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# A REVIEW ON PHARMACOLOGY AND PHYTOCHEMISTRY OF *CAJANUS CAJAN*

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## ABSTRACT

Medicinal plants are store house of various types of phytochemicals and considered as a potential therapeutic remedy for numerous ailment. To encourage a disease free healthy life Mother Nature has gifted mankind medicinal plants. The world craves new ideas and looks to the Far East and Asia for inspiration and innovation. There is a wealth of technical data to support the safe use of this plant and this review will produce the data to justify the use of this plant in a wide range in the field of ayurveda. The cajanus cajan belongs to the family Fabaceae (or Leguminosae).The results showed the presence of bioactive constituents of alkaloids, flavonoids, tannins, saponins, and terpenes. Phlobatannins, anthraquinones and sterols were not detected. This review article gives an overview on the biological activities of the compounds isolated, pharmacological actions and clinical studies of *C. cajan* extracts. The present review has been primed to describe the existing data on the information on traditional and medicinal use of the Cajanus cajan plant.

**KEYWORDS:** Cajanus cajan, Ayurveda, Medicinal plants.

## 1. INTRODUCTION

In the history of human ancestry plants have been used for human being owing to various medicinal properties even in modern time have formed many pharmaceuticals on the basis of plant and plant materials.[1-3] It produces a vast amount of secondary metabolites as defence against environmental stress and other factors like pest control, wound and injuries.[4-6] In case of human being pathogenic bacteria have always been suggested as one of the major cause of various diseases.[7] Worldwide drug resistance is now a matter of great concern, although pharmaceutical company has continuously generated in various types of antibacterial agents.[8] Search of new drugs is an increasing incidence in many researches due

to the adverse side effect associated with conventional drugs, resistant to antibiotics and to combat the multi-resistant microorganism.[9-12]

## PLANT INTRODUCTION

The Leguminous plants are belonging to the family Fabaceae (or Leguminosae). The fruits of these leguminous plants are called legumes. Some of the well known examples of legumes include alfalfa, clover, peas, beans, lentils, lupins, menquite, carob, soy and peanuts. Legume plants are notable for their ability to fix atmospheric nitrogen, they have the symbiotic relationship with bacteria (rhizobia) found in the root nodules of these plants.

The ability to form this mutualism reduces the fertilizer costs for farmers and gardeners who grow legumes, and allows it to be used in a crop rotation to replenish soil that has been depleted of nitrogen. The nitrogen fixation ability of legumes is enhanced by the availability of calcium in the soil and reduced by the presence of ample nitrogen.

**Fig 1: Root of the *Cajanus cajan* with nodules.**

Legume seed and foliage have comparatively higher protein content when compared with the non-legum material, probably due to the additional nitrogen that legumes receive through nitrogen - fixation symbiosis. The high protein content of these leguminous plants makes them desirable crops in agriculture. Legume seed coats, commonly referred to as hulls, are rich sources of polyphenolics and natural antioxidants.[13] The legume seed coats have been extensively investigated, both from their beneficial physiological effects in humans and deleterious effects in animal nutrition.

**Fig. 2: Flowers of the *Cajanus cajan.***

*Cajanus cajan* is commonly called as Pigeon pea in English. This is a leguminous plant belonging to the family Leguminosae-Fabaceae. It is originated from Asia to East Africa and covered America around 3000 years ago. Pigeon peas are used as both a food crop (dried peas, flour, or green vegetable peas) and a forage/cover crop. They contain higher levels of proteins and the important amino acids like methionine, lysine and tryptophan, in combination with cereals, pigeon peas make a well-balanced human food. The dried peas may be sprouted briefly, and then cooked, for a flavour different from the green or dried peas. Sprouting is the process which enhances the digestibility of dried pigeon peas via the reduction of indigestible sugars that would otherwise remain in the cooked dried peas. Various works has been done on this plant as reported. But the bulk of the work was done on the seeds.

**Fig. 3: *Cajanus cajan* plant and seeds of the *Cajanus cajan.***

The *Cajanus cajan* has been locally used for the treatment of various diseases like small pox, chicken pox, diuretic. The *Cajanus cajan* can also be used as haemostatic and astringent.[14]

The extracts or components of pigeon pea are commonly used all over the world for the treatment of diabetes, dysentery and also for treating hepatitis.[15]

Now days, the leaves of the *Cajanus cajan* were used for the treatment of wounds, bedsores and malaria as well as diet-induced hypercholesterolemia's also treated.[16-17] Chemical constituent's investigations have revealed that the parts of the pigeon pea plants are rich in flavonoids, stilbenes which are considered responsible for the beneficiaries of the leaves on human health.[18-19] However, although there are many reported folkloric claims on the medicinal usefulness of this plant and some research reports on the seed. The purpose of this work therefore was to establish and thus report the phytochemical constituents and medicinal properties of the seeds.

## 2. SCIENTIFIC CLASSIFICATION

Kingdom: Plantae
Subkingdom: Tracheobiota (Vascular plants)
Superdivision: Spermatophyta (Seed plants)
Division: Magnoliophyta (Flowering plants)
Class: Magnoliopsida (Dicotyledons)
Sub class: Rosidae
Order: Fabales
Family: Fabaceae
Genus: Cajanus adans
Species: Cajanus cajan.

## 3. SEEDS

Seeds are round or lens shaped, the colour of the seed coat varies from dirty white to silver white, light brown to chestnut brown, dark mottled brown and pinkish black, and the cotyledons are yellow coloured. The seed is orthodox and can be stored for long term under frozen condition. The seed coat colour is relatively trivial character, but it is a consistent feature of pigeon pea.

**Table No: 1 Nutrient composition in green seed, mature seed, and dhal of pigeonpea.[25]**

| CONSTITUENTS | GREEN SEED | MATURE SEED | DAL |
|---|---|---|---|
| Proteins (%) | 21.0 | 18.8 | 24.6 |
| Protein digestability | 66.8 | 58.5 | 60.5 |
| Trypsin inhibitors (units $mg^{-1}$ | 2.8 | 9.9 | 13.5 |
| Soluble sugars (%) | 5.1 | 3.1 | 5.2 |
| Flatulence factors (g $100g^{-1}$ soluble sugars) | 10.3 | 53.5 | - |
| Crude fiber (%) | 8.2 | 6.6 | 1.2 |
| Fat (%) | 2.3 | 1.9 | 1.6 |

**Table No 2: Minerals And Trace Elements (mg $100g^{-1}$).**

| CONSTITUENTS | GREEN SEED | MATURE SEED | DAL |
|---|---|---|---|
| Calcium | 94.6 | 120.8 | 16.3 |
| Magnesium | 113.7 | 122.0 | 78.9 |
| Copper | 1.4 | 1.3 | 1.3 |
| Iron | 4.6 | 3.9 | 2.9 |
| Zinc | 2.5 | 2.3 | 3.0 |

**Figure No: 4 The figure shows the pictures of pigeon pea pods of various colours and sizes.**

## GEOGRAPHICAL SOURCE

The *Cajanus Cajan* has been cultivated in ancient Egypt, Africa and Asia since prehistoric times, and was later introduced to America. Now it is cultivated in several tropical countries.

The major producer is India contributing about 90% of world production. Its altitude range is 1250 m in Hawaii, 0-3000 m in India and Columbia. The plant is having the wide adaptability even though it is essentially a plant of the semidry lowlands.[20]

**CULTIVATION**

*C. cajan* thrives best in seed beds prepared by deep plaguing and cultivating to reduce weeds. It usually responds to phosphorus, and requires enough calcium, potash, and magnesium. It is sown in rows for inter-row cultivation and mechanical harvesting. It can be seeded in holes about 2 m apart. In India it is usually sown in alternate rows with sesame, in Malawi with maize and in Hawaii with forage grasses. Seedling is fairly slow to start and weeds should be controlled for the first two months of growth considerably improves its performance.[21]

**CHEMISTRY**

Chemical constituent investigations have indicated that *C. cajan* leaves are rich in flavonoids and stilbenes. They also contain saponins, conspicuous amount of tannins, and moderate quantities of reducing sugars, resins and terpenoids. Chemical studies reveal 2'-2' methyl cajanone, 2'-hydroxy genistein, isoflavones, cajanin cahanones etc., which impart antioxidant properties[22] Roots are also found to possess genistein and genistin. It also contains hexadecanoic acid, α amyrin, β-sitosterol, Pinostrobin, longistylin A and longistylin C which impart anticancer activity. Presence of cajanuslactone, a coumarin imparts antibacterial activity. The pinostrobin, vitexin and orientin are present in the plant which is responsible for antiplasmodic activity.

## 4. ALTERNATE NAMES

**Alternate Common Names**

- pigeon pea,
- Angola pea,
- Congo pea, dhal,
- no-eye pea,
- gungo pea, and
- red gram.

**Alternate Scientific Names**

- *Cajanus indicus* Spreng.
- *Cajanus flavus* DC.

- *Cytisus cajanus* L.

## 5. NUTRITIONAL COMPOSITION

Pigeon pea (*Cajanus cajan*) is a legume reported to contain 20-22% protein, 1.2 % fat, 65% carbohydrate and 3.8% ash. Legume seed show lower lipid content and are free of cholesterol In addition, they are found to possess different minerals and vitamins and are a good source of proteins and complex carbohydrates of all monogastrics.

Considering their therapeutic value for human beings, legumes are regarded as human controller to cardiovascular disease and diabetes.[23] It is significantly higher in sulphur-containing amino acids (cysteine and methionine) Pigeon pea is therefore a good source of amino acids. In pigeon pea methionine, cystine, tryptophan, and threonine are the limiting essential amino acids. It is a good source of crude fibre, iron (Fe), sulphur, calcium, potassium (K), manganese and water soluble vitamins especially thiamine, riboflavin, niacin. The mineral content and amino acid profile of pigeon pea compares closely with those of soybean except in methionine content. Pigeon pea contains more minerals, ten times more fat, five times more vitamin A and three times more vitamin C than ordinary peas.

## MEDICINAL USES

The medicinal uses of the *Cajanus Cajan* are as follows

- Roots: Anthelmintic, sedative, expectorant
- Leaves: Pulmonary conditions like cough, diarrhoea, haemorrhages and bronchitis
- Young leaves: Chewed to treat boils on tongue
- Boiled leaves: Sores and wounds
- Decoction of the plant: used as diuretic and laxative
- An enzyme called urease can be extracted from the plant which has various medicinal applications.

## 6. PHARMACOLOGICAL ACTIONS

### Anti- bacterial activity

**Md. Motiar Rahman, Md. Sahab Uddin et al** evaluated the antibacterial activity of the leaves extract of *Cajanus cajan* (*C. cajan*) L. against coliform bacteria collected from tannery, tobacco and sugar mill waste water. In this study fresh leaves of *C. cajan* was extracted by using ethyl acetate, chloroform and n Hexane. The antibacterial activity of these plant extracts was determined by measuring zone of inhibition (ZI) using the Agar disk

diffusion method and minimum inhibitory concentration (MIC) was determined by using the microbroth dilution method. Among three extracts highest (25±0.18 mm, ZI) antibacterial activity was reported by ethyl acetate extract of *C. cajan* leaves against coliform bacteria isolated from sugar mill waste water at the highest concentration with respect to chloroform and n-Hexane extracts. In addition, antibacterial activity was also higher for ethyl acetate extract against coliform bacteria isolated from tannery and tobacco waste water compared to remaining extracts. The MIC of the ethyl acetate extract ranged 550 to 570 µg/ ml. Therefore ethyl acetate extract of *C. cajan* leaves could be used as antibacterial agents against diseases caused by coliforms.

**Anti- diabetic activity**

**S Ariviani, D R Affandi et al** conducted a research using 18 Sprague Dawley male rats aged 3 months old with an average body weight of 154 g. The rats were divided into three groups: normal group, D-H group (diabetic-hypercholesterolemia group), and pigeon pea beverage group. The results showed that pigeon pea beverage diet showed hypoglycemic and hypocholesterolemic activities, and could improve the antioxidant status of diabetichypercholesterolemia rats. Plasma glucose and total cholesterol levels of diabetichypercholesterolemia rats decreased 33.86% and 19.78% respectively. The improvement of the plasma antioxidant status was indicated by the decrease of plasma MDA (malondialdehyde) level, reaching 37.16%. The research result provides an alternative to diabetes management by using the local bean as an anti-diabetic functional drink.

**Neuroactive Properties**

*In vitro* neuroactive properties of pinostrobin, a substituted flavanone from *C. cajan* were estimated. It was demonstrated that pinostrobin inhibits voltage-gated sodium channels of mammalian brain based on the ability of this substance to suppress the depolarizing effects of the sodium channel selective activator veratridine in a synaptoneurosomal preparation from mouse brain. The pharmacological profile of pinostrobin resembles that of depressant drugs that block sodium channels.[24]

**Anti- oxidant activity**

**Ogbunugafor, H. A et al** were evaluated on some indices of good health in normal male albino rats. Two groups of six rats each were used for the experiment. The *C. cajan* seeds were compounded (1:1) with commercial rat pellet and fed to the test rats while the control was fed commercial pellets for 30 days. The effects on animal weight, serum proteins,

electrolytes and heamatological parameters, were determined. In addition, antioxidant enzymes which include superoxide dismutase (SOD), catalase (CAT) and Gluthathione perioxidase (GPx) and lipid perioxidation as biomarkers of oxidative stress and lipoproteins profile of the animals were also evaluated.

Results showed lower weight gain ($p<0.05$) in *C. cajan*-fed compared to control rats. Total proteins, and heamatological indices – PCV, Hb, RBC and MCHC were increased ($p<0.05$), while serum electrolytes were unchanged ($p>0.05$). Activities of SOD and GPx were lowered ($p>0.05$), however, catalase activity was elevated ($p<0.05$). MDA level was unchanged. There was decrease ($p<0.05$) in TC, VLDL, TAG, while HDL was increased ($p<0.05$). These results indicate positive effect on indices of good health, and parameters that predispose a subject to development of chronic diseases such as obesity, diabetes and cardiovascular disease.

**Preparation of extract**

50 g of the crude powder was extracted twice with ethanol using Soxhlet extraction method. The solid residue obtained was kept in a capped container ready for the phytochemical screening.

## 7. PHYTOCHEMICAL SCREENING

The seed extracts of Cajanus cajan were analysed for the presence of alkaloids, glycosides, tri terpenoids, steroids, saponins, flavonoids, tannins and carbohydrates according to standard methods.[26]

1) **Test for Alkaloids:** 2 ml of dilute hydrochloric acid was added to the 5 ml of extract then treated with Dragondroff's reagent, appearance of an orange brown precipitate showed the presence of alkaloids.
2) **Test for Triterpenoids:** About 5 ml of extract was mixed in 2 ml of chloroform; 2 ml of acetic anhydride and a few drops of conc. H2SO4 were added. Reddish violet colour indicated the presence of triterpenoids.
3) **Test for Steroids:** 10ml of chloroform was mixed with 2ml of extracts and conc. H2SO4 was added to form lower layer. A reddish yellow colour at the interface was an indicative of the presence of steroidal ring.

4) **Test for Saponins**: 15 ml of distilled water was added to the extract and shaken vigorously until formation of a stable persistent froth which indicates presence of saponins.
5) **Test for Flavonoids:** Few drops of dilute NaOH was mixed with 2 ml of extract. A yellow solution that turns colourless showed the presence of flavonoids.
6) **Test for Tannins**: In a test tube containing little quantity of extract few drops of 1 % lead acetate were added.Yellow precipitate appeared it showed the presence of tannins.
7) **Test for Anthraquinones:** 10ml of benzene was added to the 6g of powder sample in a conical flask and soaked for 10 min and then filtered. Further 10ml of 10% ammonia solution was added to the filtrate and shaken vigorously for 30 seconds. Pink, violet or red colour indicates the presence of anthraquinones in ammonia phase.
8) **Test for phlobatannin:** Extract was boiled with 2ml of 1% hydrochloric acid. Formation of red precipitate indicates the presence of phlobatannin.

These are the phytochemical tests used for the evaluation of phytochemical parameters in Cajanus cajan.

## 8. RESULTS

**Table No 3: The results of the phytochemical analysis.**

| S.NO | PHYTOCHEMICALS | RESULTS |
|---|---|---|
| 1. | Alkaloids | + |
| 2. | Flavonoids | + |
| 3. | Triterpenoids | + |
| 4. | Steroids | - |
| 5. | Saponins | + |
| 6. | Tannins | + |
| 7. | Anthraquinones | - |
| 8. | Phlobatannin | - |

Present: +

Absent: -

## 9. CONCLUSION

This study on *Cajanus cajan* has highlighted the potentials of this seed plant to act as functional food, a nutrient rich diet that can also prevent the development of the now common chronic diseases such as diabetes and hypertension. Amongst various food legumes, pigeon pea occupies an important place and has been rated the best as far as its biological value is concerned. It has been found that vegetable pigeon pea is considered superior to dry

splits in crude fibre, fat, protein digestibility as well as trace elements and minerals. Pigeon pea is known to prevent and cure human ailments like bronchitis, coughs, pneumonia and respiratory problem. In a nutshell, pieon pea holds the key to qualify protein supply to vegetarians on cereal legume mutual supplementation principle and also possesses therapeutic Properties and thus can also be branded as a food with neutraceutical properties.

The plant used in this study was found to contain the important constituents needed to combat various kinds of infections in human beings. Cajanus cajan contains the various phytochemicals like alkaloids, flavonoids, triterpinoids, saponins and tannins. The seeds of *Cajanus cajan* has been shown to possess secondary metabolites, some of which has also been reported in its leaves and therefore may be a very important source of phytochemical for new drug leads. It is our recommendation that bioassay guided work be carried out on the seeds with a view to isolating a useful pharmacologically active component as a drug. It is recommended that more work be done on the plant seeds for isolation and characterization of bioactive compounds that may be active against many diseases.

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