

A brief review on bioactive compounds in *Parkinsonia aculeata* plant

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ABSTRACT

Bioactive fractions of the medicinal and food plants have been used by varied human cultures since primitive times. These plants give multiple health benefits because of the presence of a large number of bioactive phytochemicals. The phytochemicals including phenylpropanoids, isoprenoids, phenolic compounds, flavonoids, carotenoids, alkaloids, sulphated compounds, peptides and polysaccharides that are responsible for various biological activities such as anticancer, antioxidant, antifungal, antibacterial, anti-dysenteric, anti-inflammatory, antiulcer, anti-hypertensive and anticoagulant properties. Some species have exhibited health-promoting effects and have been used as traditional foods and herbal remedies, though a limited information has been documented on their specific biological properties. Furthermore, medicinal plants are low cost and tend to have fewer side effects than synthetic drugs. Therefore, this survey aimed at reviewing the.

Key words: Bioactive, *Parkinsonia aculeata*.

I. INTRODUCTION

In recent year, the presence of enormous amount of bioactive compound in herbs have been found, these bioactive compounds can be found in any part of a plant or plant product, including leaves, stems, flowers, roots, and seeds.^{1, 2} These compounds are related to various beneficial effects on human health such as herbal medicine which are also called botanical medicine or phyto medicine³. There are 2,50,000 higher plant species on earth, more than 80,000 species are reported to have at least some medicinal value and around 5000 species have specific therapeutic value.⁴ Herbal medicines are used as primary health care because of better cultural acceptability, better compatibility with the human body and lesser side effects.⁵ Ancient literature also mentions herbal medicines for age-related diseases namely memory loss, osteoporosis, diabetic wounds, immune and liver disorders, etc.⁶ In India, the collection and processing of medicinal plants and plant products

contributes a major part each year to the national economy, as a source of both full and part time employment.⁷ India is one of the largest producers of fruits and vegetables in the world. These are rich sources of bioactive compounds which provide health benefits and also possess antioxidant therapeutic value. A large portion of fruits and vegetables goes unutilized in the form of pulp and peels after the extraction of juice in food processing industries. This contains a large number of bioactive compounds. Currently, people of Asia and India are utilizing plants as part of their routine health management.⁸

Herbal medicines have become more popular in the treatment of many diseases due to the popular belief, that green medicine is safe, easily available and with fewer side effects. Indeed, the market and public demand has been so great that there is a great risk that many medicinal plants today, face either extinction or loss of genetic diversity.⁹ India has several traditional medical systems, such as Ayurveda and Unani, which has survived through more than 3000 years, mainly using plant-based drugs.¹⁰

These plants can either be sold raw or as extracts, where the plant is macerated with water, alcohol, or other solvents to extract some of the chemicals. The resulting products contain fatty acids, sterols, alkaloids, flavonoids, glycosides, saponins, and other constituents.² The healing property of medicinal plants is usually linked with the presence of secondary metabolites and these differ from one plant to another.¹¹ It is worth mentioning that Indian medicinal plants are considered as a vast source of several pharmacologically principles that are commonly used as home remedies against multiple ailments.¹² It is estimated that more than 800 plant species have hypoglycemic activity^{13, 14} and more than 450 plants have been experimentally tested.¹⁵ Traditional herbal medicines are getting significant attention in global health debates.¹⁶

Medicinal plants are also found to contain a variety of phytochemicals as well as minerals,

vitamins and trace elements. Some of the phytochemicals are pharmacologically active and can exert a therapeutic action on the body.¹⁷ now days; flavonoids are becoming the interest of medical research. They have been reported to possess many useful properties, including anti-inflammatory activity, oestrogenic activity, enzyme inhibition, antimicrobial activity, antiallergic activity, antioxidant activity, vascular activity and cytotoxic antitumour activity. Plants are rich in a variety of secondary metabolites and aromatic substances, most of which are phenols or their oxygen-substituted derivatives such as tannins. Natural therapies, such as the use of the plants or plant derived natural products have become a revolutionary change in the treatment of cancer, which is a major public health problem in both developed and developing countries. Herbal medicines are proved to be beneficial to life threatening disease like cancer because synthetic drugs despite of curing disease also enhances the chances of side effects. Thus expectations from herbal drugs are growing³⁰ with every new discovery in herbal medicines. More than 60% of cancer therapeutics on the market or in testing is based on natural products these days. Near about 177 drugs have been approved worldwide for treatment of cancer.¹⁸

The World Health Organization also participated in creating awareness regarding the importance of herbal medicines to many of its member states and completely supports the use of medicinal plants and their products.¹⁹ The development of medicinal plants into therapeutic drugs takes several years and millions of dollars are needed, hence making the process very capital-intensive, the risks are also high and the success rate are not very good. All these issues have increased the interest of researchers in this field to meet the challenges of identifying the active compounds in the plants, and there should be

research-based evidence on whether whole herbs or extracted compounds are better. The use of new technologies, such as nanotechnology and novel emulsification methods, in the formulation of herbal products, will likely affect bioavailability and the efficacy of herbal components. Smart screening methods and metabolic engineering offer exciting technologies for new natural product drug discovery. Advances in rapid genetic sequencing, coupled with manipulation of biosynthetic pathways, may provide a vast resource for the future discovery of pharmaceutical agents. This can lead to reinvestigation of some agents that failed earlier trials and can be restudied and redesigned using new technologies to determine whether they can be modified for better efficacy and fewer side effects.²⁰ Herbal drug marketing should assure that the buying of these products are safe and contain specific herbal component. Consumers should also be given science-based information on dosage, contraindications, and efficacy. To achieve this, global harmonization of legislation is needed to guide then responsible production and marketing of herbal medicines. If sufficient scientific evidence of benefit is available for an herb so that these benefits can be realized for the promotion of public health and the treatment of disease.²¹

Parkinsonia aculeata

Parkinsonia aculeata is a small, spiny shrub, 4-10 m high with a short and often crooked trunk up to 40 cm in diameter, spreading branches near the ground and very thin drooping foliage; although appears leafless after leaflets fall; twigs are slender, bark of trunk, branches and twigs smooth, slightly zigzag, yellow-green or blue-green and slightly bitter, 2 short node sat nodes.²² It is a tree that grow in little water with full sun, tolerates alkaline soils and itself freely reseed.²³ Twigs have green bark, spreading, graceful, sometimes weeping, crown to 20 ft (6.1 m) wide.²⁴



Figure 1: leaves of *Parkinsonia aculeata* plant

Leaves are bipinnate, 10-40cm long; with 60-160 oblong alternate leaflets 3-8mm long.²⁵ At the end of the leaf axis larger spine (1 to 2 cm long) are present.²⁶ Leaves are appear shortly after rain, they fold up at night within a few days the tiny leaflets drop off.²⁴ Flowers are yellow-orange and fragrant. At leaf bases flower clusters 7.5-20 m long, unbranched, slender stalks, slightly pea shaped and irregular.²² flowers consisting calyx, a short tube with 5 narrow yellow- brown lobes turned back and corolla 10-13mm long.²⁶ Nearly round petals, pink spots in upper petal.²⁷ A flower consist of 10 green stamens with brown anthers, a single celled ovary and reddish tinged hairy pistil. Root are the bright green branch let's have a thin zigzag pattern, with sharp, woody spines along the stems. Bark is smooth and yellow green, and the same color branches and twigs are present.²⁸ Fruits are light brown when mature, leathery in appearance.²⁹ Seeds are 1-5 in number, dark brown in color, 1 cm long, oblong in shape.²⁸ seeds are oval and hard. Pods are green to pale brown, 5-10 cm long with small constrictions.³⁰

Taxonomy³¹

Empire- Eukaryota

Kingdom- plantae

Division- Magnoliophyta

Class – Magnoliopsida

Order- Fabales

Family-Fabaceae

Genus- Parkinsonia

Species- aculeate

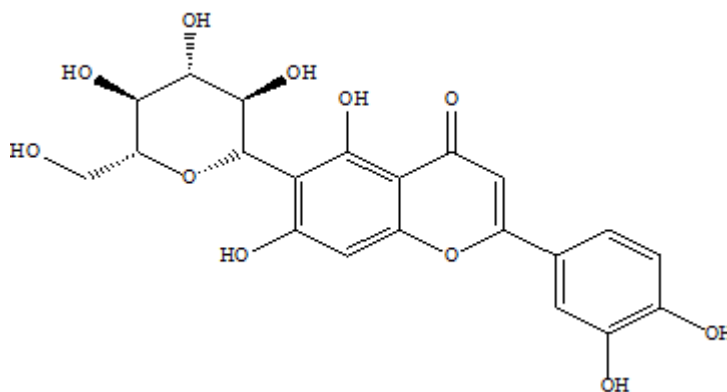
Bioactive Phytochemical Constituents

Bioactive compounds including polyphenols, carotenoids, vitamins, omega-3 fatty acids, organic acids, nucleosides and nucleotides, and phytosterols have attracted great attention due to their role in prevention of several chronic

diseases. Hanan M. Al Yousef et al.; revealed that phenolic compounds, flavonoids, and anthocyanins were identified in hydroalcoholic extract, dichloromethane, and ethyl acetate fractions of *P. aculeata* L. aerial parts using UPLC-ESI-MS/MS analysis. The ethyl acetate fraction of *P. aculeata* L. showed significant in vitro antioxidant and cytotoxic activities compared to the other tested fractions (total hydroalcoholic extract and the dichloromethane fraction). These activities might be attributed to its contents of phenolic compounds (such as coumaric acid and cinnamoyl galloyl glucose) and polyhydroxylated flavonoids (such as chrysoeriol-7-O-glucoside; luteolin-7-O-[6-O'-dihydrogalloyl]-glucosyl-8-C-pentosyl-(1'2)-glucoside; 20'-O-rhamnosyl isoorientin; orientin; vitexin; quercetin hexoside; quercetin rhamnosyl hexoside; butin and homoplantagin) detected in this fraction.³² α -Amyrin acetate, 6-Hydroxypentacosylpentanoate, 1-Cyclohexyltridec-1-ene.

R.M. Sujin et al., retorted that Isovitexin, leucenin-II, vicenin-II, apigenin, luteolin, kaempferol, chrysoeriol, diosmotin-6- β -glucoside, a new flavanone, parkintin with epoxy isopentyl moiety and permethylated 5-C-hexo-sylluteolin.³³

V.K. Bhatia et al., reported that the three c-glycosides have been found in leaves of *Parkinsonia aculeata*. Preparative paper chromatography was found effective for the separation of all three, Two could be separated after preliminary lead salt purification by fractional crystallization. The first (epi-orientin), second (parkinsonin-A), third (parkinsonin -B) are C-glucoside of luteolin are epimer of orientin, 5-o-methyl luteolin is closely related to orientin, 5,7-di-O-methyl luteolin has stereochemistry related to epi-orientin.³⁴



Orientin

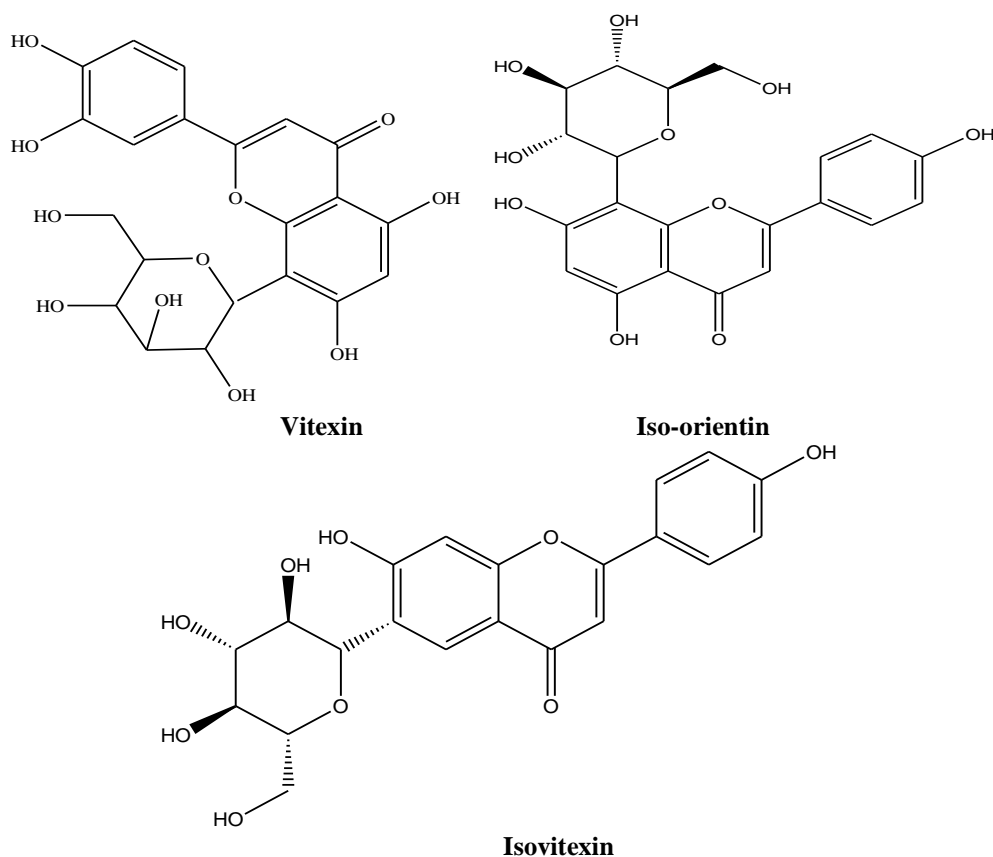


Figure 1: Chemical structure of some selected bioactive compound from *Parkinsonia aculeata*

John N. Aronson et al., N- acylamino acid aminoacylase enzyme was isolated from within cotyledons and embryo the seeds of Palo Verde (*Parkinsonia aculeata*).³⁵ E.Besson et al., C-glycosylflavones isolated from *Parkinsonia aculeata* leaves were identified as orientin, isoorientin, vitexin and isovitexin. Orientin was present in levorotatory form.³⁶ Nabil.H.El-Sayed et al., Luteolin 7,4'-Dimethyl ether 6-c -glucoside are isolated from aerial part of *Parkinsonia aculeata*. A novel flavone glycoside scutellarein-7-O-rutinoside along with two known compounds i.e. tricetin-7-β-L-arabinoside and lupeol were isolated from the flowers.³⁷ N. J. Marobhe et al., reported the purification method of coagulant protein from *Parkinsonia aculeata* seeds by ion exchange chromatography.³⁸ Marzouk, M.S et.al., isolated five novel macrocyclic monoterpene O-glycosides, and eleven known phenolic metabolites including three 3-O-glycosylflavonols, five C-glycosylflavones, p-hydroxybenzoic acid, esculetin, and diosmetin from the leaves and small twigs of *Parkinsonia aculeata* L.³⁹

Food bioactive compounds are extra nutritional constituents that typically occur in small quantities in foods. They are being intensively studied to evaluate their effects on health. Many bioactive compounds have been discovered. These compounds vary widely in chemical structure and function and are grouped accordingly. Phenolic compounds, including different subcategories, are present in all plants and have been studied extensively in cereals, legumes, nuts, olive oil, vegetables, fruits, tea, and red wine. Other bioactive compounds, including carotenoids and organosulfur compounds have antioxidant properties. Some studies have demonstrated favorable effects on different diseases such as antioxidant properties. Other studies have also shown favorable effects on disease risk factors, and in animal and cell culture models.

The health benefits deriving from the consumption of certain foods have been common knowledge since ancient times. At present, numerous research papers have been focused on the beneficial role played by certain food components in the close relationship between food intake and health status. In this sense, many foods, including

fruits, vegetables, fish, seaweeds, herbs, etc., are known to be excellent sources of bioactive compounds. For instance, carotenoids, phenolic compounds, terpenoids, fatty acids, and saponins, among others. The development of new foods or nutraceuticals with health benefits is a current topic and represents an attractive opportunity for the food and/or pharmaceutical industries. <https://www.hindawi.com/journals/omcl/si/512748/>

The development of new foods or nutraceuticals with health benefits is a current topic today and represents an appealing opportunity for the food and/or pharmaceutical industries. However, this launch of new products should be endorsed by strong scientific support on the health benefits attributable to the intake of these bioactive food ingredients. To this end, enlightenment about the most suitable source of a specific bioactive compound is required. This study should include the most suitable sources of bioactive compounds, the development of the most sustainable extraction techniques, isolation, and also an accurate analysis of the bioactive compounds by using the most adequate techniques. Moreover, the biological activities of these compounds should be elucidated in vitro, in cells, and also in clinical trials. Studies focusing on changes during storage, the digestion process, intestinal absorption rates, bio accessibility, bioavailability, biological mechanisms of action, or bioactivity of their metabolites are also required to establish the real contribution of these compounds to the health status.⁴¹

BIOLOGICAL ACTIVITIES OF PARKINSONIA ACULEATA

Angothu, S et al., evaluated the antidiabetic potential of the water soluble fraction of aerial parts of Parkinsonia aculeata. The result showed that a significant reduction in serum and urinary glucose in alloxan-induced diabetic rats at a dose 125 or 250 mg/kg.⁴²

Leite, A.C.R et al., studied the role of hydroethanolic extract of aerial parts (HEPA) of Parkinsonia aculeata in normal and alloxan-induced diabetic rats. The results showed that the plant represent a good candidate for alternative and complementary medicine in the management of diabetes mellitus.⁴³ Saha, D et al., studied the antidiabetic activity of benzene, chloroform and ethanolic extracts of Parkinsonia aculeata bark. The result showed that the rats treated with chloroform extract at a dose of 500mg/kg body weight showed

maximum antidiabetic activity amongst the other extracts.⁴⁴

Kamba, A.S et al., studied the antimicrobial activity of crude ethanolic, petroleum ether and chloroform extracts of Parkinsonia aculeata leaves. These extracts were found to inhibit pseudomonas aeruginosa, streptococcus faecalis, staphylococcus aureus, escherichia coli, salmonella typhimurium and klebsiella sp. The minimum inhibitory concentrations (MIC) of the crude extracts were determined for the various organisms which ranged between 35 and 50 mg/ml while the minimum bactericidal concentration (MBC) ranged between 45 and 60 mg/ml. The MIC and BC is normally used to evaluate the efficacy of the agents such as antiseptics, disinfectants.⁴⁵ Shrivastava, R et al., reported that chloroform extract of Parkinsonia aculeata leaves showed maximum antibacterial activity against escherichia coli with zone of inhibition 23±0.02mm at concentration of 500mg/ml.⁴⁶ Gupta, M.K et al., studied the alcoholic and aqueous extracts of Parkinsonia aculeata Linn leaves. The rats and mice treated with extracts at a dose of 200 mg/kg body weight. The alcoholic extract showed significant analgesic, antipyretic and anti-inflammatory activity as compared to aqueous extract.⁴⁷ The analgesic, anti-inflammatory and antipyretic activity of total alcoholic and aqueous extract of P. aculeata Linn bark in mice and rats. Results showed that the alcoholic extract is significant analgesic, antipyretic and anti-inflammatory activity as compared to aqueous extract.⁴⁸ Hundekari, G.I et al., reported the anti-inflammatory effect of pet ether and aqueous leaf extract of Parkinsonia aculeata. Results showed that 16.66% and 10.71% inhibitory effect in Carrageenan and formalin induced rat paw edema at a dose 500mg/kg.⁴⁹ Gavaniya, M.G et al., evaluated methanolic extract of Parkinsonia aculeata (MPA) leaves for the treatment of rheumatoid arthritis (RA) using collagen-induced arthritis (CIA) animal model in rat. The results showed that treatment with MPA markedly reduced paw swelling and arthritic.⁵⁰ Shah, V. N et al., studied in vitro and in vivo hepatoprotective activity of Parkinsonia aculeata leaf alcoholic and aqueous extracts. The result showed that the extract was found non toxic in animal (rats) at the dose of 2000 mg/kg which indicates the LD50 above 2000 mg/kg.⁵¹ Hundekari, G.I et al., concluded that pet ether and methanolic extracts of Parkinsonia aculeata leaves showed the strong hepatoprotective effect compared with standard drug.⁵²

Singh, P et al ., reported that *P. aculeata* leaf extract is a rich source of natural antioxidant that can be important in disease prevention. Results showed that the phytochemical properties of the leaves can be used for curing various diseases.⁵³ Sharma, R.K et al ., reported that methanolic extract of the stem bark of *Parkinsonia aculeata* L.can successfully scavenge various reactivity oxygen species/ free radicals under in vitro conditions.⁵⁴ Singh, P et al., concluded that flavonoid from *P.aculeata* L. leaves have growth inhibitory and cytotoxic effects on mice melanoma cell lines.⁵⁵ The in vitro antimutagenic and DNA protecting potential of organic (methanol, hexane, n-butanol) and aqueous extract/fractions of *Parkinsonia aculeata* L. (Fabaceae) was evaluated by Ames assay and DNA nicking assay. It is found that all the fractions and extract inhibited DNA damage by hydroxyl radicals. The study found that *Parkinsonia* effectively act as antimutagenic against 4-Nitro-o-phenylenediamine and sodium azide (direct acting mutagens) and 2-Aminofluorene (indirect acting mutagen) in TA98 and TA100 strains of *Salmonella typhimurium*.⁵⁶ The antifungal activity was evaluated by micro dilution assay on clinical isolates of different species of

Candida (*C. albicans*, *C. parapsilosis*, *C. tropicalis*, *C. krusei* and *C. glabrata*). *Parkinsonia* extract showed MIC values < 31.25µg/mL against at least one of the strains used.⁵⁷ The effects of Aqueous Extract of *Parkinsonia aculeata* Leaves on Kidney and Liver Function Indices in Albino Rats was studied and the results revealed that *P. Aculeata* leaves safe for the liver but toxic to the kidney and toxicity is dose-dependent. The extract is safe for the kidneys up to a dose of 1.20g/kg bodyweight, but can be toxic at doses above 1.80g/kg. Acute toxicity study showed that there was no mortality or behavioural changes at single dose of 3.00 g/kg bw up to 48 hours.⁵⁸ The antigenotoxic potential of *P. aculeata* L. leaf extract/fractions was investigated against maleic hydrazide (MH) using *Allium cepa* root chromosomal aberration assay. All extract/fractions found to increase in mitotic index and immensely reduction in chromosomal aberrations with increase in concentration against the genotoxicity of MH. It is reported that butanol and ethyl acetate fractions inhibits chromosomal aberrations in *A. cepa* cells and are chemo preventive.⁵⁹

Table1: Bioactive Phytochemicals with their medicinal uses and biological activities of different parts of *Parkinsonia aculeata*

Parts used	Bioactive compounds	Medicinal uses	Biological activities
Stem	Glycerol β-butanoate & α-dipentanoate, β-sitosterol, glycerol, β-heptanoate κ-octanoate, β-sitosteryl-β-D-glucoside and Sucrose.	Decoction used in treatment of fever, malaria and abortifacient	Antispermato-genic activity
Leaf	C-glycosylflavones orientin, isoorientin , vitexin and isovitexin 3-O-glycosylflavonols, five phenolic metabolites C-glycosylflavones, p-hydroxybenzoic acid , esculetin , and diosmetin	Decoction used in treatment of fever, malaria and abortifacient. Alcoholic extract used as rheumatism.	Antidiabetic activity and Anti-malarial activity, Antibacterial activity, Antioxidant,
flower	Luteolin 7,4'-Dimethyl ether 6-	Alcoholic extract used as rheumatism.	Antidiabetic activity and Anti-malarial activity
Root	β-sitosterol		Antibacterial activity, Antioxidant, Amoebicidal activity

II. CONCLUSIONS

Medicinal plants have been used for thousands of years as food, feed and medicaments to treat and prevent various infectious and non-infectious diseases. Plants belonging to Fabaceae family have been used in traditional medicine for treating several disorders including urinary inflammation, hepatitis, chronic cutaneous diseases, jaundice, fever, skin burns, osteomyelitis, gallstones and as diuretic, laxative and anticancer agents. Therefore, in this survey, we collected the latest literature on bioactive of *Parkinsonia aculeata* that exhibited pharmacological activities and can be suggested as innovative food and feed.

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