



A REVIEW ON POTENTIAL THERAPEUTIC ROLE OF *CAJANUS CAJAN*

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ABSTRACT

Cajanus cajan or Pigeon pea or arhar is the most important pulse having multiple therapeutic effects. It is both a food crop and a cover/forage crop with high levels of proteins and important amino acids like methionine, lysine and tryptophan. A number of studies have been carried out regarding the phytochemistry and medicinal applications of *C. cajan*. During the last few decades a large number of compounds have been isolated from *C. cajan* and some of them have got excellent biological activities. A new natural coumarin cajanuslactone has been isolated from the leaves of *C. cajan* which is a potential antibacterial agent against Gram-positive micro-organisms. The three stilbenes, cajanin, longistylin C and longistylin A from leaves have been found to possess hypocholesterolemic effects. Anti-plasmodial activities have also been confirmed in betulonic acid isolated from roots and longistylin A and C obtained from leaves. Pinostrobin, a substituted flavanone isolated from leaves possesses anti-inflammatory activity and inhibits sodium channel-activated depolarization of mouse brain synaptoneurosome. Two isoflavonoids genistein and genistin isolated from the roots were found to possess antioxidant activity. Cajanol an isoflavonone found in the roots is found to possess anticancer activity. Four important compounds, pinostrobin, cajaninstilbene acid, vitexin and orientin isolated from ethanolic extracts of leaves were found to possess significant antioxidant properties. Isoflavonoids isolated from ethanolic extract of leaves also showed significant antimicrobial activities. Some protein fraction isolated from leaves also showed hepato-protective effects and the presence of phenolics (flavonoids and tannins) impart anthelmintic activity.

KEYWORDS: Pigeon pea, Arhar, Hepatoprotective, *Cajanus cajan*, Anti-microbial.

INTRODUCTION

Cajanus cajan or Arhar or Pigeon pea is a perennial member of the family fabaceae. Its other common names are red gram, congo pea, gungo pea, and no-eye pea. The centre of origin is most likely Asia, from where it travelled to East Africa and by means of the slave trade to the American continent. India is a principal pigeon pea-growing country contributing nearly 90% of the total world production. It is a multipurpose plant as it is extensively eaten as a dal. It is rich in proteins. In India its leaves are used for rearing silkworms; green pods are used as a vegetable; husk, green leaves and tops are used as fodder and also as green manure.^[1] Amongst its many medicinal uses, *C. cajan* is indicated in the relief of pain in traditional Chinese medicine and as a sedative.^[2] In recent years it has also been explored for the treatment of ischemic necrosis of the caput femoris, aphtha, bedsore and wound healing. Chemical investigations have revealed the presence of two globulins, cajanin and concajanin.^[1] It has been used widely for many years for treating diabetes, sores, skin irritations, hepatitis, measles, jaundice, dysentery and many other illnesses;

for expelling bladder stones and stabilizing menstrual period.^[3]

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'-methyl cajanone, 2'-hydroxy genistein, isoflavones, cajanin, cajanones etc., which impart antioxidant properties.^[4] Roots are also found to possess genistein and genistin. It also contains hexadecanoic acid, α amyryl, β -sitosterol, Pinostrobin, longistylin A and longistylin C which impart anticancer activity. Presence of cajanuslactone, a coumarin imparts antibacterial activity. Presence of cajaninstilbene acid, pinostrobin, vitexin and orientin is responsible for antiplasmodic activity.

During the last few decades a large number of compounds have been isolated from *C. cajan* and some of them have got excellent biological activities. A new natural coumarin cajanuslactone has been isolated from

the leaves of *C. cajan* which is a potential antibacterial agent against Gram-positive micro-organisms.^[5] The three stilbenes, cajanin, longistylin C and longistylin A from leaves have been found to possess hypocholesterolemic effects.^[5] Anti-plasmodial activities have also been confirmed in betulinic acid isolated from roots and longistylin A and C obtained from leaves.^[6] Pinostrobin, a substituted flavanone isolated from leaves possesses anti-inflammatory activity and inhibits sodium channel-activated depolarization of mouse brain synaptoneurosomes.^[7] Two isoflavonoids genistein and genistin isolated from the roots were found to possess antioxidant activity.^[8] Cajanol an isoflavanone found in the roots is found to possess anticancer activity.^[9] Four important compounds, pinostrobin, cajaninstilbene acid, vitexin and orientin isolated from ethanolic extracts of leaves were found to possess significant antioxidant properties.^[10] Isoflavonoids isolated from ethanolic extract of leaves also showed significant antimicrobial activities.^[11] Some protein fraction isolated from leaves also showed hepato-protective effects^[12] and the presence of phenolics (flavonoids and tannins) impart anthelmintic activity.^[13]

THERAPEUTIC EFFECTS

Different parts of *C. cajan* have numerous potent therapeutic effects.

Antimicrobial Activity

In vitro antimicrobial activities of *C. cajan* were evaluated against eight microbial strains: *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Bacillus subtilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Aspergillus niger* and *Candida albicans*. Prominent inhibitory effect of *C. cajan* extracts was observed against *S. epidermidis*, *S. aureus* and *B. subtilis*. *In vivo* antimicrobial activity was also studied in mice that had been inoculated with *S. aureus* and the potential mechanism of antimicrobial activity was studied by histopathology.^[3] It was found that cajanuslactone possessed good antibacterial activity against *S. aureus*.^[4]

Anti hypercholesterolemic Effects

C. cajan has potent anti hypercholesterolemic effects.^[14] Its anti hypercholesterolemic effects may involve enhancement of the hepatic Low Density Lipoprotein-receptor and cholesterol-7- α -hydroxylase expression levels and bile acid synthesis.^[5]

Antidiabetic Effects

C. cajan has antidiabetic effects.^[6] Various studies showed that *C. cajan* significantly reduced the fasting blood sugar of alloxan diabetic rats in a dose-related manner with maximum hypoglycemic effect at 4-6 h.^[15]

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.^[7]

Antioxidant Activities

Antioxidant activities of the aqueous, ethanol, ethyl acetate, *n*-butanol, petroleum ether extracts of *C. cajan* leaves and the four main compounds separated from the ethanol extract, i.e. cajaninstilbene acid (3-hydroxy-4-prenylmethoxystilbene-2-carboxylic acid), pinostrobin, vitexin and orientin, were examined by 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical-scavenging assay^[16, 17, 18] and β -carotene-linoleic acid test. Based on the results obtained, it was concluded that the pigeon pea leaf extracts may be valuable natural antioxidants and potentially applicable to medicine and the health food industry.^[10]

Anticancer Activity

Cajanol, an isoflavanone from *C. cajan* roots is an important phytoalexin. The anticancer activity of cajanol towards MCF-7 human breast cancer cells was investigated. In order to explore the mechanism of cell growth inhibition of cajanol some parameters like cell cycle distribution, DNA fragmentation assay and morphological assessment of nuclear change, reactive oxygen species (ROS) generation, mitochondrial membrane potential disruption and expression of caspase-3 and caspase-9, Bcl-2, PARP and cytochrome c were measured. Cajanol inhibited the growth of MCF-7 cells in a time- and dose-dependent manner. Cajanol arrested the cell cycle in the G2/M phase and induced apoptosis via a reactive oxygen species (ROS) -mediated mitochondria-dependent pathway.^[9]

Hepatoprotective Effects

Various studies have shown that *Cajanus cajan* and 'alkaloids, flavonoids, steroids and also triterpenoids' present in it have hepatoprotective effects. These phytochemicals are present in *Cajanus cajan* and may be responsible for the protective effect against hepatotoxicity.^[19] The methanol extracts of *C. cajan* were studied for hepatoprotective activity against Swiss albino mice with liver damage induced by carbon tetrachloride (CCl₄). It was found that the same extract exhibited a moderate protective effect by lowering the serum levels of alanine aminotransferase (ALT) or serum glutamate pyruvate transaminase (SGPT), aspartate aminotransferase (AST) or serum glutamate oxaloacetate transaminase (SGOT), and cholesterol to a significant extent.^[12] The methanol-aqueous fraction (MAF2) of the leaf extract was also used to prevent alcohol induced rat liver damage. Co- administration of MAF2 reversed the liver damage; it decreased the activities of liver marker enzymes and augmented antioxidant enzyme activities and showed a promise in therapeutic use in alcohol-induced liver dysfunction.

Anti-helminthic Activity

The extracts of the aerial parts of *C. cajan* were evaluated for anthelmintic properties using Indian adult earthworm (*Pheretima posthuma*) due to their anatomical and physiological resemblance with intestinal parasites and round worms.^[20, 21] Anti-helminthic activity of *C. cajan* might be due to the presence of flavanoids and tannins which are reported to have good anthelmintic property.^[13]

CONCLUSION

C. cajan is a rich source of protein and it has numerous therapeutic effects. Several flavonoids, isoflavonoids, tannins and protein fractions have been isolated from its different parts and their medicinal uses have been established, but many bioactive constituents and pure compounds have so far been neglected by phytochemists and pharmacologists and a large amount of work has been done only on extracts and not the isolated fractions which shows scope for further study in this direction. Extensive research is needed to establish *C. cajan* as a medicinal drug.

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