

Study of Different Biological and Medicinal Properties of *Cajanus* *Cajanus* L.: A Review

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Submitted: 10-04-2022

Accepted: 28-04-2022

ABSTRACT

Cajanus *Cajanus* (L.) is also known as pigeon Pea in English, arhar in Hindi, adakhi in Sanskrit, and tur in Bengali. It is mostly used as a food crop and forage crop with a high level of proteins and important amino acids like lysine, methionine, and tryptophan also have other components. Such as flavones, isoflavones, and tannins which have important medicinal properties in treating different types of disease. Due to their properties, it is known as important food grains legume crop. Plant component showed various type of activity such as antioxidant activity, diabetic activity, antihypertensive, anti-inflammatory activity antihyperglycemic activity etc. This article gives an overview of the study of different biological and medicinal properties of *Cajanus* *Cajanus* extract.

Keywords: Protein, Medicinal Properties, Biological Properties, *Cajanus* *Cajanus* extract, Leave, Seed, antidiabetic, fiber, phytic acid.

I. INTRODUCTION

Cajanus *cajan* [(L.) millspaugh] is also called pigeon pea and Arhar. It is a perennial legume (subfamily papilionoideae) from the family leguminosae, and it is also called red gram, no eye pea, congo pea, gungo pea. The pigeon pea was propagated in the Indian subcontinent from 300 to 500 years ago. Pigeon pea seeds are used as a public food in Asia Latin America and Africa and are the major source of protein all over the world.[1] production of Pigeon pea ranks only six in area as compared with other grain legumes, but it is used in more diverse ways than others. It is an important legume plant crop grown in many developing countries in the semi-arid tropical and subtropical region. Its leaves are used for rearing silkworms, green pods are used as a vegetable, and husk green leaves and tops are used as fodder and also as green manure. Pigeon pea contains a high amount of protein in seeds, and it is a multipurpose plant. The extract component of pigeon pea

commonly used for the management of diabetes, hepatitis, measles, dysentery, and as a febrifuge to stabilize the menstrual period in all over the world. As a traditional medicine, leaves of the pigeon pea have been widely used to arrest blood, kill worms and relieve pain. Nowadays, leaves of *Cajanus* *Cajanus* used in the management of various problems such as wounds, bedsores, and malaria, as well as diet-induced hypercholesterolemia, etc.[2]

Some protective effect of pigeon pea leaf extract has been reported against hyper-ischemic brain damage and alcohol-induced liver damage. Different investigations have indicated that leaves of pigeon pea are rich in flavonoids and stilbenes chemical constituent, which are responsible for the beneficial efficacies of pigeon pea leaves on human health.[3]

Pigeon pea is a legume crop that produces more nitrogen per unit of plant biomass than other legumes, and this valuable legume can be tolerated by poor soil and dry weather conditions.[4]

Cajanus *Cajanus* (L.) Millsp is commonly known as pigeon pea or Congo pea. It has been used to achieve the need for food (dry pulse, green vegetable), forage, feed, and therapeutic activity. Different parts of pigeon pea (seeds, leaves, roots) have been used as an important part of food traditional medicine as a therapeutics in India, China, and South America. *Cajanus* *cajan* leaves have a high amount of flavonoids, stilbenes, saponins and alkaloids. Pigeon pea roots have antioxidant properties due to genistin and Genistein Isoflavonoids. *Cajanol* is an isoflavanone has anticancer activity. Various essential compounds present in pigeon pea leaves include orientin, vitexin, *cajaninstilbene* acid, and pinostrobin which have antioxidant properties. Methanolic extracts of *C. Cajanus* have hepatoprotective potential on CCl₄ including hepatotoxicity.[5]



Fig: Leaves of Cajanus Cajan

HEALTH BENEFIT OF DIFFERENT PART OF CAJANUS CAJAN PLANT

Leaves

Pigeon pea leaves contain a high amount of flavonoids. There are six flavones, two isoflavones, two flavonol, two flavonones, an isoflavonones and the single chalcone. Flavones are only recorded in the leaves of pigeon pea which is likely linked with their role in photo protection against UV radiation. Orientin (18.82mg/g) and vitexin (21.03mg/g) are the most abundant flavonoids reported in pigeon pea.[6]

There are two Isoflavones biochanin A and formononetin (also known as biochanin B) are reported from leaves.[7] Isoflavonoids are an important component in plant defense reported as phytoalexins. Pinostrobin chalcone is the single chalcone found in pigeon pea leaves which were challenged with the narcotic fungus *Botrytis cinerea* and it is also hypothesized to play a role in photoprotection.[8]

A new natural coumarin cajanuslactone has been isolated from the leaves of *Cajanus cajan* which is a potential antibacterial agent against gram positive microorganisms. Three stilbenes, cajanin, longistylin C, and longistylin A, forms have been found in leaves that have hypocholesterolemic effects.[9]

Penstrobin, a substituted Flavanone isolated from leaves which inhibits sodium channel activated depolarization of mouse brain synaptoneuroosomes and have anti-inflammatory activity.[10] Pinostrobin, cajaninstilbene acid, vitexin, and orientin isolated from ethanolic extract of leaves also show antioxidant properties.[11] Isoflavones is isolated from Ethanolic extract of leaves and also has significant antimicrobial activities.[12] Some protein fractions isolated from leaves also showed hepatoprotective effects and the presence of phenolic (flavonoids and tannins) impart anthelmintic activity.[13]



Fig: Seeds of Cajanus cajan

Seeds

Pigeon pea is a good source of fiber, protein, and minerals which make it a good candidate for the production of protein and fiber-fortified foods. There are different types of protein present in pigeon pea pulse seeds in the form of storage proteins like globulin, albumin, and glutelins.[14] Globulin (approximately 70 % of total protein in pulse) soluble in salt water solution, albumin (approximately 10-20% of the total protein in pulse) soluble in water, glutelins (approximately 10-20% of the total protein in pulse) soluble in dilute acid. Globulins exhibit significant antihyperglycemic activity in selected cucurbitaceae seeds.[15]

Some type of other compound are also present in pigeon pea pulses like carbohydrates (non-starch polysaccharides and starch) about 55% to 65% in dry matter.[16] Lugslems contain a large amount of starch and fibers that are resistant to

digestion in the small intestine and pass into the large intestine for bacteria fermentation producing short-chain fatty acids.[17] Non-starch polysaccharides in pulses are reported with various health benefits including gut health, colon cancer prevention, anticancer and ant-inflammation effects, etc.[18]

Other than the major component such as protein and carbohydrates, there are some minor constituents in pigeon pea exhibiting bioactive effect as a phytochemical. Phytochemicals are chemical that is produced by plants through primary or secondary metabolism.[19] The minor constituents in the pulse-like phenolic compound, enzyme inhibitor, and lectins, fatty acids phytosterols, phytic acid, and saponins are present as anti-nutrients (such as tannins, saponins, and phytic acids) found with health-promoting activity.[20]

Table: 1 Different Constituents Present in Mature Seeds of Cajanus Cajan

| Constituents | Mature Seeds |
|----------------------------|--------------|
| Amino Acid (g/100g) | |
| Tryptophan | 0.212 |
| Threonine | 0.767 |
| Isoleucine | 0.785 |
| Cysteine | 0.25 |
| Vitamins (mg/100g) | |
| Thiamine | 0.643 |
| Riboflavin | 0.187 |
| Niacin | 2.965 |
| Vitamin B-6 | |
| Nutrients (g/100g) | |
| Carbohydrates | 62.78 |
| Protein | 21.7 |
| Dietary fibers | 15 |
| Total lipid | 1.49 |
| Minerals (mg/100g) | |
| Ca | 130 |
| Fe | 5.23 |
| Mg | 183 |
| P | 367 |
| Na | 17 |
| K | 1392 |
| Zn | 2.76 |

Phenolic compounds are one of the most contributors to the antioxidant activities in plants which protect the body against the damaging effects of free radicals by neutralizing them via donating one of the electrons.[21]

Flavonoids provide color to most of the flowers, fruit and seeds and they protect against different types of diseases related to free radicals.[22] There are a total of 27 flavonoids present in the whole pigeon pea plant containing six flavones, eight isoflavones, four Flavonols, two

anthocyanins, three Flavanones, three isoflavones, and a single chalcon.[23] Two unidentified isoprenylated flavones are tested positively in soaked, sliced, and incubated conditions pigeon pea seeds and these phytochemicals shows different activity like antimicrobials, antioxidants, antifungal, etc.[24,25]

Phytic acids are the major phosphorus compound in pulses located in the protein bodies in the endosperms. Myoinositol hexakisphate (Ip6) and phytic acid are soluble in sodium or potassium salts known as phytates, these are present in many seed plant [26]. Phytic acid prevents kidney stones, delays postprandial glucose absorption, reduces the bio-accessibility of toxic heavy metals, and has antioxidant activity by chelating iron and

cooper.[27] High fiber food with phytic acid have a shielding effect against cancer and heart disease.[28] The dietary phytic acid may help in lowering the occurrence of colonic cancer and has defends against other inflammatory bowel diseases.[29] Phytic acid contributes 66-75% of phosphorous in pigeon pea.[30]

Saponins are low molecular weight plant glycosides, reported in many edible legumes and little is known about detailed structures. Chemically, saponin has a part of carbohydrate attached to a triterpenoid or steroids, known as sapogenins. [31] Saponins are also reported for the anti-hyper-cholesterol, cardiac depressant, and anti-inflammation and it also shows the activity against cancer and lowers the blood glucose level.[32-33]

Table: 2 Biological Activity of Cajanus Cajan with Their Respective Active Constituents.

| Sr. No. | Plant Parts | Active constituents | Activity |
|---------|-------------|--|--|
| 1. | Leaf | Cajanuslactone (Coumarin) | Antibacterial Activity |
| | | Cajandin, Longistylin C, Longistylin A | Hypocholesteremic Activity Antiplasmodial |
| | | Pinostrobin | Anti-inflammatory, neuroactive, Antioxidant, Antimicrobial |
| | | Cajandin, Stilbene acid Orientin, Vitexin | Antioxidant, Antimicrobial |
| | | Protein fraction Cl-1 | Hepatoprotective |
| 2. | Root | Betulinic Acid | Antiplasmodial |
| | | Genistein, Genistin | Antioxidant |
| | | Cajanol (Isoflavonoids) | Anticancer |
| 3. | Aerial part | Phenolic (flavonoids and Tannins) | Anthelmintic |
| 4. | Seed | Cajanol | Antioxidant |
| | | Cajandin, Isoprenylated flavones | Anticancer |

MEDICINAL PROPERTIES OF PIGEON PEA

There are various parts of Cajanus Cajan that have been utilized for health benefits. There are several reports on the biological and pharmacological activity of Cajanus Cajan based on modern scientific investigations.

Antimicrobial activity

Synthesis and characterization of silver nanoparticles and their antimicrobial effect on Bacteria were investigated by using leaf extract of Cajanus Cajan. Silver nanoparticles are prepared by green synthesis process from 1 mM AgNO3 solution and characterization was carried out by UV Visible spectrometer, FTIR, SEM, and high

resolution transmission electron microscopy (HRTEM) revealed the spherical structure of nanoparticles and average particles size in between 5 to 60 nm and antibacterial activity carried out for gram +ve (Staphylococcus aureus) and gram -ve (E. Coil) bacteria and compared with the standard antibiotic ampicillin. [34]

In-vitro antimicrobial activity of cajanuslactone (a new coumarin) was investigated against gram +ve and gram -ve microorganism and found good minimum inhibitory concentration, minimum bactericidal concentration, and good activity against staphylococcus aureus and found that the leaf part of pigeon pea is an excellent source of antibacterial material and cajanuslactone

is a potent antibacterial against gram +ve microorganisms. [35]

Solvent-free microwave extraction of essential oil from pigeon pea leaves (*Cajanus Cajan*) and evaluation of its microbial activity were evaluated by Qi Xiao-lin, Li Ting-Ting in 2014 and find out that the essential oil showed strong antimicrobial activity against *Bacillus Subtilis* and *Propionibacterium acnes* with MIC and MBC value 1.06mg/ml and 2.123mg/ml, 0.1mg/ml and 0.26mg/ml. The essential oil was a potential source of natural antimicrobial. [36]

Leaf extract of *Cajanus cajan* L. extracted for antibacterial activity in various organic solvents such as pet ether, chloroform, methanol, ethanol, and aqueous, tested against *Bacillus Subtilis*, *Staphylococcus aureus*, *Streptococcus Pneumonia*, etc. by agar diffusion method. The minimum inhibitory concentration (MIC) of the extract was in the range of 12.5-75mg/ml.[37]

Antioxidants activity

The antioxidant activity of extract and the main component of pigeon pea (*Cajanus Cajan* (L.) Millsp) leaves and the main four components were separated from ethanol extraction and examined by DPPH radical-scavenging assay and β linoleic acid test. Among the four fractions, the ethyl acetate one showed the highest scavenging activity with an IC50 value of 194-98 μ g/ml. [38, 39]

Hepatoprotective Activity

The hydroalcoholic extract of *Cajanus Cajan* is tested for hepatoprotective activity against the Wistar rat with liver damage induced by carbon tetrachloride (CCl4). This test found that *Cajanus Cajan* has a protective effect on liver damage injury by reduction of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) and increasing initial protein. [40]

Antidiabetic activity

The methanolic leave extract of *Cajanus Cajan* (L.) was studied for diabetic activity in oral glucose-loaded rats. Acute toxicity and lethality (LD50) and the phytochemical analysis of extract were evaluated and find out that the extract reduced fasting blood sugar of alloxan diabetic rats with maximum hypoglycemic effect at 4-6 hr. *Cajanus Cajan* leaves extract suppressed the peak postprandial rise in blood glucose of normal rats by 101.8 and 57.40%. The result indicates that the leaves of *Cajanus Cajan* may be beneficial as an antidiabetic therapy.[41]

Antihyperglycemic activity of methanolic extract of *Cajanus Cajan* (L.) Millsp. Leaves and roots were treated on albino mice. The root of the

cajanus cajan contains a-amyrin, genistin, and lupeol, and, a-amyrin show an antihyperglycemic effect, Genistein induced proliferation of pancreatic b-cells and lowers the Blood glucose level. Leave extract to inhibit the absorption of glucose in the gut, thus reducing the presence of glucose in serum.[42]

Hypocholesterolemic Activity

The hypocholesterolemic effect of stilbenes containing extract fraction from *Cajanus Cajan* was observed on diet-induced hypercholesterolemia in kunming mice. The stilbenes containing extract fraction from *Cajanus Cajan* L. show the reduction of serum LDL cholesterol and increased the activity of serum superoxide dismutase. HMG-COA reductase, CYP7A, and LDL-receptor enhanced with stilbenes containing extract fraction of Hypocholesterolemic *Cajan*. The SECC reduced the atherogenic properties of dietary cholesterol and increase the hypocholesterolemic effect and also enhanced the hepatic LDL receptor and cholesterol 7 alpha-hydroxylase level and bile acid synthesis. [43]

Antiviral Activity

Antiviral Effect of ethanolic extract of *Cajanus Cajan* on embryonated chicken eggs and tissue culture was carried out and found that all concentration of *Cajanus Cajan* extract lower the virus concentration and this was indicated by hem-agglutination (HA) titration and *Cajanus Cajan* treat some viral disease. [44]

II. CONCLUSION

Cajanus Cajan is a rich source of protein and fro rage crop, and is widely cultivated in different regions in India. Due to its medicinal properties, it is traditionally used in many areas of the world, but still, its identity is not established as a medicinal plant.

Cajanus Cajan has several flavonoids, tannins, isoflavones, and proteins fraction in its different parts, its medicinal use has been established and some other pure compounds have been neglected by the researchers. Several works have been done only on extraction but isolation fractions show further study.

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