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Uraria picta: A comprehensive review on evidences of utilization and strategies of conservation

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ABSTRACT

Uraria picta (Jacq.) DC. (Prishnaparni) is one of the most important medicinal plants used in different traditional systems of medicines including the Ayurveda and Traditional Chinese medicine. The major use of this plant was found in the most popular Ayurvedic formulation "Dashmula" and in several many other important Ayurvedic formulations. IUCN placed this woody herb in the least concern category as per version 3.1. It has extensive therapeutic uses and pharmacological activities. Though this plant is a source of many phytochemicals, the uses are uncertain because the raw plant parts or crude extracts are being used in all formulations. Therefore, extensive investigations are necessary to focus on the identification of these phytochemicals. It is an urgent need to give special attention to collecting various aspects and more efforts are required in all areas for utilization and conservation of this valuable medicinal herb. Herein, a compilation of all information with various aspects has been presented, including the authors published work on *Uraria picta*. This review pursues attention towards biological activity, phytochemical profile, utilization, propagation and conservation of *Uraria picta*.

KEYWORDS: Biological activity, Dashmula, *In vitro* propagation, Phytochemical

INTRODUCTION

In addition to the allopathic system of medicine, Ayurveda, Homeopathy, Unani, Siddha and Yoga are also used as traditional systems of medicines in India. Among these, Ayurveda is the oldest system of medicines which originated in pre-vedic period. Rigveda and Atharvaveda are the most primitive documented evidences on ancient Indian knowledge about medicines. Ayurveda is an upvedas of Rigveda and Atharvaveda. Of the different Ayurvedic texts, Charak Samhita and Sushruta Samhita deal elaborately with maintenance of health throughout the life and its various phases and developed a wide range of therapeutic measures related to physical, mental, social and spiritual health. Ayurveda, mostly deals with the herbal based medicines which contains therapeutic potentials description of over 2000 plants. As the Ayurvedic medicines are of natural origin, found to be many beneficial effects over allopathic system, as observed satisfactory effects of these medicines to temperament of individuals and fewer side effects. The overall cost of treatment is also low as compare with the allopathic systems. In India, more than 7500 plant species are being used in various alternative medicinal systems (Mukherjee & Wahile, 2006). Recently, the interest in the use of herbal preparations has grown dramatically throughout the world (Patwardhan *et al*., 2003)

Most of recent pharmaceutical drug have been discovered from the traditional knowledge and methods used by tribal peoples (Balick & Cox, 1996; Gilani & Rahman, 2005). Many of the modern day drugs are derived from plant based products. Furthermore, it is estimated that about 25% of modern drugs and as many as 60% of antitumor drugs are derived from natural products (Brower, 2008; Newman & Cragg, 2012). According to the World Health Organization (WHO), as many as 80 % of the world's population depends on traditional medicine and about 65% of the population in the rural areas use Ayurvedic and medicinal plants to meet their primary health-care needs in India (WHO, 2002).

Among the Ayurvedic medicines, Dashmula plants are top traded group. It is estimated that more than 10,000 Metric tonnes of Dashmula plant raw drugs are being consumed every year by Indian herbal industry contributing to nearly

Rs. 500 crores turnover (Ved & Goraya, 2008). Dashmula is the compound which is prepared by using powder of roots of ten different medicinal plants such as *Aegle marmelos* Corr., *Desmodium gangeticum* DC., *Gmelina arborea* Roxb., *Oroxylum indicum* Vent., *Premna integrifolia* Linn., *Solanum indicum* Linn., *Solanum xanthocarpum* Schrad., *Stereospermum suaveolens* DC., *Tribulus terrestris* Linn., *Uraria picta* (Jacq.) DC (Singh *et al.*, 2011). Among these, one of the major ingredients is the roots of *U. picta*. Apart from Dashmula, the plants is also used in several other Ayurvedic formulations such as: Abhrak bhasma, Agastya hartiki rasayana, Amritaprasa ghrita, Amritarishta, Angamardaprasaman kashay churna, Anu taila, Bharngi guda, Brahma rasayan, Brhacchagaladya ghrita, Brihatmasa taila, Dahika ghrita, Dantyadyarishta, Darunagaradi kvath churna, Dahmula taila, Dashmoola ghrita, Dashmool katutray kvath churna, Dashmool kvath churna, Dashmoolpanchakoladi kvath churna, Dashmoolsatpalaka ghrita, Dashmularishta, Dhanvantara ghrita, Dhanvantara taila, Indukanta ghrita, Kalyanak ghrita, Madhyam narayan taila, Mahakalyanak ghrita, Maha narayana taila, Maha panchgavya ghrita, Maha vishgarbha taila, Mritasanjivani sura, Mushikadya taila, Narayana taila, Rajanyadi churna, Rasnadi kvath churna, Sahacharadi taila, Shira shuladi vajra rasa, Siva gutika, Sukumar ghrita, Vastyamayantaka ghrita, Vayucchaya surendra taila, Vidaryadi ghrita, Vidaryadi kvath churna, Vishnu taila, Vyaghri taila (Ahire & Nikam, 2013).

In Ayurveda 'Chyawanprash' is the traditional multi herbal formulation, which is widely used as health tonic, rejuvenator, anabolic, immune-modulator and memory enhancer. Chyawanprash are of different class like Dashmula, Ashtavarga and Chaturjata. Among these, Dashmula is a best Ayurvedic formula used for treating fatigue, worries, poor sleep. It is also used as hormone to cures post-delivery problems, all types of inflammations and detoxify the entire body. Dashmula is an excellent sedative used in balancing the tri doshas VATA, PITTA and KAPHA (Kasar *et al.*, 2007).

Genus *Uraria* belongs to family Fabaceae, contains about 35 species distributed throughout the world including *Uraria picta* (Hutchinson & Dalziel, 1958). *Uraria picta* also recognised by *Doodia picta* Roxb., *Hedysarum pictum* Jacq., *Uraria aphrodisiaca* Welw., *Uraria leucantha* Span., *Uraria linearis* Hassk. It is commonly called as Dabra, Pithvan, Prishnaparni. In Nigeria, *U. picta* is locally known as 'Alupayida' (Yoruba) meaning 'the power of changing object'; 'kaskaifi', 'dakushe', 'wutsiyarbera', 'wutsiyarkusu' (Hausa) meaning 'weapon sharp edge-destroyer'; and "Obuǒ;do dumbwada' (Igbo) meaning 'tail bearer that seeks help to dig the ground'. Chinese traditionalists called *U. picta* Mei Hua Li Wei Dou (Oyesiku *et al.*, 2013). In spite of the large number of medicinal uses, the genus *Uraria* is neglected and got a very little attention from researchers in view of taxonomical, pharmacological and phytochemical studies. Few reports were available in the literature about ethnobotanical role of this genus (Waghire *et al.*, 2013).

CLASSIFICATION AND DISTRIBUTION OF *URARIA PICTA*

Classification of Plant

Kingdom: Plantae
Clade: Fabids (Eurosids I)
Order: Fabales
Family: Fabaceae
Subfamily: Faboidae
Tribe: Desmodieae
Subtribe: Desmodiinae
Genus: *Uraria*
Species: *U. picta*

Distribution

U. picta is commonly found in areas of dry grass-lands, grassland with scattered trees including *Acacia*; waste places, on rocky ground, deep sandy soils; by riverbanks, flood-plains and gallery forest. *U. picta* is a widespread species found in tropical Africa, South and South East Asia and Australia. It is not considered to be specifically threatened or in decline at present. The species does not meet any threatened criteria therefore a rating of Least Concern is given (Groom, 2012).

BOTANICAL DESCRIPTION

Uraria picta is annual herb, stem woody at maturity, and it covered with scarce modified fine, short, straight and hooked hairs. Plant body is erect, height ranging from 0.5 to 2.0 m. Leaves are dimorphic, young leaves are simple and at maturity they are odd-pinnately compound covered with the hairs as present of stem (Figure 1). Inflorescence is of raceme type. Racemes are terminal and elongated upto 1.5 feet. The flowers are small, present in large number (35-75) on dense spike (figure 1). The inflorescence axis is pink, purple or pale lead in colour. Flowers are purple, pink or bluish in colour. Flowers are bracteate, bracts persistent at the base and apex. Calyx is four mm long; teeth plumose much longer than the short tube. Corolla papilionaceous, sepals are 4-5 mm long.Pods are segmented with 3-6 segments, each 2-3 mm broad and 5-9 mm long, smooth, polished, folded on one another (Hutchinson & Dalziel, 1958; Bhattacharya & Datta, 2010). Pods contain 2-6 seed and segments are nearly separated (Waghire *et al.*, 2011). Flowering and fruiting time in the month of august to September.

PHYTOCHEMICAL CONSTITUENTS

U. picta constitute number of important bioactive compounds such as phenolics, tannins, saponins, cardiac glycosides, flavonoids, isoflavanones, triterpens and steroids (Table 1). Two Isoflavanones namley 5,7-dihydroxy-20-methoxy-30,40-methylenedioxyisoflavanone and 40,5-dihydroxy-20,30-dimethoxy-7-(5-hydroxyoxychromen-7yl)-isoflavanone were isolated from roots (Rahman *et al.*, 2007). Additionally,

researcher also identified stigmasta-4,22-diene-3-one, b-sitosterol and lupeol by direct comparison of the spectral data to those published in the literature (Kojima *et al.*, 1990; Parsons, 1991; Rahman *et al.*, 2007). Yadav and his team reported the isolation, quantitation and validation of flavone glycoside Rhoifolin from aerial parts of *U. picta* (Yadav *et al.*, 2009). Turner & Harborne, 1967 and Ambe *et al.*, 2010, reported the Canavanine, essential and non-essential amino acids from the seed of it. The albumin like proteins and different fatty acids such as linoleic acid (38.9%), palmitic acid (14.2%), linolenic acid (11.3%) and oleic acid (11.1%) from seeds (Ambe *et al.*, 2010; Waghire *et al.*, 2011). Along with different phytochemical, determined different macro elements such as Na, K, Ca, Mg and P in leaves of the plant (Saxena *et al.*, 2014).

Figure 1: Habit of *Uraria picta* (Jacq.) DC. a: Well grown mature plant; b: Inflorescence and c: Matured inflorescence of *U. picta* with green pods

ETHNOMEDICINAL USES

Ethnomedicines defined as the use of plants by humans as medicines (Farnsworth, 1994). Ethnopharmacology is a highly diversified approach to drug discovery involving the observation, description and experimental investigation of indigenous drugs and their biologic activities. Attention of people received towards the traditional ethno-botany due to their wide local acceptability in recent years (Tripathi, 2000). Tribal peoples of Purulia district in West Bengal used root paste of *U. picta*, Mahadevjata and Ishwarjata, with honey (4:2) once daily for 5 days as abortificients. Leaf paste is given twice daily as antidote to snakebite (Chakraborty & Bhattacharjee, 2006). Tribal's of the Saurashtra region used seed paste for haemorrhoids disease (Jadeja *et al.*, 2006). Tribal of Chittagong hill used the leaf paste for suppuration of boil disease and applied on it for burst (Yusuf *et al.*, 1994, 2007). The combination of leaves and roots of *Aristolochia indica*, *Desmodium motorium* and *U. picta* are crushed and the juice taken orally. Tribal communities of Chitrakoot (MP) and Wayanadu districts of Kerala applied leaf paste on cuts and wounds twice a day (Sikarvar *et al.*, 2008; Thomas *et al.*, 2014). *U. picta* alone or on combination with others are used as an antidote or for gall bladder pains in Kushita and Sherpur district in Bangladesh (Rahmatullah *et al.*, 2009; Alom *et al.*, 2011). Jain & Singh in 2010, reported that, half teaspoon of root decoction is taken orally for seven days in snakebite and sore mouth (Jain & Singh, 2010). The paste made from three gram flowers of *U. picta* is taken once a day in empty stomach to sterile women for one month for pregnancy (Sahu *et al.*, 2010). The different communities like Gond, Kols, Mushar, Baiga

Table 1: Phytochemicals constituents from different plant parts of *Uraria picta*

Phytochemical constituents	Plant parts used	Solvent used for extraction	Reference
Alkaloid	leaves, roots and stem	ethanol and methanol	Saxena *et al.,* (2014)
Amino acids	Leaves	ethanol and water	Garg *et al.,* (2012)
Carbohydrate	Leaves	ethanol and water	Garg *et al.,* (2012)
Cardiac glycosides	leaves, roots and stem	diethyl ether, chloroform, ethanol, ethyl acetate, methanol, petroleum ether and water	Saxena *et al.,* (2014)
Flavonoides	leaves, roots and stem	chloroform, ethanol, methanol and water	Garg *et al.,*(2012) and Saxena *et al.,*(2014)
Phenols	leaves, roots and stem	aqueous and methanol	Saxena *et al.,*(2014)
Saponin	leaves, roots and stem	ethanol, methanol and aqueous	Saxena *et al.,* (2014)
Steroids	leaves, roots and stem	aqueous, diethyl ether, chloroform, ethanol, ethyl acetate, methanol, petroleum ether and water	Garg *et al.,* (2012) and Saxena *et al.,* (2014)
Tannins	leaves	diethyl ether, ethanol, ethyl acetate and water	Garg *et al.,* (2012) and Saxena *et al.,* (2014)
Triterpenoides	leaves	aqueous, diethyl ether, chloroform, ethanol, ethyl acetate, methanol, petroleum ether and water	Garg *et al.,* (2012) and Saxena *et al.,* (2014)

and Nutts from Vindhya region of Uttar Pradesh used *U. picta* against bodyache and wounds (Chaudhary, 2010). Whole plant is used by the tribal's of Tamil Nadu for the antibacterial purpose (Jayaprasad *et al.*, 2012). Root decoction is used against snake bite in Chhattisgarh region (Minu *et al.*, 2012). The root for snake bite, vomiting, fever, cough and gonorrhea in Nasik district (Ahire, 2012). The tribal of Jhabua district of Madhya Pradesh used root decoction for respiratory diseases (Wagh & Jain, 2014, 2015). A decoction of whole plant is used for the treatment of female infertility by the Badagry people of Lagos State, Nigeria (Makinde *et al.*, 2015).

THERAPEUTIC USES

U. picta has been historically used as purported medicines and magic's. The whole plant and different plant parts are being used in different therapeutic treats (Prasad *et al.*, 1965; Osazuwa & Igboechi, 1988; Igboechi *et al.*, 1989). The leaf powder is used to cure the gonorrhea and for uterus contraction which leads to abortion (Ainslie, 1937). Aphrodisiac ingredient detected in alcoholic and aqueous extracts in roots (Dalziel, 1937). The leaves are used as antiseptic. These are also used in treating child malaria as it showed traces of alkaloids (Adegoke *et al.*, 1968). The leaves prove to reactivate the movement of foetus in pregnant women and have the power to change the sex of a foetus (Lambo, 1979). It is also reported that the fresh leaves juice was proved to be skin hardener against sword or knife cut when rubbed on skin (Lambo, 1979). It is used in the preparation of Ayurvedic drug Abana, which is useful in the treatment of hypertension, tachycardia and angina (Khanna *et al.*, 1991). Pods are useful in sore-mouth of children. Roots and leaves are used for treatments of typhoid and tetanus. Traditionally, the plant is used as an antidote to the venom of *Echis carinata* (Kirtikar & Basu, 1993; Hamid *et al.*, 2004). The use of dashmula, for significant improvement in neurological disorder (Garg *et al.*, 2012). Decoction of root and whole plant is given on heart trouble, fractured bones, cough, chills, fevers, gonorrhea, gout, swelling, obesity and on skin diseases (Mishra *et al.*, 2012; Rahman & Parvin, 2014). Protective effect of aqueous extract of *Uraria Picta* on acetaminophen induced nephrotoxicity in rats (Kale *et al.*, 2012; Odubanjo *et al.*, 2013). Odubanjo *et al.*, 2013 reported that use of phytochemicals for treatment of Alzheimer's disease (Odubanjo *et al.*, 2013).

PHARMACOLOGICAL ACTIVITIES

Antimicrobial Activity

Different plant part extract and isolated bioactive compounds showed antimicrobial activity. Chemical isolate from the leaf extract of *U. picta* showed antimicrobial activity (Osazuwa & Igboechi, 1988). Two isoflavanones isolated from root bark showing the antimicrobial activities against both Gram +ve and Gram -ve bacteria and fungi (Ved & Goraya, 2008). The methanol extract showed significantly higher inhibitory effects on the growth of *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus* and *Streptococcus pneumoniae* (Khalili *et al.*, 2013). Additionally, the antibacterial activity of methanolic extracts of leaf, root and callus against the pathogenic bacteria (Ahire *et al.*, 2011).

Acaricidal Activity

Potent acaricidal properties of methanolic extracts of *U. picta* by using human and domestic animal model compared to the aqueous extract (Ahirrao *et al.*, 2007).

Hypolipidaemic Activity

Abana tablets is prepared from mixture of different herbals including *Uraria* showed hypolipidaemic activity in rats (Khanna *et al.*, 1991).

Anti-inflammatory Activity

The anti-inflammatory of aqueous and methanolic extracts of *U. picta* using *in vitro* and *in vivo* animal models. The evaluation parameter of *in vitro* model was nitrous oxide radical scavenging assay, lipooxygenase assay and Carrageenan induced rat paw edema model was used *in vitro* model (Ahirrao *et al.*, 2007).

Anti-oxidant Activity

The total antioxidant capacity of ethanolic extract. *U. picta* extract showed significant antioxidant activity. The antioxidant activity was found to be associated with presence of phenolic, flavonoid, sterol and terpene derivatives (Patel *et al.*, 2011). It also inhibits the acetylcholineesterase and butyrylcholinesterase which could make it a good resource to treat Alzheimer's disease (Odubanjo *et al.*, 2013). Poly herbal formulation consisting with *U. picta* helps to protect the liver cells from CCl_4 induced liver damages (Ghosh *et al.*, 2015).

IN VITRO CULTURE

Natural regeneration of Prishnaparni is less due to poor seed viability and low percentage of germination. Studies were conducted to enhance the percentage of germination of the viable seeds (Okusanya *et al.*, 1991; Ahire *et al.*, 2009). Although plants can be raised by sowing seeds directly in the field, it results in very poor crop stand and yield. *In vitro* clonal propagation technique is applied to produce large numbers of identical individuals and conservation. In plant species like Prishnaparni, the whole plants are uprooted for the medicinal preparations as the roots contains the active metabolites. This generated extra pressure on natural populations of the plant. In earlier reports, the plant is considered to be rare and endangered in some parts of India (Anand *et al.*, 1998; Gurav *et al.*, 2008; Ahire *et al.*, 2009; Rai *et al.*, 2010). Recently, the plant is categorized in least concern category by IUCN (Groom, 2012). In this context, several authors has made efforts for *in vitro* clonal propagation of this plant using different plant parts as explants (Table 2). Micropropagation of Prishnaparni using cotyledonary node and node as explants has been reported through direct organogenesis (Anand *et al.*, 1998; Mukundan *et al.*, 2002; Gurav *et al.*, 2008; Rai *et al.*,

2010; Parmar & Jasrai, 2012; Parmar & Jasrai, 2015). In addition to this, callus mediated shoot organogenesis using leaf explants as well as hardening and acclimatisation of these plantlets (Figure 2). Among the different reports on shoot organogenesis, higher number of shoots per culture was reported (Ahire *et al.*, 2011).

Efficient root initiation and survival of the hardened plantlets under field condition is the key success of any micropropagation protocol (Nikam *et al.*, 2013). Among the different micropropagation reports available on *U. picta*, most of the authors succeeded to produce roots either on half strength MS basal medium or the medium fortified with IBA. Maximum number of roots/shoot (16.2±2.4) was found on half strength MS basal medium + 0.25 mg/l IAA + 0.50 mg/l IBA (Rai *et al.*, 2010). The acclimatized *in vitro* grown plantlets showed 98% survival (Ahire *et al.*, 2011). The genetic fidelity analysis using randomly amplified polymorphic DNA (RAPD) analysis of regenerants revealed 100% uniformity as mother plants (Figure 3). Quantitative estimation of isoflavones from the roots of *in vitro* raised plantlets further confirmed the genetic identity of regenerants (Rai *et al.*, 2010). In addition to the genetic fidelity, the antibacterial activity of methanolic extracts of *in vitro* raised callus in comparison with leaves and root harvested from wild plants (Ahire *et al.*, 2011). Among the different extracts, callus extract showed strong antibacterial activity against pathogenic bacteria. The results suggested that, presence of higher concentrations of active chemical components (isoflavanoids) in callus cultures of *U. picta*.

Table 2: Shoot organogenesis in *Uraria picta*

Explant	Medium and PGR used	Development Stage	Number of shoots per explant/culture	References
Axillary bud and node	MS+2.47 µm AS	Direct organogenesis (Bud formation)	7.1±0.6	Anand *et al.*, (1998)
	MS+5.37 µm NAA+2.22 µm BAP	Indirect organogenesis (Callus inoculated on 0.13 µm BAP)	17.3±2.8	
Node	MS+1mg/l BAP	Direct organogenesis	-	Mukundan *et al.*, (2002)
Cotyledonary node	MS+13.2 µM BAP	Direct organogenesis	36.3±1.7	Gurav *et al.*, (2008)
Nodal stem segment	MS+0.1 mg/l IAA+0.1 mg/l BAP+25 mg/l AS+0.5mg/l GA_3	Direct organogenesis	19.6±2.6	Rai *et al.*, (2010)
Leaf	MS+4.44 µM BAP	Indirect organogenesis	58.8±0.8	Ahire *et al.*, (2011)
Node	MS+4.44 µM BAP	Direct organogenesis	14.4±3.8	Parmar *et al.*, (2012)
Node	MS+0.5 mg/l TDZ	Direct organogenesis	10.3	Parmar *et al.*, (2015)

Figure 2: Indirect shoot regeneration of *Uraria picta*. (a) Leaf derived organogenic callus (b) Induction of shoot primordia from callus (c) elongated shoots (d) rooted shoot and (e) mature plant in natural conditions.

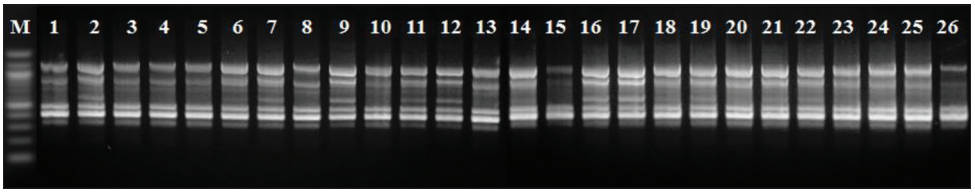

Figure 3: Genetic fidelity analysis of micropropagated plants using randomly amplified polymorphic DNA (RAPD), M 100-bp DNA ladder, lane 1 Mother plant, 2–26 micropropagated plants

CONCLUSIONS AND FUTURE PERCEPTIVE

Dashmula is one such preparation where roots of ten different plant species are used in mixture, among these *U. picta* is one. Low rate of seed germination, long maturation period are major reason to restrict the population of it. Multiple uses of *U. picta* have resulted in destructive over-exploitation from the wild to satisfy the ever-increasing demand of pharmaceutical industries. Due to this reasons the available drug of Dashmula in the market is devoid of *U. picta* roots and hence the necessity of conserving it is almost needful. Though there were some attempts on *in vitro* shoot culture of *U. picta* but development of further methods are necessary for large scale propagation of this. Focus on root culture, somatic embryogenesis, elicitation, mutagenesis and transformation research may help in large scale propagation, improvement and their applications in many diseases. *In vitro* culture techniques can be an alternative to overcome the shortage of natural source of plant material and conservation of this plant. From phytochemical techniques the chemical profile, biological activity and characterization may be helpful in development of specific drug of *Uraria picta*.

DECLARATION OF COMPETING INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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ABBREVIATIONS

BAP=6-Benzylaminopurine, GA3=Gibberellic acid, IAA=Indole-3-acetic acid,IBA=indole-3-butyric acid, m=meter, mg/l=milligram per litre, mm=millimetre, MS=murashige and Skoog, NAA=α-naphthaleneacetic acid, PGRs=Plant Growth Regulators, RAPD=Random Amplified Polymorphic DNA, TDZ=1-phenyl-3-(1, 2, 3-thiadiazol-5-yl)-urea, μM=micro-molar

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