

TRADITIONAL FOODS OF MEXICO: ADVANCES IN DISCOVERING OF THEIR MEDICINAL PROPERTIES

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Abstract

Nowadays, many food products are investigated in order to establish their medicinal proprieties, active components and possible medical applications for prevention o treatment of different diseases. In the present work we have summarized some advances in investigation of medicinal potential of 4 traditional Mexican foods: nopal cactus, chili pepper, cinnamon and agave. The results have demonstrated that all 4 merit being present on daily basis in diet of Mexicans.

Resumen

Hoy en día, muchos productos alimenticios se investigan con el fin de establecer sus propiedades medicinales, componentes activos y las posibles aplicaciones médicas para la prevención o el tratamiento de diferentes enfermedades. En el presente trabajo hemos resumido algunos avances en la investigación del potencial medicinal de 4 alimentos tradicionales mexicanos: nopal, chile, canela y agave. Los resultados han demostrado que los 4 merecen estar presente a diario en la dieta de los mexicanos.

For many people food is only a source of energy and a plastic material for build tissues. For others food is also a pleasure, a mode to calm down or to feel themselves happy. This property of food may be dangerous, because it is well known that excess of the calories may provoke some diseases, including obesity and diabetes. Apart from those obvious properties, a variety of foods also possesses some medicinal value. Some of this effects are well known by mankind, like a chamomiles which provoke a calming effect and is beneficial for gastric system. Another example is cranberry juice, which is used as a part of therapy and prevention of urinary diseases (cystitis). The component claimed to be responsible of this action is mannose. Mannose can inhibit the adhesion of pathogens to cell wall, so it impede the colonization.

On the other hand, some medicinal properties of the foods were disclosed lately and many more are yet to be discovered. In Mexico, nowadays, there is no culture to use traditional culinary plants for their medicinal effects, but the latest research has demonstrated their potential. In this review we describe health beneficial effects of some plants used as a food on daily basis in Mexico.

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Nopal cactus

Opuntia ficus-indica (L.) Mill. is the larger member of *Cactaceae* family, which comprises about 1500 species of cactus. The cladode and fruits (commonly known as cactus pear or prickly pear) are used as a food in many countries of Latin America, including Mexico (Butera, 2002). The flowers of *Opuntia ficus-indica* are not used for cooking but along with other parts is an important source of biologically active components. In Mexico different parts of the plant were used in folk medicine for the treatment of indigestion, wounds, edema, etc. (Kaur, 2012). Researchers have disclosed some of the active components of nopal cactus, responsible for its beneficial action.

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First of them is a fiber. The cladode of the cactus is very rich in soluble and insoluble fiber. It is estimated that dried cladode contains approximately 40-50% of total fiber. The soluble fraction of fiber is composed mainly by pectin and hemicellulose, then the insoluble one is mostly cellulose (Hernández-Urbiola, 2011, Sáenz, 1997). The high fiber content is thought to be responsible of the antidiabetic action of the cactus. It was demonstrated that supplementation of the diabetic patients with nopal cactus resulted in improving of their blood glucose content and lipid profile (Godard, 2010, Frati-Munari, 1983). In base of fiber complex from nopal cactus enriched with *Acacia* sp. soluble polysaccharide, Litramine IQP-G-002AS was developed. This product is claimed to promote dietary fat absorption, which in turn leads to weight loss (Grube, 2013). Also, some other formulation with *Opuntia ficus-indica*, which may be used as coadjuvant therapy of diabetes and/or obesity, were developed (patents US2014186466 (A1), MX20100007535 (A), US2012052137 (A1)).

Others main active components of the cactus are antioxidant compounds, like polyphenols and flavonoids. All parts of the plant are rich in these compounds, but the most important source of the antioxidants is the flower. There are 8 major antioxidant components, but the most abundant are gallic acid and 6-isorhamnetin 3-O-robinobioside that may reach about 4 mg/g of dry matter (De Leo, 2010, Ammar, 2012, Clark, 1980). The cactus fruit is also a potent source of antioxidants. The content of antioxidants varies depending on a part of the fruit. The pulp contains 0.22 mg/g of active components (Fernández-López, 2010) and seeds 0.5 – 0.8 mg/g (Chougui, 2013). The richest part is peel, which may contain 457 mg/g of antioxidants, primary kaempferol and quercetin (Jorge, 2013). Normally, prickly pear is consumed without peel because it contains small spines, but it is possible to extract active components in order to use them separately. The use of antioxidants is known to reduce an oxidative stress, caused by many diseases: Alzheimer's disease (Kumar, 2015), cardiovascular diseases (Pagliaro, 2015), diabetes (Nasri, 2015), etc.

The prickly pear rather than cladode may be considered as a superfood, because apart of antioxidants it possesses a significant variety of other active components. Its seed oil contains more ω -6 fatty acids than sunflower oil – 70.29% against 60.15% (Ennouri, 2005). The fruit also is rich in vitamins, such E, C and K1, and sterols, mainly β -sitosterol and campesterol (Ramadan, 2003). Seeds of the fruit are good source of potassium (0.163 mg/g) and phosphor (0.153 mg/g) (Sawaya, 1982, Medina, 2007).

Also suggest their use as a component in nutraceutical compositions

Taken together, the data not only support the use of nopal and its fruit as food but also suggest their use as a component in nutraceutical compositions.

Chili pepper

The most known worldwide typical Mexican food is hot chili pepper. Pepper belongs to the genus *Capsicum*, which includes 32 species. The most cultivated of them are *C. annum L.*, *C. baccatum L.*, *C. chinense Jacq.*, *C. frutescens L.*, and *C. pubescens* (Perry, 2007). Peppers present a wide diversity of fruit shape, size, and color. The total production of pepper was 34.6 million tons fresh fruit and 3.5 million tons dried pods in 2011 (www.fao.org). The great variety of chili peppers is used in Mexico due to their unique hot flavor.

Studies of the effects of capsaicin on gastrointestinal tract are controversial

Capsaicinoids are known to be responsible for the spicy flavor of chili peppers; 90% of all capsaicinoids are capsaicin and dihydrocapsaicin, but capsaicin is predominant (Walpole, 1996). Taken in account great pharmacological potential of capsaicin, methods of its chemical synthesis were developed (Kaga, 1996). Capsaicin is efficiently absorbed from the skin than applied topically or by the oral administration and quickly reach maximum concentration. Then applied to the skin, interaction between capsaicin and sensory neurons produces inflammation and a localized heat sensation. Topical application of capsaicin is effective as a treatment of neuropathic conditions caused by diabetes (Deli, 2013).

Studies of the effects of capsaicin on gastrointestinal tract are controversial. In animal model in concentrations 0.13-160 μM capsaicin seems to protect gastric mucous against ulcer formation, but at concentrations 1-2 mg/mL it promotes gastric mucous damage (Holzer, 1988, Szolcsanyi, 1990).

Capsaicin also have demonstrated an interesting effect in obese mice: administrated as injections it promotes an antiinflammatory response, suppressing production of some cytokines and boosting adiponectin (Kang, 2007). This effect may be useful for treatment of metabolic syndrome and obesity.

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More studies should be performed in order to establish all beneficial and side effects of capsaicin, as well an adequate form of its administration.

Cinnamon

Than the term cinnamon is used it is generally refers to two from 300 species of plants of genus *Cinnamomum* (family *Lauraceae*): *C. zeylanicum* and *C. aromaticum*. The plant is used to cook, primary, sweet dishes because of its unique aroma and taste. In Mexico sometimes cinnamon is used as an additive to coffee to enrich its flavor. Also, chewing cinnamon is useful to remove bad breath.

Some of components that are responsible for nice aroma of cinnamon are cinnamaldehyde and trans-cinnamaldehyde. These components are also claimed to present some medicinal benefits (Yeh, 2013). Another active component are polyphenols, their benefits have been discussed previously in this review.

Regarding to biological activities of cinnamon, it was evidenced that extracts from *C. zeylanicum* bark have high antibacterial activity against *Klebsiella pneumonia*, *Bacillus megaterium*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, *Enterobacter cloacae*, *Corynebacterium xerosis* and *Streptococcus faecalis* (Keskin, 2011). So, cooking with cinnamon may prevent some diseases, caused by pathogen bacteria.

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To the date, the main biological activity disclosed for cinnamon is antidiabetic effect. The results of the studies are controversial. Some of them report lowering of blood glucose and cholesterol (Khan, 2003), meanwhile the others do not (Safdar, 2004). The found variances may be caused by different protocols used for these researches, since a meta-analysis performed by Allen in 2013 conclude that a decrease of fasting plasma glucose, total cholesterol, LDL-C, and triglyceride levels, and an increase in HDL-C levels are significant than cinnamon is consumed, but the recommended dose and duration of treatment are yet to be establish.

Some studies have investigated use of cinnamon for treatment of nuerological diseases. The study conducted by Peterson in 2009 suggest that cinnamon may be used in treatment of Alzheimer's

Some studies have investigated use of cinnamon for treatment of neurological diseases

disease, due to reduction of tau aggregation and filament formation by the aqueous extract of *C. zeylanicum*.

In summary, cinnamon may be used not only because of its good taste and flavor, but also because of its possible health benefits.

Agave

Agave tequilana is commonly used in Mexico to produce tequila, a traditional alcoholic beverage. The core of the plant produce sugars, mostly fructose, and a variety of other components. Medicinal use of *Agave* is relatively new field for researchers. Some of possible active components of the plant are fructans, diet fiber and antioxidant compounds.

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In the studies, fructans and inulin –a fiber isolated form *Agave*- presented a prebiotic activity and protective effect against colon cancer in animal model (Allsopp, 2013, Dávila-Céspedes, 2014). Few papers describe the use of agave syrup as an antidiabetic agent. It is possible, that syrup may reduce blood glucose and cholesterol (Rendón-Huerta, 2012).

There are scarce published research regarding to medicinal use of *Agave*, but the results suggest that agave may be the next superfood.

Table 1. Summary of main active components and activities of the plants.

Name of the plant	Active components	Actions
<i>Opuntia ficus-indica</i> (L.) Mill. (nopal cactus)	Fiber	Improving of blood glucose content and lipid profile
	Polyphenols and flavonoids	Antioxidant compounds
Chili pepper	Capsaicin	Treatment of metabolic syndrome and obesity
Cinnamon	Cinnamaldehyde	Antibacterial effect
		Lowering of blood glucose and cholesterol
Agave	Fructans and inulin	Prebiotic activity

Conclusions

The summary of main active components and medicinal activities of the plants described in this review are present in the table 1. There are many more traditional Mexican foods that may possess

some medicinal qualities. Also a more detailed analysis of plants described in this review should be performed in order to establish them as a possible coadjuvant therapy of emergent diseases, but it is clear that the use of these plants daily is beneficial for consumers. ■

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