

## Preliminary phytochemical screening of the medicinal Plant *Adenanthera pavonina* and its morphological variation

A P Anoma Jayasiri<sup>1</sup>, S P Senanayaka<sup>2</sup>, P Paranagama<sup>3</sup>, A P G Amarasinghe<sup>1</sup>

### Abstract

*Adenanthera pavonina* L.(vernacular:Madatiya) is a medicinal plant, belongs to family Fabaceae. It is widely used for the treatments of many diseases in various therapeutic systems including Ayurveda. The medicinal uses and the distribution of the species were studied using a structured questionnaire survey considering 100 sample population. Morphological characters were analyzed using the specimens collected from their natural habitats to infer the phenetic relationships and has shown no variations with respect to their habitat differences. Qualitative phytochemical analysis was done to identify the chemical compounds present in the stem bark extracts of different solvents such as hexane, chloroform, methanol and water. Phytochemical screening of stem barks of the different samples confirms the presence of phytochemicals; alkaloids, flavonoids, glycosides, tannins, steroids, and saponins in the extracts of the methanolic, chloroform and water. This study draws attention to the need of further analysis of the active principles of the species in order to understand their mode of action in different diseases.

### Introduction

*Adenanthera pavonina*, belongs to family Fabaceae, is earlier reported as endemic to India. However, the tree has been introduced throughout the humid tropics. Therefore, it has become naturalized in Malaysia, Western and Eastern Africa and most island nations of both Pacific and the Caribbean [1]. It is also introduced in the American countries. Currently *A.pavonina* is cultivated in all the tropics. There are two *Adenanthera* species available in Sri Lanka known as *A.pavonina* (vernacular: Madatiya) and *A.bicolor* (vernacular:Mas mora).The latter is endemic species and found in wet, South East area of Sri Lanka specifically in Sinharaja forest reserve. In Sri Lanka *A.pavonina* is commonly found in low country up to 1300m altitude. This species is cultivated and was reported in Kandy, Kalutara, Ratnapura, Badulla, Gampaha and Colombo districts [2].

The entire plant of *A.pavonina* is used for its timber value, medicinal properties, an ornamental garden plant and shady

tree. This tree is useful for nitrogen fixation therefore often cultivated for forage. Seeds are used as beads in necklaces and also used as a measuring unit in weighing ingredients in medicinal preparations [3].

From ancient time, plants are known as rich source of effective and safe medicines. Herbal medicines have been main source of primary health care in many nations. About 80% of world population is still dependent on traditional medicines [4]. In traditional societies, nutrition and health care are strongly interconnected and many plants have been consumed both as food and for medicinal purposes [5]. Medicinal plants are natural sources of compounds that can be used against many diseases today. Plants and plant based medicaments are the basis of many of the modern pharmaceuticals use for various ailments.

Phytochemicals are naturally occurring secondary metabolites produced in plants that help to provide their characteristic odor, flavor, smell and texture of plants. Apart from that phytochemicals are used to control diseases including cancer and cardiovascular diseases and to inhibit pathogenic microorganisms [6,7]. These phytochemicals work with nutrients and fibers to form an integrated part of defense system against various diseases and stress conditions (8). The most important bioactive constituents present in plants are alkaloids, tannins, flavonoids, steroids, terpenoids, carbohydrate and phenolic compounds [9].

In terms of medicinal uses, the seeds of *A.pavonina* have been found to be effective in treating cardiovascular diseases in pregnancy. The ground seeds are used to treat boils and inflammatory reactions. Decoction of leaves is used to treat gout and rheumatism [10]. Methanol extract of seeds has been evaluated for pharmacological effects in animal models, and the study demonstrated the anti-inflammatory and analgesic effect [11]. In Sri Lanka *A.pavonina* is mentioned in herbal formulations practiced among traditional ayurvedic practitioners, and in different drug preparations in ayurveda pharmacopeia. Different parts: bark, leaves, seeds and roots of the tree are used for

1.Institute of Indigenous Medicine, University of Colombo, Sri Lanka

2.Department of Botany, Faculty of Science, University of Kelaniya, Sri Lanka

3.Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka

Correspondence: A P A Jayasiri, Lecturer, Department of Dravyaguna Vignana, Institute of Indigenous Medicine, University of Colombo, Sri Lanka E mail: anoma\_jayasiri@yahoo.com

preparation of different drugs in Sri Lanka [12]. Therefore findings of this investigation would provide important information to develop drugs using this plant materials as ingredients in future studies.

## Materials and Methods

### Morphological Study

#### Identification and collection of plant material

Morphological characters and distribution of the plants were studied by referring to available literature and by conducting several field visits to their natural habitats. Based on the findings of the biogeographical survey specimens were collected from their natural habitats and were identified against authenticated specimens at National Herbarium, Peradeniya. Morphological variation was studied for their seedling, leaf, bark, floral, pod and seed characters.

#### Socio-economical survey

A structured questionnaire survey was carried out to determine the uses of *A.pavonina* using hundred sample population consist of ayurvedic physicians, traditional ayurvedic practitioners, drug suppliers, drug manufacturers and general public. *A.pavonina* was reported as a substitute plant of *Albizia lebbek* in the similar questionnaire survey carried out in the preliminary study under the present project.

### Phytochemical Screening

#### Preparation of solvent extracts of *Adenanthera pavonina* stem bark

Stem bark of *A. pavonina* was shade dried and powdered using a mechanical grinder (Disk mill, SHC23, China). Powdered stem bark (1kg) was subjected to sequential solvent extraction using hexane (2L), chloroform (2L) and methanol (2L) after keeping overnight in the shaker (Orbital shaker, Lab-Line, UK) separately. Each extract was filtered and the solvent was removed using a rotary evaporator (Buchi, R-114, Switzerland) and the yield of crude extracts were weighed using an analytical balance.

#### Preparation of the aqueous extract of *Adenanthera pavonina* stem bark

Powdered stem bark (250 g) of *A. pavonina* was mixed with 750 ml of distilled water and kept in the shaker for overnight. Filtrate was separated from the residue, and then

the filtrate was freeze dried. The weight of the freeze dried sample of the extract was recorded and the extract was used for preliminary phytochemical screening.

### Phytochemical analysis

Each solvent and aqueous extract of *A.pavonina* (1g) was dissolved in of its own mother solvent hexane (1ml), chloroform (1ml), methanol (1ml), and distilled water (1ml), separately to obtain a stock solution (1% w/v). The obtained extracts were subjected to preliminary phytochemical screening using the standard procedures given below [13,14, 15].

#### Tests for phytochemical analysis

##### Carbohydrates

Molish's test  
Fehling's test  
Bednadic't's test

##### Proterins and Amino Acids

Biuret test  
Millon's test  
Xantho protein test

##### Alkaloids

Dragendroff's test  
Mayers test  
Hager's test

##### Flavonoids

Shinoda test  
Ferric chloride test  
Alkaline reagent test.

##### Glycosides

Hydrolysis test  
Legal's test  
Borntrager's test

##### Tannins and Phenolic compounds

5% Ferric chloride solution  
Lead acetate solution  
Gelatin solution  
Acitic acid solution Dilute acid

##### Phyto steroids

Salkowski test

##### Saponins

Foam test

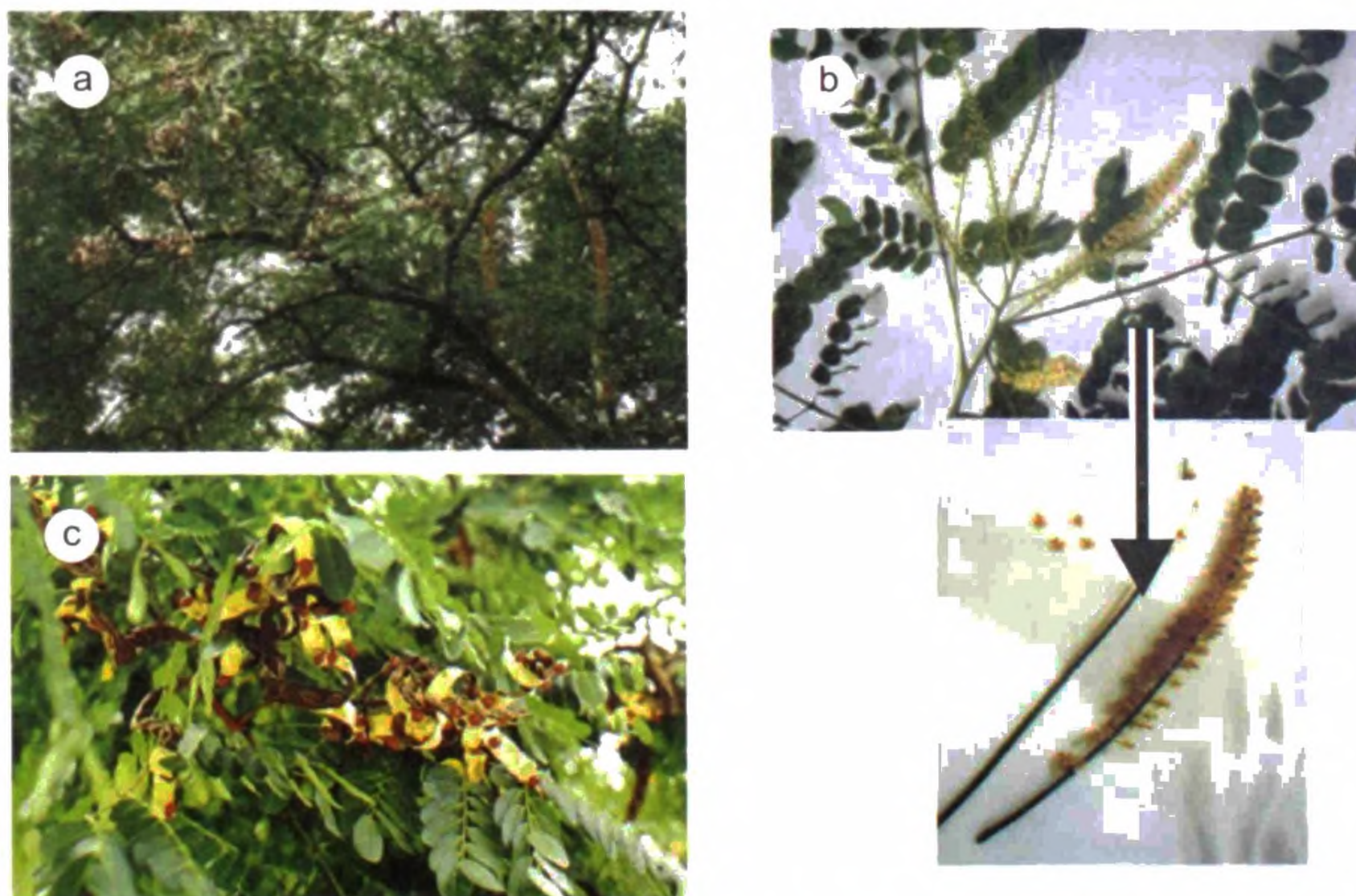
### Results

#### Morphological study

It was found that the erect racemose inflorescence, pale yellow flowers, dark brown coiled legume pods and shiny scarlet lens shaped seeds of *A. pavonina* as important diagnostic characters in field identification (Table 1 and Figure 1).

**Table 1: Morphological characters of *Adenanthera pavonina***

No.	Character	Character State
1	Habitat	Terrestrial
2	Type of plant	Woody
3	Type of leaf	Compound
4	Leaf pattern	Bipinnate; leaflets alternate
5	Trunk-bark characters	B-Smooth to fissured grey; IB-light brown, h-red, hard durable
6	Single/Inflorescence	Inflorescence
7	Type of inflorescence	Erect racemes
8	Colour of flowers	Pale Yellow
9	Fruit	Legume
10	Colour of pod	Dark Brown
11	Appearance	Coiled legume
12	Length of pod	28cm – 30cm
13	Width of pod	1.2cm – 1.5cm
14	Number of seeds	20-25
15	Color of seeds	Shiny Scarlet
16	Shape of seeds	Lens – Shape
17	Seeds arrangement	Marginal

**Figure 1 : Habit of *Adenanthera pavonina* ; (a)Vegetative Features, (b)Flowers, (c) Pods and Seed**

The questionnaire survey revealed that *A. pavonina* is used to prepare local application Dashangalepa in few ayurvedic hospitals (09%) as a substitute for *Albizia lebeck*. Further, different parts are used in various other medicinal preparations.

### Phytochemical Study

Crude weight of different solvent extracts obtained are given in (Table 2). The highest yield was obtained from methanolic extract of stem bark of *A. pavonina* revealed the bark contained more polar compounds. Preliminary phytochemical screening to detect the different chemical principles present carbohydrates, protein and amino acids, glycosides, alkaloids, phytosteroids, flavonoids, saponins, tannins and phenolic compounds were recorded in (Table 3). Some phyto-chemicals present in methanol, water, and chloroform and not found in hexane extract.

**Table 2 : Crude weight of different extracts**

Solvent	Crude weight of plant extract (g)
Hexane	2.238
Chloroform	1.940
Methanol	126.629
Water	1.315

**Table 3 :**

### Qualitative phytochemical constituents of *A. pavonina*

Test for secondary metabolites	Hexane	Methanol	Chloroform	Water
Flavonoids	-	+	-	+
Glycosides	-	+	-	-
Tannins and phenolic compounds	-	+	-	+
Phytosteroids	-	+	-	-
Proteins and amino acids	-	-	+	-
Saponins	-	-	-	+
Carbohydrates	-	+	-	-

Note: (+) indicates presence (-) indicates absence

### Discussion

Similarity in morphological characters with respect to the geographical distribution of *A. pavonina* was observed and that supported the absence of morphological variation in the ecotypes. This would be very useful for accurate identification of the plant for the medicinal properties.

Phytochemical analysis has shown nature of the chemical constituents present in different solvent extracts. In the preliminary phytochemical screening highest yield was obtained from the methanolic extract of *Adenanthera pavonina*. This observation suggested that stem bark

contained more polar compounds. Further, results indicated that the methanol extract have high amount of phytoconstituents i.e tannins and phenolic compounds, alkaloids, carbohydrates, glycosides, phytosteroids and flavonoids than the other extracts.

Alkaloids are known as effective phytoconstituents associated to their sedative properties and powerful effect on the nervous system [3]. Hence the presence of alkaloids in stem bark of *A. pavonina* supported the efficacy of the use of the plant parts of *A. pavonina* in pain relief herbal preparations. Presence of flavonoids in methanol and aqueous extracts of *A. pavonina* suggested the possibility of developing antioxidant agents. The presence of steroids in methanol extracts of *A. pavonina* in the present study also attested the possible efficacy of therapeutic use of *A. pavonina*. Steroidal compounds are of highly important and interest in pharmacy. It was reported that the chemical structure of these compounds are related to some of the sex hormones hence could be used as potent starting material in the synthesis of sex hormones [16]. Presence of tannins in both methanolic and aqueous extracts of this species is a good finding for pharmaceutical industry. Saponins are bioactive plant constituents which are known to be responsible for numerous pharmacological properties [17]. Saponin is a key ingredient in Traditional Chinese Medicine and is responsible for many of the attributed biological effects [18, 19]. Saponins are known to produce inhibitory effect on inflammation [20], therefore presence of saponin in aqueous extract of *A. pavonina* can be used to develop drug preparations for many diseases as well as for anti-inflammatory agents.

Socio-economical survey has revealed that *A. pavonina* is used as a substitute for *Albizia lebeck* by traditional ayurvedic practitioners in Sri Lanka due to the restricted distribution of *Albizia lebeck*. Therefore, further isolation, identification, purification, characterization and elucidation of the structure of the bioactive compounds of these species would be necessary to develop useful chemotherapeutic agents.

### Conclusion

The present study has provided the necessary knowledge in accurate identification of the specimens and medicinal uses of *A. pavonina* in Sri Lanka. The findings of preliminary phytochemical evaluation of *A. pavonina* provided useful information for developing new drugs in future herbal therapeutic preparations.

### Acknowledgement

Authors are grateful to the National Center for Advance Studies of Sri Lanka, grant (10/NCAS/IIM/Ayu/30) and university research grant (RP/03/02/01/20210) University of Kelaniya, for supporting this research.

## References

1. Aduragbenro DAA, Yeside OO, Adeolu AA, Olanrewaju MJ, Ayotunde SA, Olumayokum AO and Janet MM, Blood pressure lowering effect of *Adenantha pavonina* seed extract on normotensive rats, *Records of natural products*, 2009; 3(2), 82-89.
2. Kosterman AJGH: Memosaceae In: Dassanayake MD, Fosberg FR, editors. A revised hand book to the Flora of Ceylon, Amerind Publishing Co., New Delhi, India 1980; 469-472.
3. Corner EJH, *Wayside Trees of Malaya* : Malayan Nature Society, 4<sup>th</sup> ed., 1997.
4. Tiwari S, *Plants : A Rich Source of Herbal Medicine*, *Journal of Natural Products*, 2008;1: 27-35.
5. Packia J, Jacob S, Shenbagaraman S, Evaluation of antioxidant and antimicrobial activities of the selected green leafy vegetables, *International Journal of Pharm Tech Research*, 2011; 13(1): 148-152.
6. Renu S., Useful metabolites from plant tissue cultures, *Biotechnology*, (2005), 4(2), 79-93.
7. Pius OU, Egbuonu ACC, Obasi LN and Ejikeme PM, Tannins and other phytochemicals of the *Samanea saman* pods and their antimicrobial activities, *African Journal of Pure and Applied Chemistry*, 2011; 5(8), pp.237-244.
8. Koche D, Shirsat R, Imran S, Phytochemical screening of eight traditionally used ethnomedicinal plants from Akola district (ms) India, *International Journal of Pharma and Bio Science*, 2010; 1(4).
9. Pascaline J, Charles M, Lukhoba C, Phytochemical constituents of some medicinal plants used by the Nandis of south Nandi district Kenya, *Journal of Animal and plant sciences*, 2011; 9(3): 1201-1210
10. Burkill HM, *The useful plants of west Tropical Africa*. (1994), Royal Botanical Gardens, Kew.
11. Olajide OA, Echianu CA, Adedapo ADA, and Makine JM, Anti-inflammatory studies on *Adenantha pavonina* seed extract, *Inflammo pharamacol.*, 2004; 12(2):196-202.
12. *Ayurveda Pharamacopoeia* , Department of ayurveda, Colombo, Sri Lanka, 1979; 124.
13. Rajan M, Kishor Kumar V, Satheesh Kumar P, Venkatachalam T, Anbarasan V, Pharmacognostical and Phytochemical studies of the leaves of *Albizia odoratissima* (L.F.) Benth : *International Journal of Pharmacognosy and Phytochemical research*, 2011; 3(3): 47-55.
14. Khandelwal KR, *Practical Pharmacognosy*, Published by Nirali Parakshana, Pune, 19<sup>th</sup> Edition, 2008: 146-148, 149-156.
15. Harbone JB, *Phytochemical method, A guide to modern techniques of plant analysis*. 3<sup>rd</sup> Edn., Chapman and Hall Int.ed., New York, 1998.
16. Okwu De, Evaluation of the chemical composition of indigenous species and flavouring agents, *Global J. Pure Appl. Sci.*, 2001; 7(23): 455-459.
17. Estrada A, Katselis GS, Laarvied B, Isolation and evaluation of Immunologocal adjuvant activities of saponins from *Polygaja senega*. L. com, *Immunol, Microb. Infct, Dis.*, 2000; 23
18. Liu J, Henkel T, Traditional Chinese medicine (TCM) Are polephenols and saponins the key ingredients triggering biological activities *Med. Chem*; 2002; 9: 1483-1485
19. Li Hy, Cui L, Cui M, Hot topics in Chinese herbal drugs research documented in PubMedI Medline by authors inside China and outside of China in the past 10 years : Based on co-word cluster analysis. *J. Altern. Complement Med.*, 2009; 15 : 779-785
20. Just MJ, Recio MC, Giner RM, Cueller MJ, Manez S, Billia AR, Rios JL, Anti-inflammatory activity of unusual lupine saponins from *Bupleurum fruticosens*, *Planta Medica*, 1998; 64: 404-407.