

A review of *Plantago* plant

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Received 29.08.13, revised 15.05.14

The Plantain plant with the scientific name *Plantago major* L. belongs to Plantaginaceae family. It is a plant with wide geographic distribution in temperate grasslands of the world. *Plantago* is an important medicinal plant which has different compounds such as phenolic compounds (caffeic acid derivatives), flavonoids, alkaloids, terpenoids, vitamin C, antioxidants, anti-inflammatory agents. The World Health Organization has approved the use of *Plantago* as laxative agent, to treat hypercholesterolemia and to reduce the blood glucose. *Plantago* consumption can also have side effects, including bloating and allergic reactions. *Plantago* has Interactions with the carbamazepine, lithium, warfarin, iron supplements, minerals and vitamin B12 supplements.

Keywords: *Plantago* plant, Traditional medicine

IPC Int. Cl.⁸: A61K 36/00

The Plantain plant with the scientific name *Plantago major* L. belongs to Plantaginaceae family. The family includes three types of *Plantago psyllium*, *Plantago coronopus* L., and *Plantago major* L.; the family has more than 200 species. *Plantago major* L. is a perennial forage plant, lasting several years, apparently glabrous, with a short root and with multiple standing or crouching stems that do not have slots and are equal to or slightly longer than the leaves. Its wide oval leaves (major type) with large veins and dentate margins have relatively long petioles¹. *Plantago major* L. is usually found in poor soils with shortage of phosphorus and potassium. In the presence of nitrogen the number of leaves, stem growth, and total biomass increase, but nitrogen has a limited impact on root growth² (Fig. 1))

Plantago major L. is a plant with wide geographic distribution in temperate grasslands of the world and it grows in a wide area of Europe and temperate regions of Asia, South Australia as well as North Africa and North America. It naturally grows in northern Europe and Central Asia but now it is almost found all over the world³.

Chemical constituents in the plant

This forage plant contains 2 - 6.5 % mucilage which is composed of at least four polysaccharide, 6.5% tannin, Anvrtyn, emulsions and a glycoside called Aucubin, Diastase, hetrozeid, coloring materials, pectin, Plantagin, more than 1% salicylic acid, carboxylic phenolics acids, flavonoids, minerals, including zinc, potassium, silicic acid, and saponin. The seeds have a lot of glotinic materials plus Plantenolic acid, Succinic acid, Adenine, Choline, and Aeocoeine⁴.

Plantago is an important medicinal plant which has different compounds such as phenolic compounds (caffeic acid derivatives), flavonoids, alkaloids, terpenoids, and vitamin C⁵. *Plantago* plants have high levels of phenol toms and the powerful antioxidant quality of the plant may be due to its phenolic compounds^{6,7}.

Phenolic compounds, especially flavonoids have antioxidant qualities, but they are not able to inhibit all mutations induced by mutagenic agents. Based on the researches, the phenolic compounds of *Plantago* plant is used against UV radiation. The anti-mutation activities of phenolic compounds are associated with its antioxidant activity, because phenolic compounds in the presence of free radicals lead to the inhibition of DNA damage⁸.

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Trepeneids isolated from leaf wax contain Ursolic acid and Oleonic acid, which are both inhibitors of tumor progression⁵. Actoside and Plantamajosid are the main derivatives of caffeic acid in *Plantago major* L.⁹. *Plantago major* L. has some alcaleoeids called Plantagonin and Indican⁵.

Plantago from the perspective of traditional medicine

Plantago has a number of unique properties that makes it suitable to be widely used in traditional medicine around the world. This perennial herb has been used as a traditional medicinal plant for centuries to treat several illnesses including colds, hepatitis, skin diseases, infectious diseases, problems related to the digestive organs, respiratory organs, reproduction, circulation, and it is used to reduce fever. Several biological activities have been attributed to *Plantago* leaves including anti-inflammatory, antiviral, analgesic, antioxidant, anti-cancer, anti-tumor, anti-fever, immune modulator, and anti-hypertensive effects and it has also been used to neutralize internal and external toxins¹⁰⁻¹⁴.

Recently, in many countries including Mexico and Argentina a lot of reports on the use of *Plantago* species in traditional medicine against cancer have been presented¹⁵. In addition, in Chile, Venezuela and *Plantago major* has been used to treat cancer¹⁶.

In traditional medicine, *Plantago major* is introduced as a sputum inhibitor, bleeding inhibitor, and a topical analgesic. Boiled leaves and roots are useful for bloody sputum, sore throat, diarrhea and dysentery¹⁷. The species of *Plantago ovata*, *Plantago psyllium*, and *Plantago indica* are used as traditional medicines that are expectorant, anti-tussive, antibacterial, diuretic, and are useful in treating rheumatism and gout pains, bronchitis, and swollen glands^{18,19}. The herb tea is helpful for sore throat, dry cough and stomach irritation. Also, its topical ointment is used for sty, boils and ulcers¹⁷.

Other applications include the following:

- *Plantago* seed acts as laxative which is due to the increased volume of the mucilage within the seed membrane; thereby it increases the volume of stool and softens intestines. Plantain seeds should always be administered with plenty of water. The amount of usage is 7.5 gm²¹.
- The mashed balm of the leaves relieve arthritis. The seeds are laxative and seeds balm mixed



Fig. 1—*Plantago major*

with alyssum and lemon juice relieve swellings. The food with *Plantago* seeds licorice (and a quarter-weight Pepper) is useful for chest pain and cough when is ingested with milk (boil up to 100 gm of *Plantago* in one liter of water, and drink a cup of its filtered water every morning, noon and night).

- It stops fever and causes relaxation. It is useful for the treatment of colico malaria and for relieving cough and bronchitis asthma. It can effectively remove kidney disorders, bladder disorders, and gonorrhoea. It stops bleeding. *Plantago* can be used to treat pulmonary tuberculosis and chest ulcer bleeding.
- If you sweeten the boiled juice with honey drink three cups every day, it will prevent heartburn, pricking sensation, and queasiness. It relieves stomach pain and cures anemia.
- Grind a bunch of new *Plantago* twice a day and use it as a poultice to treat varicose ulcers and various burns; it also cures wounds and injuries and improves inflammations. It can cure rash and swelling of the face which are caused by tooth abscess.
- Extract its fresh juice and use it to wash your mouth several times a day; it cures the mouth sores.
- Boil *Plantago* in water and use it to wash your face three times a day; it will remove the brown stains on the face.
- Mix a spoon of *Plantago* with barberry juice and drink it every morning and evening; it will remove the blood in the urine which is due to the weakness of the liver²².

Therapeutic effects from the perspective of modern medicine

Plantago has antioxidant, anti-inflammatory, and hematopoiesis effects and protects the liver and is used for the treatment of cancer^{6,7}. It has shown anti-asthma and anti-dyspnea therapeutic effects. Studies have shown a significant reduction in the number of coughs when *Plantago* is used. The ethanol extract of *Plantago* can generate antitussive effects comparable to codeine, but more research is needed to prove this²³.

All vegetative and reproductive parts of the *Plantago* plant, with the scientific name *Plantago major* L. are used as medicines for treating skin diseases, respiratory, digestive and circulatory disorders, preventing cancer, preventing tumor formation, healing wounds and infections, etc.^{5,24}.

Luteolin-7-O- β -glucoside, as the major flavonoid compounds in most species of *Plantago*, is used as a potent anti-cancer molecule with inhibitory effects on breast adenocarcinoma. The exact mechanism of inhibitory activity of Luteolin-7-O- β -glucoside in *Plantago* species is not identified in detail, but it seems that inhibiting DNA damages by topoisomerase inhibitors is the major cause of Luteolin-7-O- β -glucoside performance in inhibiting cancer¹⁶. The Luteolin-7-O- β -glucoside compound is effective for cancer prevention and control⁵. It has been proved that the methanol extract of aerial parts (leaves and inflorescences) of *Plantago major* L. has Inhibitory effects on the layers of human adenocarcinoma cancer cells (MCF-7) and the layers of human melanoma cells (UACC-62)¹⁶.

There are various species of plantain plants which are laxative, diuretic, anti-inflammatory, anti-bacterial, anti-diarrhoeic, and anti cicatrizing²⁵.

The seeds are sputum-inducer and strong disinfectants for the respiratory system. Boiled plantain seed is used for orally to eliminate diarrhea and inflammations of the kidneys and bladder. Besides, the seed's paste is diaphoretic, diuretic and anti-rheumatic and is used to sure dry coughs and fever²⁶. Roots, leaves and seeds of this plant have softening effects and are used as blood purifier and can cure and alleviate wet asthma, diarrhea, and swelling of the oral mucosa (Table 1).

Indications approved by the World Health Organization based on clinical data

The World Health Organization has approved the use of *Plantago* in the following cases:

- Laxative: for treating constipation, temporary constipation due to illness or pregnancy, irritable bowel syndrome, constipation caused by duodenal ulcer or diverticulitis; hemorrhoids stool softener after surgery in patients with anorectal^{18,19}.
- To treat hypercholesterolemia as an adjunct to diet to reduce the risk of coronary heart disease.
- To reduce the blood sugar that is increased after a meal¹⁹.

Instructions for the use and dosage of the drug and its side effects

Plantago can be administered both orally and topically. It is prepared in the following manners:

A. Oral

Plantago major and *Plantago lanceolata* species:

- infusion: 1.4 gm herb in 150 ml of boiling water for 15-10 minutes in a closed container; 3-4 times a day.
- Fluid extract (1:1 gm / ml): 1.4 ml; three to four times a day.
- Tincture (5:1 gm / ml): 7 ml; three to four times a day²⁷.
- *Plantago ovata* and *Plantago psyllium* and *Plantago indica* Species:
- Seeds: 5-10 gm of seeds, two to three times a day. World Health Organization has recommended an average dose of 7.5 gm of seeds dissolved in 240 ml of water or juice, one to three times a day. For children aged 6-12 yrs the dosage is half the adult's dosage¹⁸.
- Seed husk: 4-5 gm, one to four times a day. The seed husk must be soaked in 150 ml of warm water for several hours before consumption²⁸.
- Seed husk powder: 4-5 gm, one to four times a day. The powdered seed husk must be stirred in 150 ml water and be drunk immediately; after consumption, a large amount of water should be consumed²⁸.

Table 1—Summarized the medical effect of *Plantago*

Research	The part of usage of the plant	The effective material in the plant	Medical uses
Srivastava <i>et al.</i> (15)			Cancer
Kuhn <i>et al.</i> (20)	leaves and roots		sore throat, dry cough, stomach irritation, boils and ulcers
Samuelson (5)	leaves	Terpenoids, Flavonoids, alkaloids	preventing tumor formation, healing wounds and infections,
Souri <i>et al.</i> (6)		phenolic compounds	Antioxidant , anti-inflammatory, hematopoiesis effects, protects the liver
Pourmorad <i>et al.</i> (7)		phenolic compounds	Antioxidant , anti-inflammatory, hematopoiesis effects, protects the liver
Boskabady <i>et al.</i> (21)		ethanol	reduction in the number of cough
Galvez <i>et al.</i> (16)		Luteolin- 7-O- β -glucoside	inhibitory effects on breast adenocarcinoma
Galvez <i>et al.</i> (16)	leaves and inflorescences	methanol	Inhibitory effects on the layers of human adenocarcinoma cancer cells
Bürger <i>et al.</i> (26)	Roots, leaves and seeds		blood purifier, alleviate wet asthma, diarrhea, and swelling of the oral mucosa.
Bürger <i>et al.</i> (26)	seed		eliminate diarrhea and inflammations of the kidneys and bladder
Bürger <i>et al.</i> (26)	seed		anti-rheumatic and is used to sure dry coughs and fever
Riault M A <i>et al.</i> (8)		phenolic compounds	inhibition of DNA damage & against UV radiation
Kuhn M.A., <i>et al.</i> (17)	leaves and roots		bloody sputum, sore throat, diarrhea and dysentery

(B) Local

- Cold infusion: 1.4 gm of chopped herb in 150 ml of cold water, stirred for 1-2 hrs; use to wash and gargle, three to four times a day²⁷.

Side effects

Plantago consumption can also have side effects, including:

- Bloating, and gas^{18,19}.
- Allergic reactions including nettle rashes, anaphylactic reactions, and even bronchial obstruction in patients allergic to plant^{18,19}.

Drug Interactions

Plantago has Interactions with the following drugs:

- Carbamazepine, lithium, warfarin: decreased drug absorption^{18,19,29}.
- Iron supplements: decrease Iron absorption²⁹.
- Insulin: insulin dependent diabetics may need less insulin in case of using the plant^{18,19,29}.
- Minerals (calcium, magnesium, copper and zinc), vitamin B12, cardiac glycoside, coumarin derivatives: decreased drug absorption^{18,19,29}.

Conclusion

Recently, plantago has been studied in the medical field. Plantago has some useful effects in the medical sciences. It has different compounds such as phenolic compounds, flavonoids, alkaloids, terpenoids, and vitamin C. So, plantago has antioxidant, anti-inflammatory and hematopoiesis effects. World health organization has approved using plantago compound for treating constipation, hypercholesterolemia and high blood glucose.

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