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Pharmacological Advances and Recent Insights Into Calopogonium Mucunoides: A Natural Plant Review

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ABSTRACT

Calopogonium mucunoides Desv., commonly known as wild groundnut, is a leguminous plant native to tropical America and now widely naturalized across tropical and subtropical regions. Traditionally valued for its forage and soil-enriching properties, C. mucunoides has recently garnered scientific interest for its rich phytochemical profile and broad pharmacological potential.

This review highlights its major bioactive constituents, including flavonoids, alkaloids, tannins, and saponins, which contribute to a spectrum of biological activities such as antioxidant, anti-ulcer, antidiarrheal, antimicrobial, and urease-inhibitory effects. The presence of isoflavonoids, such as genistein and daidzein, underscores its potential in managing oxidative stress, microbial infections, and inflammatory conditions. Nutritional evaluations also reveal high protein and mineral content, supporting its role in animal nutrition.

Despite its classification as an aggressive weed, Calopogonium mucunoides Desv emerges as a promising candidate for pharmaceutical and nutraceutical development. This review consolidates current ethnopharmacological knowledge and experimental findings in pharmacological studies, offering a foundation for future studies and potential therapeutic applications of this underutilized medicinal plant.

Keywords: *Calopogonium mucunoides Desv, ethnopharmacological, urease-inhibitory, daidzein.*

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1. INTRODUCTION

Nature has been providing medical materials for thousands of years, and an incredible number of contemporary drugs have been found to have their origins in natural sources. The revelation that plant extracts include a wide variety of secondary metabolites with enormous pharmacological potentials in addition to minerals and primary metabolites has given the therapeutic use of plants a greater significance in recent decades. The greatest natural supply of pharmaceuticals for pharmaceutical intermediaries, modern medicine, dietary supplements, folk remedies, and chemical entities for synthetic drugs is medicinal plants. The World Health Organization reports that 25% of pharmaceuticals are derived from plants, and 80% of the world's population uses medicinal plants to treat illnesses. The primary cause of the current rise in demand for herbal medications is that plant-derived medications are generally safer than synthetic equivalents, providing significant therapeutic benefits and more reasonably priced treatment[8].

An annual indigenous woody weed *Calopogonium mucunoides*, is leguminous plant that grows widely as a legume forage and nitrogen-fixing plant in tropical and sub-tropical regions. Perennial *Calopogonium mucunoides* species are grown in pasture mixtures. The Global Compendium of Weeds lists *C. mucunoides*, a woody vine with a robust growth habit, as an extremely aggressive weed that primarily affects agricultural and semi-natural habitats[1]. The extracts included alkaloids, terpenoids, tannins, and saponins, as shown by phytochemical screening. Alkaloids and flavonoids are two of these bioactive plant components that are particularly significant. According to reports, flavonoids have a variety of beneficial

pharmacological properties, such as antibacterial, antifungal, antidiarrheal, and anti-inflammatory properties. They are also known to inhibit the activity of free radicals, which have been linked to the pathogenesis of numerous diseases, including diabetes, ischemic heart disease, atherosclerosis, cancer, Parkinson's disease, and the aging process[2,3]. The grazing behavior of goat is nominally increased in *C.mucunoides* due to its highest forage mass[5]. To lessen erosion and increase soil fertility, C. mucunoides is frequently planted as a pioneer species and as a nitrogen-fixing species[8]. The urease inhibitory capability of isoflavone based compounds from synthetic sources is the most well-known work documented in the literature[9]. The study's findings demonstrated that the Calopogonium plant has a considerable amount of secondary metabolites with strong antioxidant potential that are beneficial for medication development and can be used to treat oxidative stress-related illnesses. The plant's excellent nutritional value and low anti-nutrient content make it suitable for use as an ingredient in animal feed formulations[10].

2. CALOPOGONIUM MUCUNOIDES

Synonyms

Calopogonium brachycarpum (benth), Calopogonium orthocarpum Urb, stenolobium brachycarpum

Habitual names[1]

English – Calopo, Wild ground nut, Caloponiums
Spanish – Cama, Jequirana, Calopogonio indico
Portuguese – Mielillo
Indonesia – Kacang asu
Colombia – picapica , gusanillo

Figure 1.0 Calopogonium mucunoides

Taxanomic Hierarchy[1,2]

Kingdom – Plantae
Phylum –Spermatophyta
Clade- Angiosperms
Class - Dicotyledonae
Order – Fabales
Family – Fabaceae
Sub-family – Faboideae
Genus – Calopogonium
Species – C.mucunoides
Botanical name- *Calopogonium mucunoides*

Topographical description

About six to eight species of the genus Calopogonium are endemic to tropical continental America and have spread far throughout tropical and subtropical regions of the world. Updated checklists, however, regard Cuba and Puerto Rico as naturalized habitats for this species. From Mexico to Argentina, as well as several West Indies islands, tropical America is home to C.mucunoides. In India, it is widely distributed in the states of Kerala, Karnataka and Tamil nadu[1].

Morphological overview

Calopogonium mucunoides Desv. is an annual trailing legume of 3-5 m long, slightly woody, twining vine with many branches. Alternate trifoliate with obtuse apex measuring about 2-10 x 1.5-6.5 cm assymetrical leaflets were seen. Both the surfaces are dull pubescent with prominent venation at lower side. Axillary pseudo-racemous inflorescence of about 10cm long with bracts is present. Leguminous fruits which are flattened that have reddish-brown quadrangular seeds are found. Succulent stems with long, brown hairs covering them with twning at the upper part. A dense shallow roots with nodules were seen[1,3,8].

Ethnopharmacology

Medicinal weed Calopogonium mucunoides has wide range of therapeutical effect in various extracting forms[3]. Extract from seed shows better larvicidal action against *Aedes aegypti* mosquito that is responsible to spread dengue and yellow fever[2]. The ethanolic extract of leaves possess anti-ulcer activity as well as has anti-diarrheal activity. The methanolic and ethyl acetate extracts of the plant leaves shows higher zone of inhibition against bacteria and other microbes[8]. Flavonoids, a bioactive secondary metabolite which is most prominent in the plant has maximum urease inhibitory action[9]. The inherited bioactive compounds in this plant shows various effects like anti-oxidant, anti-cancer, spasmolytic, analgesic and anti-pyretic actions[10].

Nutritional values[11,13]

The AOAC standard method was used to determine the calopo's nutritional values. Calculating the proportion of moisture, ash content, crude protein, crude fiber, crude fat, and crude carbohydrate are all included in this. The high protein and mineral levels of C. mucunoides are readily apparent. The neutral detergent fibre and acid detergent fibre in this herb aids digestion.

Phytochemical evaluation[3,6,8,9]

The qualitative phytochemical screening results different phytochemical constituents like alkaloids, flavonoids, glycosides, tannins, saponins, phenols and resins.

Pharmacological effects

- **Anti-oxidant[10,13]**

The anti-oxidant effect of C.mucunoides is due to the presence of bioactive compound flavonoids and phenolic compound. Tuberosin is a flavonoid from this herb exhibits biochemical scavenging activity.

- **Urease inhibition[9]**

Isoflavones extracted from this medicinal herb possess urease inhibitory effect on *Helicobater pyroli* which damages stomach wall.

- **Anti-ulcer[6]**

Flavonoids and tannins in the ethanolic extract of C.mucunoides show a better anti-ulcerogenic action. Flavonoids stimulates mucous and prostaglandins that counteracts damage of mucosal layer. Intake of ethanolic extract of this herb shows gastroprotective effect in ethanol-induced ulcer in wistar rats.

- **Anti-diarrheal[3]**

Medicinal herbs antidiarrheal properties have been linked to the presence of bioactive components such tannins and flavonoids. The extract's antidiarrheal activity was comparable to lomotil's, indicating a similar mode of action.

Anti-microbial activity[3,8]

This tropical forage herb has potential activity against gram positive and gram negative micro organism. Free flavonoid has maximum range of anti-microbial activity then bound flavonoids. When compared to the nystatin an anti-fungal drug this medicinal herb shows Higher zone of inhibition.

- **Anti-bacterial[10]**

Anti-bacterial activity has been observed due to the presence of free flavonoids. Meanwhile selective maximum anti-bacterial activity is due to the presence of hydroxyl (OH) and aldehyde (-CHO) groups of flavonoids

- **Anti-scrobutic activity[11]**

A decoction of leaves used as an antiscorbutic and to fortify the immune system.

Toxicological studies[6]

Acute toxicity studies on the ethanolic extract of the herbal leaves shows low toxicity at maximum dose level

Table 1: Nutritional composition

Nutritional content	Percentage
Crude protein	20.54
Carbohydrate	21.56
Crude fibre	21.42
Crude lipid	18.62
Calcium	1.2
Magnesium	0.2
Phosphorous	0.1
Potassium	2.1
Sodium	0.1
Manganese	11.4

Iron	11.2
Copper	1.0
Zinc	10.8

Table 2: Phytoconstituents List

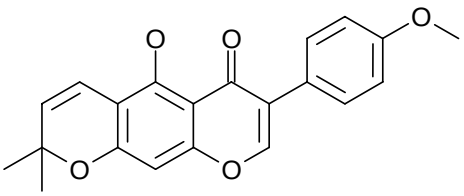
Phytoconstituents [2,6,8]
Saponins
Tannins
Alkaloids
Glycosides
Flavonoids
Resins
Cardiac glycosides
Terpenoids
Phenols
Reducing sugars
Isoflavonoids

Table 3: Isoflavonoids in the herby weed[26]

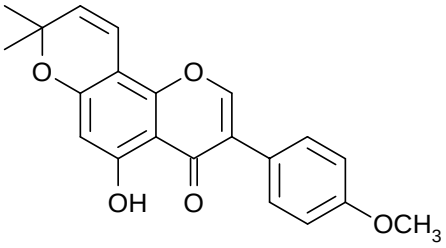
Isoflavones	**Uses**
Formononetin	Menopausal symptom relief, anticancer, anti-inflammatory, Bone health.
Genistein	Anticancer, Neuroprotective, Cardiovascular health, anti-inflammatory.
4'-O-methylalpinumisoflavone	Immunosuppressive [17]
4'-O-methylderrone	Anti-protozoal and Ant-microbial[14,15]
Alpinumisoflavone	Anti-oxidant, anti-inflammatory and Anti-osteoporotic[18,20]
Atalantoflavone	Cytotoxicity, Antimicribial activity, antioxidant,antiinflamatory
Calopogonium isoflavone-B	Anticance rproperties, Bone health, Estrogenic and antiestrogenic effect, cardiovascular health[21].
Daidzeine[27]	Anti-osteoporotic, anti-aging , anti-cancer, nutraceutical supplement, anti-fibrotic and anti-androgenic activity[17,22]
7,2',4'.5'-tetra methoxy isoflavone	Anti-microbial activity[18]
2'-O-methylcuneantin	
Cabreuvin	Antioxidant, anticancer, antiaging, anti-inflammatory, neuroprotective effect and cardiovascular effect[17].
7-O-methylpseudobaptigenin	Anticancer, Estrogenic effect, Antioxdant properties.
6a,12a-dehydrodegueline	Organic pesticide[23]

Chemical structures of the various isoflavonoids

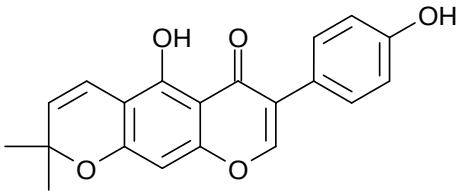
COMPOUND 1:- 4'-O-METHYLALPINUMISOFLAVONE



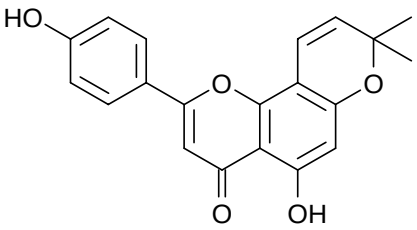
COMPOUND 2:- 4'-O-METHYLDERRONE



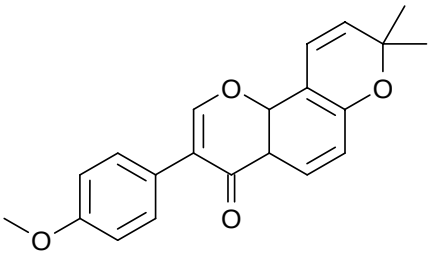
COMPOUND 3:- ALPINUMISOFLAVONE



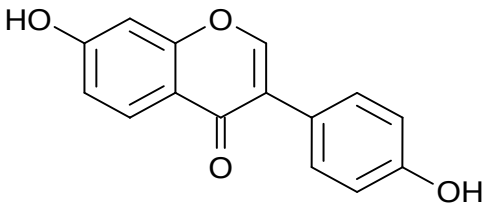
COMPOUND 4:- ATALANTOFLAVONE



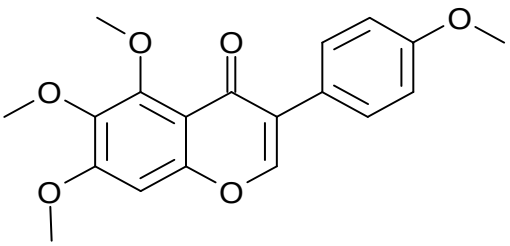
COMPOUND 5:- CALOPOGONIUM ISOFLAVONE



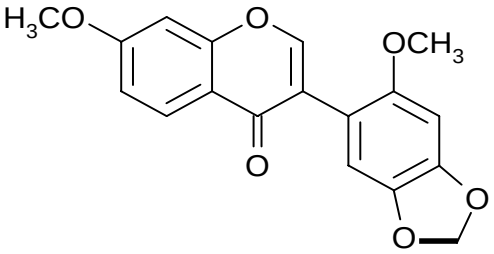
COMPOUND 6:- DAIDZEINE



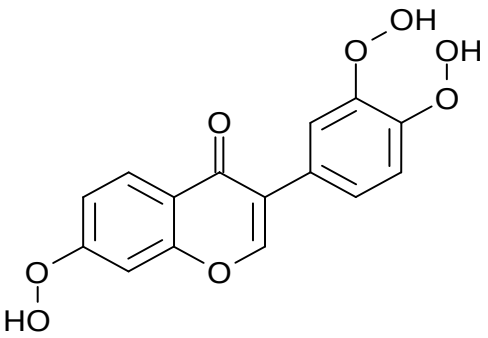
COMPOUND 7:- 7',2',4',5'-TETRA METHOXY ISOFLAVONE



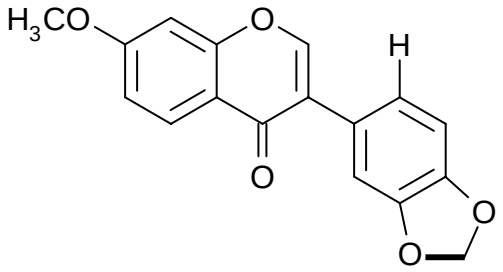
COMPOUND 8:- 2',O-METHYLCUNEANTIN



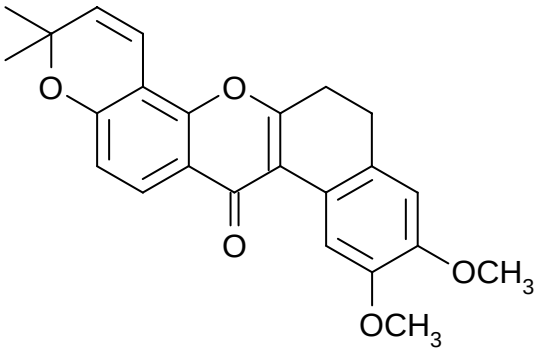
COMPOUND 9:- CABREUVIN



COMPOUND 10:- 7-O-METHYLPSEUDOBAPTIGENIN



COMPOUND 11:- 6a,12a- DEHYDRODEGUELINE



3. SUMMARY AND CONCLUSIO

Summary: Calopogonium mucunoides, also known as wild groundnut, is a leguminous plant used traditionally in various cultures for its medicinal properties. The plant is rich in bioactive compounds, including alkaloids, flavonoids, tannins, and saponins, which contribute to its therapeutic effects. These compounds demonstrate significant pharmacological properties such as anti-oxidant, anti-ulcer, anti-diarrheal, anti-bacterial, and anti-cancer activities. The plant is particularly valued for its flavonoid content, which plays a key role in its antioxidant and anti-inflammatory effects. It is also utilized in various applications like animal feed due to its high nutritional value. Additionally, C. mucunoides shows promise in treating diseases linked to oxidative stress, and its medicinal properties have been supported by both traditional knowledge and modern scientific research.

Conclusion: *Calopogonium mucunoides* is a valuable plant with considerable medicinal and nutritional potential. Its rich content of bioactive compounds, particularly flavonoids and alkaloids, offers therapeutic benefits that can be applied in the treatment of various ailments, including oxidative stress-related conditions, ulcers, and bacterial infections. The plant's high nutritional profile further enhances its suitability for use in animal feed. Despite its aggressive nature as a weed, the plant's low toxicity and significant pharmacological properties make it a promising candidate for future pharmaceutical research and development. Thus, *Calopogonium mucunoides* could play an essential role in the development of new natural remedies and health supplements.

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