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Uraria picta: An Overview

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ABSTRACT

Uraria picta (Jacq.) DC. (Family Leguminosae, Papilionoidae) is an important plant species in Ayurvedic medicine and one of the most important constituents of the 10-herb formulation called 'Dashmula'. The ayurvedic name of the species is *Prishni parni* while the trade name is *Dabra*. The species is endangered, hence requires special attention and an overview was conducted involving the various aspects of *U. picta* to provide necessary information and to induce interest among researchers for its conservation and utilization in traditional as well as modern systems of medicine.

Keywords: agronomic aspects, anatomical aspects, biochemical analysis, cytological aspects, description, *in vitro* propagation
Abbreviations: AI, anaphase I; **AR**, analytical reagent; **ARS**, Agricultural Research Service; **AYUSH**, The Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy; **BAP**, 6-benzylaminopurine; **DAP**, diammonium phosphate; **DF**, degree of freedom; **IBA**, indole-3-butyric acid; **IR**, infra red; **MI**, metaphase I; **MIC**, minimum inhibitory concentration; **MS**, mass spectrophotometry; **NAA**, α-naphthalene acetic acid; **NMR**, nuclear magnetic resonance; **P**, probability; **PMC**, pollen mother cell; **RP-LC**, reverse phase-liquid chromatography; **t**, test of significance; **TS**, transverse section; **UV**, ultra-violet

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INTRODUCTION

A comprehensive overview of *Uraria picta* (Jacq.) DC. (Family: Leguminosae, Papilionoidae) is presented to provide information, to disseminate knowledge and to evoke interest among researchers. *U. picta* is reported to be an erect woody herb (Burkill 1985; Okusanya *et al.* 1991), perennial herb (Nasir and Ali 1970; Turrill and Redhead 1952; Anand *et al.* 1998; Rahman *et al.* 2007), perennial shrub (Gill and Husaini 1986) and annual woody erect herb and undershrub (Ambe *et al.* 2001) with immense traditi-onal uses. The species is also one of the most important constituents among ten herb formulation called 'Dashmula' (Khare 2007), a well established Ayurvedic medicine. The Ayurvedic name of the species is *Prishni Parni* while the trade name is *Dabra*.

Therapeutic uses

Almost all parts of the plant species are therapeutically important. The root decoction is used to treat cough, cold, chills, fever, antiseptic and general healing (Burkill 1985; Kirtikar *et al.* 1993; Yusuf *et al.* 1994; Singh *et al.* 2002; Khare 2007) while leaves are used as a diuretic, aphrodisiac, general antiseptic and to cure oral sores (Okusanya *et al.* 1991; Billore *et al.* 2004). The whole plant is reported to possess antivenom activity against *Echis carinata* (Allen and Allen 1981; Kirtikar *et al.* 1993), common name: *afai*. It is also effective for the treatment of gonorrhea (Jain and Defilipps 1991), gynaecological disorders (Billore *et al.* 2004) and fracture healing (Sankaran *et al.* 1964; Prasad *et al.* 1964, 1965; Gurav *et al.* 2008). According to African folklore the plant species has also purported medicinal uses, including influencing the sex of the unborn fetus and breaking up of friendship and love affairs (Saunders 1958; Lambo 1979). The plant species (extract of dried arboreal parts) is also reported to possess antimicrobial (Osazuwa and Igboechi 2006; Rahman *et al*. 2007), acaricidal (Igboechi *et al.* 1989) and antiulcerogenic (Manonmani *et al*. 1995) properties. Sharma *et al*. (2009) noted the influence of the root

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extract in improving the egg shell quality in older laying hens due to calcium and phosphorus supplements.

Synonyms

Doodia picta (Jacq.) Roxb., *Hedysarum pictum* Jacq., *Uraria aphrodisiaca* Welw., *Uraria leucantha* Span., *Uraria linearis* Hassk. (Huang and Huang 1987) – updated 2003 by ARS Systematic Botanists; *Drimia indica* Roxb. non-(Wt.) Baker – Khare (2007).

Distribution

The species, though widely distributed throughout India (Kirtikar *et al.* 1993), is increasingly becoming rare and endemic (Anand *et al.* 1998). *U. picta* is commonly found in dry grasslands, growing densely and producing poorly viable seeds and it also extends up to 300 m in the Tarai region of the Himalayas (AYUSH 2008). Apart from India, *U. picta* is also reported from parts of Asia (China, Japan, Bangladesh, Pakistan, Bhutan, Nepal) and Africa (Nigeria, Egypt, Ethiopia, Congo, South Africa) (McNeill *et al*. 2006; Osahi and Iokawa 2007) and Queensland Australia (Batianoff *et al.* 2000).

Plant description

As per the cultivation of *U. picta* in the Experimental field of University of Kalyani in West Bengal plains (22° 99' N, 88° 45' E, elevation – 48 feet above mean sea level, sandy loamy soil, organic carbon-0.76%, soil pH 6.85), the species (**Fig. 1**) is erect (growing period in eastern India – Kalyani University Experimental field – late May to early November), 90.0 cm to 120.0 cm in height, 1 to 3 branched; roots stout (**Fig. 5**), nodulated, branched (5–8), 35.0 to 55.0 cm in length; leaves alternate, compound; unipinnate, imperipinnate; leaflets 4 pairs with 1 odd as terminal (**Fig. 3**); opposite, linear–oblong, 13.5 to 15.7 cm long and 2.2 to 3.0 cm wide, obtuse to acute at apex, entire at margin, rounded at base, herbaceous, unicostate reticulate with prominent secondaries, hairy on both surfaces more beneath, *green* (12163, color confirmed from British Atlas of Colour, 9th Edt., 2007) with *copper* (26791) shade and with *white* (00320) blotches along the mid vein on the upper surface, petiolulate; petiolules pulvinous about 3 mm long, hairy, *dull green* (12163); stipules linear dentate, hairy, acute, *dull green* (12098); petiolate; petioles hairy, *green* (12163), pulvinous at base; stipulate; stipules free lateral, ovate, angular, 6-9 mm long × 3.5 mm wide, hairy, *green* (12163), persistant; flowers small on dense villous spike like racemes (**Fig. 2**), inflorescence rachis 25.0 to 35.0 cm long (flowering time: June to October), bisexual, actinomorphic, bisymmetric; corolla color *fuchsia mauve* (19163/19163D), stamens 9 + 1, short single styled, superior ovary, 1 loculed containing 2 to many marginal ovules; pistil simple stipitate; pollen grain ovoid, tricolpate, regular and uniform (43.0 µm × 43.0 µm) (**Fig. 4**); pollen fertility – 97.58% (1562 pollen grains estimated) as assessed from 1% acetocarmine (Gurr, AR) staining (Marks 1954); pods (**Fig. 6**) two types – *charcoal grey* (13691), length 3.1 ± 0.26 mm and breadth 2.8 ± 0.21 mm and *brownish black* (26213), length 3.04 ± 0.23 mm and breadth 2.8 ± 0.20 mm (size difference between pod types were non significant; $t = 0.072$, DF- 28, $P > 0.05$); grey pods were found in 76.2% per raceme and black pods making up the rest, black pods were mostly in middle parts of the racemes; pods moniliform, jointed (5-7) oppositely, arranged face to face, each segment 1 seeded; seeds of grey pods were significantly larger (length: $t = 2.18$, DF- 58, $P < 0.05$; breadth: $t = 1.16$, DF- 58, $P > 0.05$) in length (2.1 ± 0.31 × 1.4 ± 0.22 mm) and different in color (*yellow* 10193 – **Fig. 6a**) than those of black pods (size: 1.80 ± 0.36 × 1.20 ± 0.22 mm; color: *greenish yellow* 10603 – **Fig. 6b**); seeds oblong-ovoid with elongated hylum.

Seeds of grey pods were 100.0% viable, as assessed by dipping half seeds in 1% aqueous solution of tetrazolium chloride (LOBA Chemie, AR) (Moore 1976) while, seeds of black pods were totally non–viable.

Size difference of pods and seed types were analyzed following computation of Student's *t*-test to assess variation, if any. The size of the samples is evident from DF values.

Figure plate *Uraria picta*. (**1**) The whole plant of *U. picta*; (**2**) Inflorescence showing flower color; (**3**) Juvenile leaflets; (**4**) Fertile pollen grains. (Scale bar = 100 µm); (**5**) Stout branched root with nodules; (**6**) *Charcoal grey* fruits with *yellow* seeds (A) and *brownish black* with *greenish yellow* seeds (B); (**7**) T.S. of stem showing secondary activity. Transverse fibre patches evident in cortex. (Scale bar = 0.5 mm); (**8**) T.S. of root with secondary activity. (Scale bar = 0.5 mm); (**9**) AI cell showing 11/11 chromosome separation ($2n = 22$). (Scale bar = 10 µm); (**10**) PMC with 11 II ($2n = 22$) at MI. (Scale bar = 10 µm).

Anatomical studies

Transverse sections (hand sections) of the stem from the basal region (4.0 to 5.0 cm above ground level) and root (6.0 to 7.0 cm below ground level) were made from fully matured plants (at fruit ripening stage; 90-100 days from sowing), and the sections were double stained using 1.0% Safranine (Merck, AR) dissolved in 50.0% alcohol and 1.0% Light green (Merck, AR) dissolved in 90.0% alcohol (Johansen 1940).

Stem (**Fig. 7**): Epidermis disrupted due to the secondary growth, cells rectangular; hypodermis few cell layered, thick walled cells; cortex (1.21 mm) thicker than hypodermmis, fibrous cells present in transverse patches; stellar region extended, phloem as triangular patches outwardly, xylem interrupted with series of ray cells; vessel elements prominent, primary xylem towards center often associated with inner phloem patches; pith parenchymatous, large thick walled polygonal cells, compactly arranged, no intercellular spaces.

Root (**Fig. 8**): Epiblema disrupted, secondary growth

present, cork layer (0.46 mm) thick, few cell layered; cortex 25 to 30 cell layered (1.63 mm), cell shape polygonal rounded to oblong, thin walled, compact, scattered dark cells; stele major part, secondary xylem present, ray cells prominent, secondary phloem in patches, peripheral; pith absent, primary xylem present centrally.

Sections were dehydrated using graded alcohol (30.0, 50.0%) for 5 min each, stained in 1.0% safranine solution for 20 min, destained (removal of superficial stain) repeatedly in 50% alcohol, transferred to 70% (5 min), 90% (5 min) alcohol grades, counter stained using 1.0% light green for 1–2 min depending on the thickness of the sections, destained repeatedly in 90% alcohol and transferred to Xylol for clearing (5-10 min) before mounting in Canada balsam.

Plantation and agroclimatic factors

The crop can be raised successfully from seeds. It germinates well in humus and sand compared to red earth (Okusanya *et al.* 1991). Loam to clay loam soil is suitable for its cultivation and the species can tolerate a soil pH of up to 8.5 (AYUSH 2008). However, Okysanya *et al.* (1992) reported that wet and moist soil conditions produced significantly better growth than dry or waterlogged conditions. The authors further suggested that the species responded identically to pH 3.5, 5.5 and 7.5. The species also possesses salinity tolerance.

About 4-5 kg seeds are reported to be required for plantation in 1hectare of land and overnight pre-soaking of seeds in water improves germination (AYUSH 2008). Okusanya *et al.* (1991) reported that germination frequency increases with decrease in soil moisture and burial of seeds up to 1.5 cm increases germination, thereafter germination leveled off. The authors further suggested that alternating temperatures of 31/21 and 31/15°C favored germination, while 21/15°C inhibited germination.

Land preparation (deep ploughing followed by harrowing twice and leveling), fertilizer application (farmyard manure at 10 tonnes/hectare at the time of field preparation; DAP at 100 kg/ha as basal dose), transplantation (50 to 60 days old seedlings from nursery bed given to field plots), optimum spacing (30 cm × 30 cm in 1 ha land), intercropping (mixed with *Desmodium gangeticum* and other herbs may be grown in inter-row spaces and in such case spacing and row distance should be increased), weeding (manual weeding recommended at 25, 45 and 90 days after transplantation) and irrigation (after transplantation and repeated at an interval of 12-15 days in summer, depending on monsoon rain) are the cultural practices formulated for *U. picta* by the National Medicinal Plant Board, AYUSH (2008).

Harvest management

Roots may be harvested at the flowering stage during the months of November–December at Kalyani, West Bengal and stored in humidity free condition. For collection of roots the entire plant is dugout carefully. The approximate yield of dry roots per hectare is 3 to 4 quintals and it accounts to Rs. 80,000 (AYUSH 2008).

Disease and pests

Water stagnation causes stunted growth, curling and browning of leaves; however, the plants recover easily after the stress period is over. No disease or insect pests are reported in the crop causing serious damage. However, 0.1% $HgCl_2$ untreated seeds were reported to be infected by *Fusarium* spp. and *Alternaria* spp. (Okusanya *et al.* 1991).

Nutritional value

Pandey and Srivastava (1991) studied the nutritional capabilities of four wild legumes in North-Eastern India including *U. picta* using seed protein concentrate (SPC) to evaluate contents of amino acids, ash, starch, sugar, fibre, phosphorus, ether extractive and calories as well as for in vitro enzymatic digestibility by pepsin-trypsin enzyme system. Results indicated promising nutritional potential of these SPCs.

Ambe *et al.* (2001) estimated the amount of essential amino acids (nutritional value obtained from chemical score, which was about 87.0%) from seeds of *U. picta* and found it close to cultivated legumes (garden pea, horse bean, kidney bean, amongst others) and cereals (bread-wheat, rice and barley). The authors also reported that though the lipid content of seed was low (1.6%), but the seed oil contains large proportions of essential and long chain fatty acids. Thus from the potential nutritive value of the seeds of *U. picta* the species may be included in the diet of rural/tribal populations.

Cytogenetical aspects

From the available literature it seems that only chromosome number $n = 11$ (Bir and Kumari 1975; Gill and Husaini 1986) and $2n = 16$ (Sanjappa and Dasgupta 1977) are reported in the species. Wheeler *et al.* (1992) and Pridgeon *et al.* (2003) documented $2n = 20$ and 22 (18 species analyzed), and $2n = 20$ (20 species studied) respectively as the chromosome number for the genus *Uraria*. Meiotic analysis of *U. picta* revealed $2n = 22$ (**Figs. 9, 10**) chromosomes always with secondary association of chromosomes and secondary polyploidy has been attributed as the possible cause of it (Bhattacharya and Datta 2010). The authors suggested that the basic chromosome number for the species is $x = 6$ with probable autopolyploid lineage.

In vitro propagation

Micropropagation of *U. picta* was achieved through axillary bud culture and nodal callus culture (Anand *et al.* 1998). The authors reported that bud break was best when nodes were cultured in MS (Murashige and Skoog 1962) medium supplemented with NAA 2.0-6.0 µM and N^6-benzyladenine (4.4 µM). Competent calluses regenerated into profusely growing shoots on transferring to 0.13 µM N^6-benzyladenine and the elongated shoots (5 nodal lengths) were rooted on half-strength MS basal medium and about 400 plants transferred to the field showed 80% survivability. Gurav *et al.* (2008) performed successful *in vitro* shoot organogenesis by culturing 1.0 to 1.5 cm length of nodal explant and whole cotyledons (4 weeks old) on basal MS medium with 13.2 µM BAP. The cultured shoots were rooted in half MS medium with 9.8 µM IBA and the regenerated plantlets were hardened and transferred to field.

Biochemical analysis

Rahman *et al.* (2007) isolated and elucidated the structures of two new isoflavones (5,7–dihydroxy-2' methoxy-3',4'-methelenedioxyisoflavanone; 4',5-dihydroxy-2',3'-dimethoxy-7-(5-hydroxychromen-7yl)-isoflavanone) following UV, IR, MS and 1D and 2D NMR analysis from roots of *U. picta*. Those compounds were found effective (MIC ranging from 12.5-200.0 µg/ml) against Gram-positive (*Staphylococcus aureus* NCTC10788 and *Bacillus subtilis* NCTC8236), Gram-negative (*E. coli* NCTC90001 and *Proteus vulgaris* NCTC4175) and fungi (*Aspergillus niger* NCPF3149 and *Candida albicans* IMII49007). Apart from the two new compounds the authors also found six previously known compounds. Yadav *et al.* (2009) quantified rhoifolin amount by RP-LC method from air-dried, finely powdered aerial part of the plant species and reported the highest amount (0.571% w/w) from methanolic extract with ultra sonication.

CONCLUSION

A comprehensive overview on *Uraria picta* is documented with the purpose that it will definitely provide additional emphasis to breeders and geneticists for raising superior

plant types (higher phytochemical yielding varieties) through efficient breeding and induced mutagenesis notwithstanding the significance of its mass propagation and *ex situ* conservation. Identification and complete evaluation of the phytochemical constituents are most desirable for better utilization of *U. picta* for modern as well as traditional system of medicine. Further, biogeneraton of the plant species is also recommendable for globalization and maximizing trade.

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