Prickly Pear Cactus

Opuntia spp

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Botanical family: Cactaceae

Common names in Spanish: Nopal, Chumbera**.**

Habitat: Prickly pear cactus is native to New World, where it grows well in dry regions, such as the Southwestern United States and Northern Mexico (Noble 2002).

History

This xerophytic plant is a large bushy cactus with a definite woody trunk growing to 5 m high. Prickly pear cactus, commonly known to the Mexican American population by its Aztec name, *Nopal*, consists of the stem of various species contained in the genus Opuntia., extensively employed as a foodstuff and medicinal plant by the people of Mexico and those of Mexican descent, living in the United States (Yarnell et al., 2003; Poss et al. 2002; Linares et al., 1994).

This plant has been employed both as a medicine ands a source of nourishment, since prehistoric times, and was traded by various ethnic groups in Mexico and other parts of tropical America, long before the arrival of the Europeans (Lozoya, 1999).

The sliced or diced tender young pads or “paddles” (cladodes) of some species of the genus *Opuntia* are commonly known as "nopalitos" (meaning “little nopales”), which have been a traditional vegetable in the Mexican diet for centuries, and more recently, a specialty vegetable in the United States. Usually, prickly pear cactus is consumed as a fresh or cooked green vegetable (Pimienta, 1993; Russell and Felker, 1987). The cactus pads, or stems, are sliced, diced and cooked (boiled or broiled) much like string beans, and consumed as a salad or as part of a meal. (Nobel, 2002).

Sliced cactus stems or '"Nopalitos"

Cactus cladodes or pads have a chemical composition that is similar to most vegetables: Water (85-92%), carbohydrate (4-6%), protein (1%), fat (0.2%), minerals (1%), vitamin C (12.7 mg/ 100g fresh weight), and ß-carotene (12.9 µg/ 100 g fresh weight) (El Kossori et al., 1998; Rodriguez-Felix and Cantwell, 1988).

Medicinal parts: Principally the stems (pads or cladodes). The roots are sometimes used, especially as a source of dietary fiber. The fruit is very sweet but has an astringent action.

Active principles: If any, the active principles in this plant are currently unknown. The raw plant contains abundant mucilage, which is a complex carbohydrate that may delay absorption of glucose. The cactus also contains fiber, which is known to delay glucose absorption (Wolfram et al., 2002; Lozoya, 1999, 2000).

Applications in herbal therapy

- The flamed or microwaved joints are split open and applied as a healing pad in cases of rheumatic and asthmatic symptoms of the chest, liver trouble, earaches, skin abrasions and tumors (skin growths that are not necessarily malignant). A cataplasm is made from the fleshy joint and applied to the skin, externally, for cases of sun/windburn, minor rash/burn, hemorrhoids, snake/insect bites, and minor abrasions.

- A sweetened infusion is drunk to lower fever and relieves chest pains (Yarnell et al., 2003; Aguilar, 2001; Martinez, 1989). Nopal is the most commonly used herbal hypoglycemic among persons of Mexican descent (Shapiro and Gong, 2002; Taddei-Bringas et al., 1998).

- Capsules containing dried prickly pear cactus are a popular item on both sides of the border and are used to treat diabetes, high cholesterol and obesity (Aguilar, 2001). Although nopal capsules are known to lower serum cholesterol levels both

in humans and animals, they may not be efficient in the treatment of diabetes as , theoretically, the active ingredients are possibly lost upon heating and drying or processing (Lozoya, 1999).

- Flavonoids present in the plant and its fruit can have neuroprotective effects on cells cultured in vitro (Dok-Go et al., 2003), as well as antioxidant and free radical scavenging properties (Lee et al., 2002). Antioxidant constituets are also found in its fruits (Butera et al., 2002).

- Research in experimental animals has found a diuretic effect inn rats fed prickly pear cactus (Galati et al., 2002 [a]), as well as gastro protective effects that could potentially be useful in the treatment of gastric ulcers (Galati et al., 2002 [b])

Dehydrated cactus capsules

Clinical Studies with Prickly Pear Cactus Against Diabetes

Limited clinical studies have been undertaken in Mexico and the United States. The methodology employed is not always uniform or meets the adequate standards for a clinical trial. (Veronin and Ramirez, 2002).

Studies performed in Mexico with *Opuntia streptacantha* Lemaire sap in three different animal species (rabbits, rats and dogs), induced hypoglycemic effects when orally administered to intact animals under induced states of moderate increase of blood sugar. In animals with normal blood glucose levels, as well as in pancreatectomized animals, the effect of the product was not detected. The results indicate that further research using human subjects could be of value in validating the popular use of this plant for treatment of Diabetes mellitus symptomatology (Ibañez-Camacho et al., 1979).

Frati et al. (1981), described the effects produced by feeding liquefied nopal and extracts from this plant to healthy and pancreatectomized rabbits. Preliminary results showed that this species of prickly pear cactus has hypoglycemic properties when administered orally

to animals with experimentally induced diabetes as well as in healthy ones with physiologic hyperglycemia.

In an experiment employing a purified extract of another species of prickly pear cactus (*Opuntia fuliginosa*), Trejo-Gonzalez et al.(1996), administered an extract of the cactus to experimentally induced diabetic rats. Blood glucose levels were reduced to normal values initially employing the cactus extract plus insulin. The hypoglycemic effects of the extract became more apparent after insulin was discontinued in the treated group, and normoglycemic values were maintained solely by the administration of the cactus extract.

Capsules containing the dehydrated and pulverized stems of nopal are a popular herbal supplement product on both sides of the US / Mexico border and are freely available to the population (Shapiro and Gong 2002). These capsules are touted as being efficient in lowering blood glucose levels in non insulin dependent or *Type II* diabetics. Their effects have been questioned by Mexican researchers (Lozoya 1999; Aguilar 2000), due to the fact that processing and dehydration of the plant probably diminishes its medicinal (hypoglycemic) activity.

In a study undertaken in Mexico, the daily intake of 30 *Opuntia* capsules by patients with diabetes mellitus had a discrete beneficial effect on glucose and cholesterol. However this dose was considered impractical and therefore was not recommended in the management of diabetes mellitus (Frati et al. 1992).

Dehydrated extracts of nopal (*Opuntia ficus-indica* Mill) did not show acute hypoglycemic effect, although it could attenuate postprandial hyperglycemia (Frati et al. 1989).

To assess the hypoglycemic effect of the nopal *Opuntia streptacantha* Lemaire (*O. streptacantha* Lem.), Frati et al. 1989, studied three groups of patients with non-insulin-dependent diabetes mellitus (NIDDM). Group one consisted of 16 patients who ingested 500 g of broiled nopal stems. Group 2 consisted of 10 patients who received only 400 ml of water as a control test. Three tests were performed on group 3 (6 patients): one with nopal, a second with water, and a third with ingestion of 500 g broiled squash. Serum glucose and insulin levels were measured at 0, 60, 120, and 180 minutes after ingestion of the test material. After the intake of *O. streptacantha* Lem., serum glucose and serum insulin levels decreased significantly in groups 1 and 3, whereas no similar changes were noticed in group 2. The mean reduction of glucose reached 17.6 +/- 2.2% of basal values at 180 min in group 1 and 16.2 +/- 1.8% in group 3; the reduction of serum insulin at 180 min reached 50.2 +/- 8.0% in group 1 and 40.3 +/- 12.4% in group 3. This study shows that the stems of *O. streptacantha* Lem. has a hypoglycemic effect in patients with NIDDM. The mechanism of this effect is unknown, but an increased sensitivity to insulin was suggested.

To evaluate the relationship between the doses of *O. streptacantha* Lem. and its acute hypoglycemic action in diabetics, eight patients with type II diabetes mellitus were studied. Four test were performed to each patient with the intake of: (a) 400 ml of water, (b) 100 g (c) 300 g and (d) 500 g of broiled stems of *O. streptacantha* Lem. Serum

glucose was measured at 0, 60, 120 and 180 minutes. Maximal decrease of serum glucose was noticed at 180 minutes, with a mean of 2.3, 10, 30.1 and 46.7 mg/dl less than basal value with 0, 100, 300 and 500 g respectively (P = NS, less than 0.05, less than 0.001 and less than 0.001 respectively). A significant direct correlation (r = 0.690, P less than 0.001) was noticed between the doses and the hypoglycemic effect (Frati et al. 1989).

To record the duration of *Opuntia streptacantha* Lem. hypoglycemic effect, two tests in fasting conditions, one with the intake of 500 g of broiled *Opuntia* stems and the other one with 400 ml of water as control, were performed in eight type II diabetics. Serum glucose levels were measured hourly during six hours. In the Opuntia test the decrease of serum glucose levels was more pronounced at the fourth hour (P less than 0.01 vs. control test), serum glucose levels remained unchanged the following two hours. No significant changes on glycemia occurred in the control test. Difference between both tests was significant from the second to the sixth hour Frati et al. 1989).

In order to know the extent of the hypoglycemic effect of crude extracts of *Opuntia streptacantha* eight patients with type II diabetes mellitus were studied. Five tests were performed to each patient with the intake of (A) supernatant, (B) precipitate, (C) complete homogenate of 500 g of crude *O. streptacantha* stem (D) 400 ml of water, and (E) 500 g of broiled Opuntia stems. Serum glucose levels were measured at 0, 30, 60,120 and 180 minutes. Crude extracts did not cause a significant decrease of glycemia, and the results were similar to the water control test (P greater than 0.05). The intake of broiled Opuntia stems caused a significant decrease of serum glucose level, that reached 48.3 +/- 16.2 mg/dl lower than basal values at 180 minutes (P less than 0.01). Perhaps heating of *O. streptacantha* is necessary to obtain the hypoglycemic effect (Frati et al.1990).

To evaluate if the acute hypoglycemic effect of nopal (prickly pear cactus) which occurs in diabetic patients also appears in healthy individuals, Frati et al. 1991, gave 500 g of nopal stems (*O. streptacantha* Lem.), orally to 14 healthy volunteers and to 14 non insulin dependent diabetic patients. Serum glucose and insulin levels were measured at 0, 60, 120 and 180 minutes after nopal ingestion. A control test was performed with the intake of 400 ml of water. The intake of nopal by the diabetic group was followed by a significant reduction of serum glucose and insulin concentration reaching 40.8 + 4.6 mg/dl (n = 14) (mean+SEM) and 7.8 + 1.5 uU/ml (n = 7) less than basal value, respectively, at 180 minutes. (P < 0.001) vs. control test. No significant changes were noticed in the healthy group as compared with the control test (P>0.05). An acute hypoglycemic effect of nopal was observed in diabetic patients, but not in healthy subjects, the researchers concluding that the mechanisms of this effect differ from those exhibited by currently available hypoglycemic agents.

Research with pigs suggests that a certain species of prickly pear cactus, *Opuntia lindheimeri* Engelm., may be useful in the prospective treatment of type 2 diabetes mellitus. In this experiment, the hypoglycemic activity of the cactus was investigated in streptozotocin – induced diabetic pigs, employing an enteral route of administration. The results showed that the hypoglycemic effect of the cactus was evident 1 hour after ingestion, reaching its maximum effect 4 hours after ingestion (Laurenz et al. 2003).

In a clinical trial involving 45 human subjects and 3 species of prickly pear cactus, *O. lasiacantha* Pfeiffer, *O. velutina* Weber and *O. macrocentra* Engelman , the results showed no acute hypoglycemic effects on Hispanic type 2 diabetic patients.. This study compared possible hypoglycemic activity of these cacti compared to boiled zucchini and water. The results of this study concluded that prickly pear cacti did possess mild hypoglycemic effect, but not in a statistically significant manner. The authors did mention that ingestion of prickly pear cactus might help lower serum cholesterol levels and perhaps augment the patients' sensitivity to insulin, as well as improve glucose tolerance curves (Rayburn et al., 1998).

Safety/Precautions

- Patients currently taking hypoglycemic pharmaceuticals should not discontinue their therapy in favor of using prickly pear cactus as the sole treatment for any type of diabetes. Monitor blood glucose levels closely.
- The ingestion of high fiber plant material could, under some circumstances, cause loose stools or some other minor gastrointestinal impairment.
- Hypoglycemia could theoretically be a possibility if the cactus potentiates the action of oral antidiabetic medications.
- Other than that, there is currently no documented serious risk or complication associated with the ingestion of prickly pear cactus.
- Overindulgence in consuming the fruits however, may cause constipation due to high tannin content and in more serious cases, intestinal obstruction due to the seeds (Kleiner et al., 2002).

Herb/Drug interactions

Unknown, although due to its fiber and mucilage content, ingestion of nopal capsules or raw prickly pear in quantities above those consumed as a foodstuff, may presumably reduce the absorption of some medications. This is of concern in relation to the concomitant ingestion of nopal with antibiotics, for example.

The hypoglycemic action of various pharmaceuticals for the treatment of diabetes, such as biguanides or sulfonyl-ureas, for example, could possibly be increased if ingested concomitantly with the cactus, leading to increased hypoglycemia.

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