried figs are available in many forms: whole for the consumer and, in industrial products, as paste, concentrate, nuggets, powder, and diced forms. Usually, potassium sorbate is added to dried figs to inhibit yeast fermentation and mould growth. Dried figs are processed to bring their moisture content up from 14% to 20% to as high as 30%. Table 4 lists the nutrient composition of dried figs. figs are fat free, sodium free and, like other plant foods, cholesterol free (Vinson, 1999). According to O'Brien et al. (1998), figs constitute a "keystone" plant resource of calcium for many birds and mammals. The fresh and dried figs also present relatively high amounts of crude fibre and polyphenols, which represent 1230 and 360 mg/100 g in the dried form, respectively. Also, it was demonstrated that the antioxidant activity is correlated with the concentration of polyphenols in fruits (Solomon et al., 2006). Actually, red wine (200–800 mg/200 ml) and black tea (150–210 mg/200 ml), two well-published sources of phenolic compounds contain lower amounts of phenols than figs (1090–1110 mg/100 g of fresh matter) (Vinson, Hao, Su, & Zubik, 1998). As was mentioned, several studies have been made on the health-promoting potential of figs due to their phenolics content (Dueñas et al., 2008; Vallejo, Marín, & Tomás-Barberán, 2012).

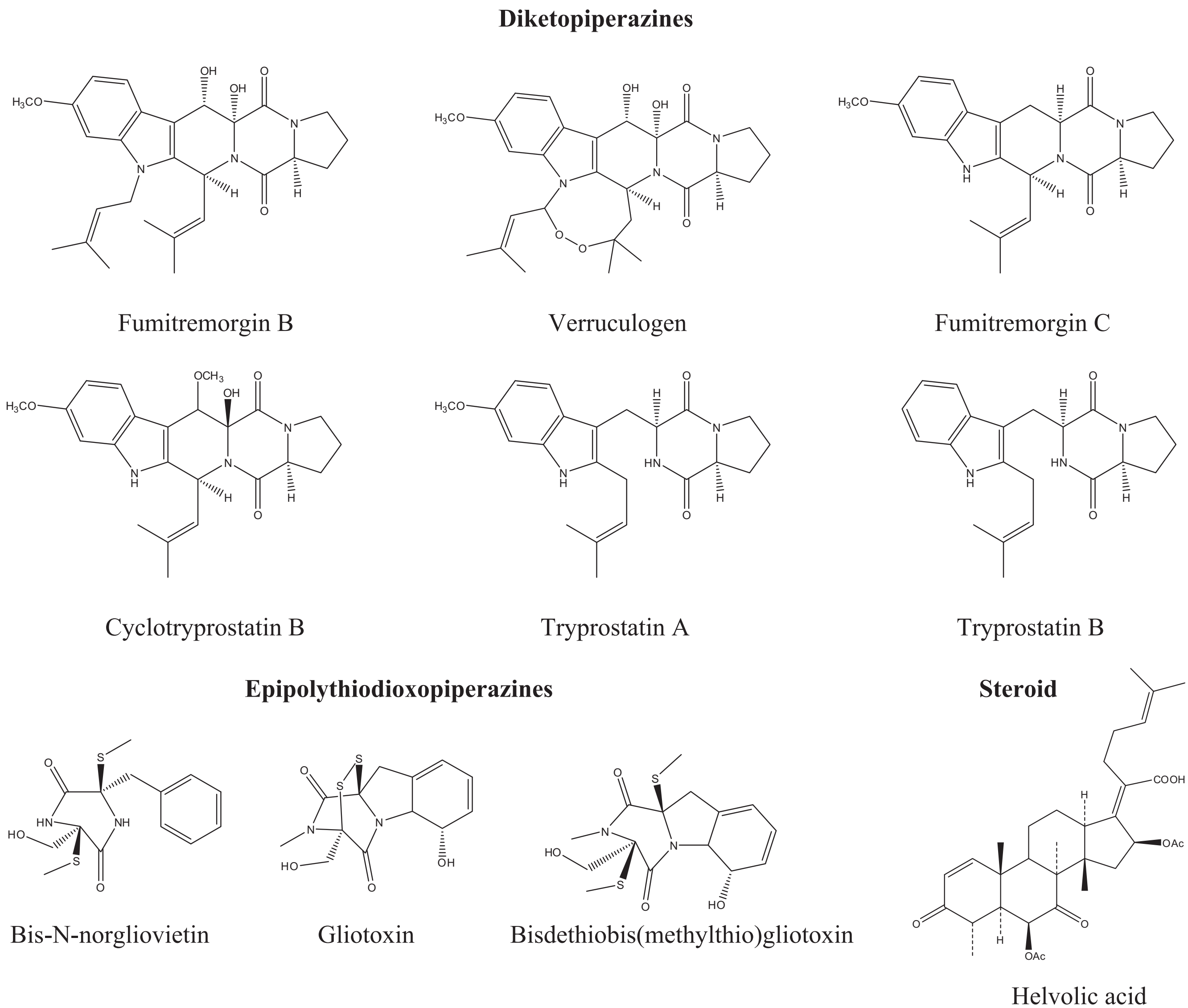

Fig. 3. Secondary metabolites isolated from endophytic fungi of *F. carica*. Diketopiperazines: Fumitremorgin B, Verruculogen, Fumitremorgin C, Cyclotryprostatin B, Tryprostatin A, Tryprostatin B. Epipolythiodioxopiperazines: Bis-N-norgliovietin, Gliotoxin, Bisdethiobis(methylthio)gliotoxin. Steroids: Helvolic acid.

Fruit skins are clearly the major source of phenolic compounds in many cases, so the consumption of whole ripe fruits is recommended. High concentrations of phenolic compounds are present both in skin (mainly anthocyanins) and in pulp (mainly proanthocyanidins) (Vallejo et al., 2012). The presence of phytosterols (433 mg/100 g dry basis) has also been reported in fig fruit (Jeong & Lachance, 2001). Despite the security offered and the great trajectory as food, some authors consider that the toxicological evaluation of fig products is still in an early stage. In the context of humans, reduced amounts of latex are ingested only with the fresh fruits.

5. Potential to obtain new chemical skeletons

5.1. Endophytic fungi and bacteria

Ecological interactions between populations of microorganisms in several ways with their hosting plants certainly open new insights to get novel chemical skeletons.

Endophytic fungi that inhabit normal tissues of the host plants without causing apparent pathogenic symptoms have been demonstrated to be a rich source of novel organic compounds with interesting biological activities (Gunatilaka, 2006). To our knowledge, only two works reporting chemical components about fungal endophytic isolates of *F. carica*, have been published. On the first, the filamentous fungus *Aspergillus tamari*, isolated from fresh leaves gave bioactive indolyl diketopiperazines in culture, which were isolated by bioassay guided fractionation (Zhang, Maa, Liu, & Zhou, 2012) and the second one, *Fusarium solani*, which produced in culture alkaloidic toxins with antimicrobial activity (Zhang, Maa, & Liu, 2012) (Fig. 3).

Another field almost uncovered in plants and particularly in *F. carica*, is the study of endophytic filamentous bacteria. Many of the antibiotics and cytostatic drugs most applied nowadays in therapeutic are produced by filamentous bacteria belonging to *Streptomyces* genus (Dewick, 2009). However, chemical investigation about secondary metabolites produced by this kind of microorganisms will be certainly crucial to obtain bioactive novel molecules.

As exposed in Section 2, latex of *F. carica* contains acyl steryl glycosides, which have gained great importance after the advent of biodiesel production from oil of soybean (*Glycine max*, Fabaceae) because of the adverse effects generated by flocculation and obstruction of filters, engines, etc. Nevertheless, some acyl steryl glycosides, such as BbGL1 from bacterial origin, which has immunogenic potential, represent good candidates to pharmaceutical industry (Kulkarni & Gervay-Hague, 2008).

5.2. Technological applications

Bekatorou et al. (2002) studied the efficiency of dried figs as an alternative natural support for yeast cells immobilization and used it as biocatalyst in brewing. Authors concluded that dried figs are an interesting carrier for cell immobilization, because they are inexpensive, abundant, edible, and confers a special organoleptic character to the produced beers with an adequate consumer acceptance (Bekatorou et al., 2002). Despite not being a way to obtain chemical diversity, this technological application constitutes a good alternative to use figs in chemical reactions, such as biotransformation.

6. Concluding remarks

The common fig is an old food that accompanied man from early time. The importance of *F. carica* to human race can be exemplified by its presence in the Gospels, the sacrum book of Christians. Either cultivated or wild, the varieties of common fig continue currently, as in the past, providing nourishment to people around the world. A large proportion of the rural population, mainly from developing countries uses traditional medicine, alone or in combination with drugs to treat a wide variety of ailments (Cavero et al., 2013). The majority of the medicinal uses of fig are based on folkloric data or anecdotal evidence; nevertheless it has been included across the centuries in several (European, Indian, etc.) pharmacopoeias, also in homoeopathic formulations, and in compendia of herbal medicines used along the world. Mostly devoid of systemic toxicity, *F. carica* constitutes an excellent option as dried fruits or as foods cooked in several forms. Although quite studied, chemical composition of the fig tree remains to be more explored, especially some organs such as barks and roots. Two ways to expand the chemical space of natural organic scaffolds using *F. carica* were discussed here, the ability of endophytic microorganisms as producers of new chemical compounds and the potential of secondary metabolites from latex as candidates to obtain drugs. These are representative examples confirming common fig as a good model for further chemical studies.

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