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Evaluation of phytochemicals in select medicinal plants of the *Caesalpinia* species

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Abstract

A comparative study of phytochemicals was made on leaf extracts of two herbal plants- *Caesalpinia pulcherrima* Swartz (a domesticated striking ornamental shrub) *and Caesalpinia bonduc* (L) Roxb (a wild spiny shrub) belonging to the family Caesalpinaceae. The leaf extracts were prepared with 4 different selected solvents for each plant to adjudge the major active principle in the solvent that has value in rational drug design. The qualitative analysis of phytochemicals encompasses carbohydrates, tannins, saponins, flavonoids, alkaloids, betacyanins, quinones, terepenoids, phenols, glycosides, cardiac glycosides and the results were the mean values of the triplet readings. The quantitative total phenol estimation has carved out the fact that the wild plants is contributing high values for the secondary metabolites than the domesticated plant triggering the notion domestication, the need of the hour for the distinct endangered wild medicinal plants shall be done without the loss of the quality of the drug, the property of the medicinal plants as a boon to the future generation.

Keywords: *Caesalpinia pulcherrima, caesalpinia bonduc*, phytochemical analysis, leaf extracts.

Introduction

The medicinal plants are those that provide people with medicines to treat illness, maintain and promote health. The phytochemicals are the wide variety of compounds produced by plants manipulated wisely in the pharmacognostic drug development and treatment of the major ailments. *C. pulcherrima* Swartz is a leguminous, perennial, large shrub or small tree found throughout India. It is commonly known as red bird of paradise. It has several medicinal properties and is used in the treatment of ulcer, asthma, fever, tumor and skin diseases (Kirtikar & Basu, 1935). The plant is believed to have originated from Asia, but it is widely distributed in the tropics. It grows to between 10 ft.-12 ft. in height and 6 ft.-12 ft. in width (Bailey, 1949). A recent study of this folk remedy has shown that it possesses antibacterial and antifungal properties (Ali *et al*., 1999). The plant is rich in many pharmaceutical active ingredients like flavonoids, carotinoids, glycosides, phenols and steroids (Guno *et al*., 2009). *C. bonduc* is a spiny, scrambling shrub that grows to 1.5 m in height and 6 m or more in extension, and has stems up to 5 cm in diameter or more. The stems, twigs and leaf rachises are covered with straight or curved prickles. By the presence of gray rounded seeds with a spiny cover the plant is commonly called as Gray Nicker Bean.

Materials and methods

Collection & processing of plant samples

The leaves of *C. pulcherrima* were collected in and around the village of Semmancheri, Kanchipuram district, Tamil Nadu. The leaves of *C. bonduc* were collected in and around Thandarai Village, Kanchipuram district, Tamil Nadu. The collected samples were air dried and powdered into a uniform powder. The extracts of the samples were prepared by soaking 100 g of dried powder in 200 ml of different selected solvents for 12 h. The extracts were filtered using Whatman filter paper no. 42. The four different solvent-extracts such as methanol, choloroform, water and petroleum ether were taken for the phytochemical analysis of the *C. pulcherrima* and ethanol, methanol, hexane and water-extracts were taken for phytochemical analysis of *C. bonduc*.

Phytochemical screening

The phytochemical tests were carried out for the above mentioned extracts using the standard procedures to identify the components. The phytochemical screening of the components such as carbohydrates (Benedict's,Fehling's Molisch's tests), saponins (Kokate, 1999), flavanoids, alkaloids (Evans,1997), anthocyanin and betacyanin, quinones (Peach & tracoy,1955), glycosides (Evans,1997), cardiac glycosides, terpenoids, triterpenoids (Libermann-Buchard Reagent test), phenols and tannins (Mace,1963), coumarins, acids, proteins and aminoacid (Biuret and Ninhydrin Reagent method).

The quantitative analysis of the total phenol content was also done by Folin Ciocalteu colorimetric method with gallic acid as standard (10 mg/10 ml). All the tests were done in triplets for each concentration and the mean values were taken as the result.

Results

The results of the phytochemical screening for the 4 solvents methanol, chloroform, water, petroleum ether-extracts of *C. pulcherrima* are given in the Table 1, 2 & 3. The presence of the carbohydrates, terepenoids, betacyanins and quinones has been seen in all the 4 solvents of *C. pulcherrima*. The presence of aminoacids and proteins were confirmed in the chloroform extracts and absent in all other extracts. The test for the phenols showed their strong presence in the chloroform extracts while their absence was much confirmed with the methanolic extracts. The anthraquinone was present only in the extract of petroleum ether. The test for the triterepenoids have not given any results with methanol, chloroform and water but a colour change was noted with

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Table 1. Results of qualitative analysis of carbohydrates, proteins & amino acids of C. pulcherrima.

Phytochemical test	Extracts			
	Methanol	Chloroform	Aqueous	*Petroleum ether*
Test for the presence of carbohydrate				
Benedict's test	++	++	++	++
Fehling's test	++	++	++	++
Molisch test	++	++	++	++
Test for the presence of glycosides				
Glycosides test	-	++	+++	++
Cardiac glycosides	++	-	++	++
Test for the presence of the protein & amino acid				
Ninhydrin test	-	++	-	-
Biuret test	-	++	-	-

Strongly present -+++, Present - ++, Weakly present - +, Absent- -

Table 2. Results of qualitative analysis of alkaloids, flavonoids, phenols & quinones of C. pulcherrima.

Phytochemical test	Extracts			
	Methanol	Chloroform	Aqueous	*Petroleum ether*
Test for presence of alkaloids				
Wagner's test	++	-	-	++
Hager's test	++	-	-	++
Mayer's test	++	-	-	++
Test for presence of flavonoid				
Alkaline test	-	+	+++	++
Test for presence of phenols				
Ferric Chloride test	-	+++	++	++
Test for presence of quinones				
Quinones	++	++	++	++
Anthraquinone	-	-	-	++

Strongly present -+++, Present - ++, Weakly present - +, Absent- -

Table 3. Results of qualitative analysis of tannins, saponins, cyanins, phytosterols & coumarins of C. pulcherrima.

Phytochemical test	Extracts			
	Methanol	Chloroform	Aqueous	*Petroleum ether*
Test for the presence of the tannins				
Ferric Chloride test	+++	++	++	_
Test for the presence of the saponin				
Foam test	-	++	-	-
Test for the presence of the anthocyanin & betacyanin				
Alkaline test (Anthocyanin)	-	-	-	-
Alkaline test (Betacyanin)	++	++	++	++
Test for the presence of phytosterols				
Terpenoids test	++	++	++	++
Triterpenoids	-	-	-	++
Test for the presence of coumarins				
Alkaline test	-	-	++	-

Strongly present -+++, Present - ++, Weakly present - +, Absent- -

the extract of petroleum ether. The results of the screening of the solvent-extracts (ethanol, methanol, hexane & water) for phytochemicals in *C. bonduc* were given in the Table 4, 5 & 6. Carbohydrates, quinones, betacyanin and terepenoids were present in all 4 extracts of *C. bonduc*. The flavonoids, alkaloids, glycosides, cardiac glycosides, phenols, coumarins were present in all other extracts except that of the hexane extract. Saponins, anthraquinone, proteins and amino acids were completely absent in all the 4 selected extracts. The presence of phenol was observed in the aqueous extract of the *C. pulcherrima* and the ethanolic extract of the *C. bonduc* with each concentration in triplets. The result of the total phenol content of both the plants with the gallic acid standard was given in Graph 1.

Discussion

The medicinal value of these plants lies in some chemical substances that have a definite physiological action on the human body. The most important of these bioactive constituents of plants are alkaloids, tannins, flavanoids and phenolic compounds (Hill, 1952). Previous studies on *C. pulcherrima* led to the isolation of several diterepenoids and flavonoids (Che *et al*., 1986; Srinivas *et al*., 2003). The anti-inflammatory effects of flavonoids isolated from *C. pulcherrima* have been reported (Rao *et al*., 2005). It was correletated with the obtained result that *C. pulcherrima* has shown the presence of the flavanoids and the terepenoids in all the extracts of methanol, chloroform, water and petroleum ether. Pure flavonoids and aqueous extracts of *C. pulcherrima Swartz* were used in experiments to test their influence on a variety of viruses (Chiang *et al*., 2003). The present study also proved the presence of alkaloid in methanolic and petroleum ether extracts. The presence of phenol was also significant in all the extracts other than the methanolic extracts.

Table 4. Results of qualitative analysis of carbohydrates, proteins & amino acids of C. bonduc.

Phytochemical test	Extracts			
	Ethanol	Methanol	Hexane	Aqueous
Test for the presence of carbohydrate				
Benedict's test	++	++	++	++
Fehling's test	++	++	++	++
Molisch test	++	++	++	++
Test for the presence of glycosides				
Glycosides test	++	++	-	++
Cardiac glycosides	++	++	-	++
Test for the presence of protein & amino acid				
Ninhydrin test	-	-	-	-
Biuret test	-	-	-	-

Strongly present -+++, Present - ++, Weakly present - +, Absent- -

Phytochemical screening of methanolic extracts revealed the presence of alkaloids, saponins, flavonoids,

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Table 5. Results of qualitative analysis of alkaloids, flavonoids, phenols and quinones of C. bonduc.

Phytochemical test	Extracts			
	Ethanol	Methanol	Hexane	Aqueous
Test for presence of alkaloids				
Wagner's test	++	++	-	++
Hager's test	++	++	-	++
Mayer's test	++	++	-	++
Test for presence of flavonoid				
Alkaline test	++	++	-	++
Test for presence of phenols				
Ferric chloride test	++	++	-	++
Test for presence of quinones				
Quinones	++	++	++	++
Anthraquinone	-	-	-	-

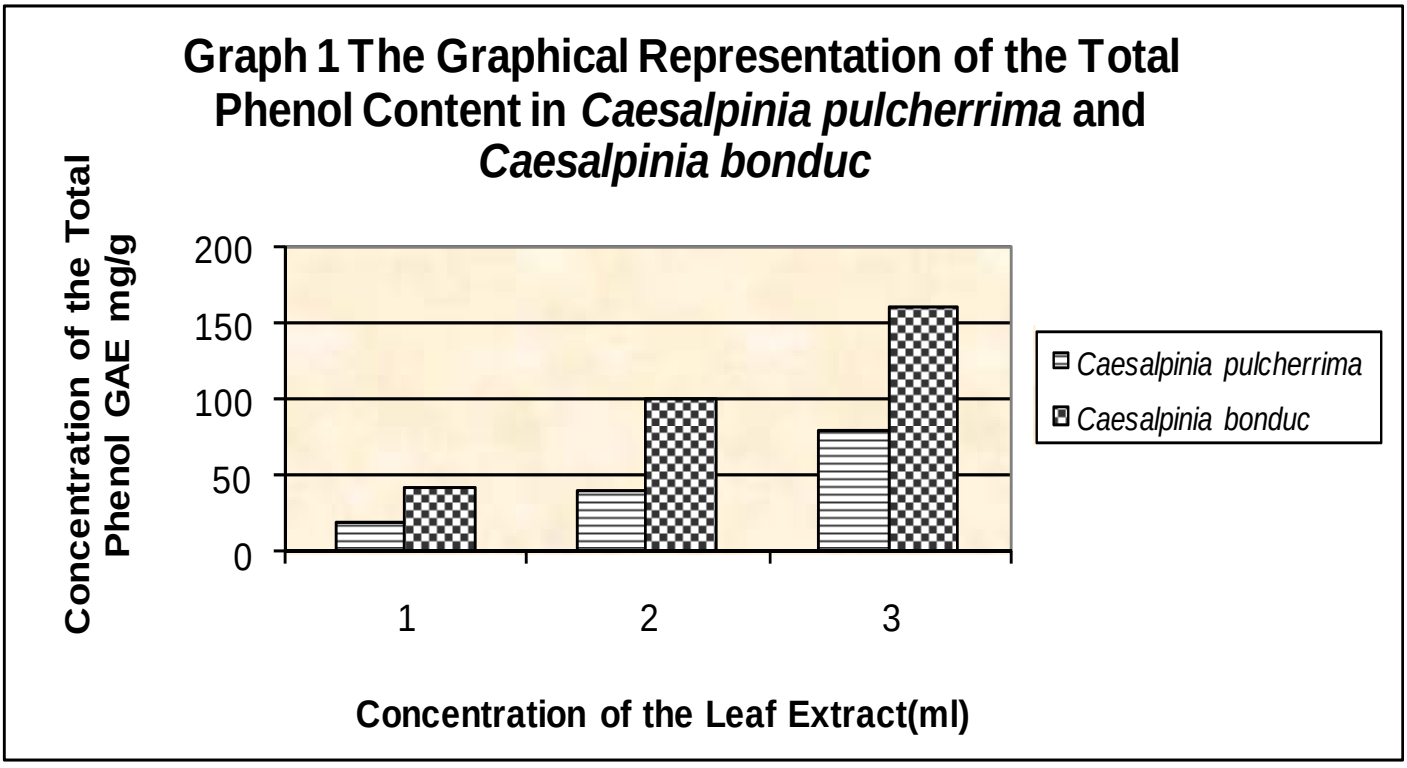
Strongly present -+++, Present - ++, Weakly present - +, Absent- -

Table 6. Results of qualitative analysis of tannins, saponins, cyanins, phytosterols & coumarins of C. bonduc.

Phytochemical test	Extracts			
	Ethanol	Methanol	Hexane	Aqueous
Test for the presence of the Tannins				
Ferric chloride test	+++	++	-	++
Test for the presence of the saponin				
Foam test	-	-	-	-
Test for the presence of the anthocyanin & betacyanin				
Alkaline test (Anthocyanin)	-	–	-	-
Alkaline test (Betacyanin)	++	++	++	++
Test for the presence of phytosterols				
Terpenoids test	++	++	+	++
Triterpenoids	++	++	-	-
Test for the presence of coumarins				
Alkaline test	++	++	-	++

Strongly present -+++, Present - ++, Weakly present - +, Absent- -

tannins and steroids (Gupta *et al*., 2004). It was controversial that Saponins were absent in the methanolic extract of the present study while all other above mentioned metabolites are significantly present in all the extracts in unison with previous studies. The extract of hexane has given fewer active ingredients when compared with the other solvent-extracts. The methanol extract of *C. bonducella* leaves containing flavonoids and triterpenoids, the antioxidant defense system has been evaluated (Gupta *et al*., 2005). All other phytochemical components discussed here are present in the present study of the C. *bonduc.* The phenolic compound has several functions such as singlet and triplet oxygen quenchers, free radical scavengers, peroxide decomposers, enzyme inhibitors and synergists (Zhang *et al*., 2004). The qualitative analysis have shown the presence of phenol in all the extracts performed other than the hexane for *C. bonduc* and methanol for *C. pulcherrima*. The agro climatic conditions shall be made conducive for domesticating new exotic plant varieties



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(Krishnaraju *et al.,* 2005). Thus or in this aspect, the wild species *C. bonduc* have shown much higher values for the total phenol content estimation than the ornamental plant *C. pulcherrima*.

Conclusion

The experimental plants *C. pulcherrima* and *C. bonduc* studied here can be a potential source of useful drugs exploiting the antimicrobial, antioxidant and antitumor activities of these plants. The wild plant harbours higher values of the active ingredients than the ornamental plant which needs further research in the angle whether the domesticating factor influences the medicinal value of any plant. Further studies are being conducted on these plants in order to isolate, identify, characterize and elucidate the structure of the bioactive compounds.

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