



Review Article

WOODFORDIA FLORIBUNDA SALISB: A BACKBONE HERB FOR ALL ASAVA AND ARISHTA

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ABSTRACT

Woodfordia floribunda salisb is a high demand medicinal plant for pharmaceuticals and dye industries. Its flowers are highly valued medicinal material used in Indian System of Medicine. The plant is distributed in North-eastern India. This review *Woodfordia floribunda* salisb, or Fire-flame bush, a plant of Indian origin, is extensively used in folk medicine for the treatment of various ailments. Various parts of this plant possess valuable medicinal properties as anti-inflammatory, anti-tumor, Hepato-protective and free radical scavenging activity, but its flowers are in maximum demand. It is the backbone herb of almost all *Asava* and *Arishta* preparations and used as a fermenting agent. Not only to speed up fermentation process in the formation of *Asava* and *Arishta* but also *Dhataki* flowers add colour and taste to them. *Dhataki* is mainly emphasized in the ancient Ayurvedic texts as one of the most important fermentation product, hence the names *Madhyhetu* and *Madakara*. Charak quoted it among the fermentating agents (*Asava yoni*). He also described *Dhataki* among the *Purisasangrahaniya* and *Mutraviranjaniya* group of drugs. So this review paper is an attempt of the author to provide details of this medicinal plant along with its spectacular properties in fermentation process.

KEYWORDS: *Woodfordia floribunda* salisb, *Dhataki*, *Sandhaniya*, *Asava-arista*, Fermentation.

INTRODUCTION

Traditional medicines have been used by the majority of the world population for thousands of years. The World Health Organization (WHO) reported that an estimated 80% of the population in developing countries depend upon traditionally used medicinal plants for their primary health care.

Panini's "Astadhyayi" mentioned about *Dhataki* as one of the useful herb (4/1/41). *Dhataki* mainly emphasized in the ancient Ayurvedic texts as one of the most important fermentating agent¹.

Among the numerous species used in folk medicine, *Woodfordia floribunda* salisb has been widely used by practitioners of traditional medicines in different South East Asian countries since long time. Though the entire plant parts exhibits therapeutic properties, but particularly, its flowers have been in great demand in domestic and international markets specialized in the preparation of herbal medicines.

Traditional Indian Ayurvedic preparations like *Asava* and *Arishta* are believed to be general health tonic in nature, having overall health stimulating properties. Of the 18 *Arishta* mentioned in the Indian ministry of Health and Family Welfare's Monograph (CCRIMH, 1978), 17 have been found to contain *W. floribunda*. According to the Indian system of medicine, flowers of this plant have pungent, acrid, cooling, toxic, alexiteric properties and are used as a sedative and as an antihelminthic².

Dhataki Flowers are used extensively in the preparation of *Asava* and *Arishta* containing self generated alcohol³. According to texts, *W. floribunda* flowers contain wild yeasts, which can tolerate high sugar concentration and are clearly able to bring about the fermentation process⁴. Due to the report available regarding *dhataki*

puspa, there is immense need to find out its role in fermentation (*Sandhan kalpana*).

Distribution: *Dhataki* is a medicinal herb of Ayurvedic medicine system and it is native to Asia and Africa. In India it is abundantly distributed throughout north India, to an ascending altitude of 1500 m and also in a majority of the countries of South East and far East Asia like *Shri Lanka*, *China*, *Malaysia*, *Indonesia*, *Japan* and *Pakistan* as well as *Tropical Africa*. Mostly it is available in waste lands and open grasslands but it is also cultivated in gardens during the summer months⁵. *Woodfordia floribunda* has been recorded amongst the IUCN red list of threatened plants. It has been categorized as lower risk or 'least concerned' (LC) plant species (IUCN, 2015).

Flowering season- February to April and fruiting in April to June.

Scientific classification⁶

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Myrtales
Family	Lytharaceae
Genus	<i>Woodfordia</i>
Species	<i>floribunda</i>

Synonyms

W. floribunda is also known as fire flame bush in English, *Dhataki*/ *Dhaay ke phool* in Hindi. Other Sanskrit synonyms of *Dhataki* are:

Bahupuspika - It bears flowers profusely.

Gucchapuspa - Flowers are in bunches.

Dhatupuspi - Having red (blood coloured) flowers.

Tamrapuspi - Has coppery red flowers

Vahnijwala - Flowers are red in colour, resembling flame.

Paarvatiya - Prefers hilly region

Madahetu / Madyavasini / Sidhupuspi - Flowers are used in fermentation of alcoholic beverages.⁷

Ayurvedic properties

Ras (Taste) *Kashay*

Guna (Quality) *Laghu, Ruksha*

Virya (Potency) *Sheet*

Vipak (Metabolism) *Katu*

Prabhav (Impact) *Stambhan*

Dosaghnatha *Kapha- pitta shamak*⁸

Useful Parts: Flower, stem bark, Leaves⁹

Dose: Powder- 2-4 gm¹⁰

Formulations: *Dhatakyaadi churna, Dhatakyaaadi tail*¹¹

Taxonomical Description of *W. floribunda* salisb

A). Macroscopic- The full-grown leafy shrub is about 3.5 m high, having spreading and long branches with fluted stems.

Bark- It is cinnamon-brown coloured and smooth, peels off in fiber.

Flowers- Brilliant red, innumerable, arranged in dense axillary paniculated- cymose clusters, with short glandular pubescent pedicels. The calyx is long, striated, covered with glandular dots, with a small campanulate base and a slightly curved long bright red tube that contracts above the included capsule. The petals are slightly longer than the calyx-teeth, narrowly linear, extended at the apex to a long fine point.

Fruit- these are small capsules, ellipsoid and membranous, usually splitting the calyx near the base, and are irregularly dehiscent.

Seed- these are brown, very minute, numerous, shining, smooth angular and obovate.¹²

Leaves- Opposite or sub- opposite, grey-pubescent beneath, ovate or linear- lanceolate.

B). Microscopic- Transverse section of sepal shows, single layered cuticularised epidermis, provided with both glandular and covering trichomes multi-cellular, long, consisting of a stalk and a globose, thin -walled, multi-cellular head, covering trichomes, unicellular thick-walled broad at base and pointed at the apex, ground tissue consisting of thin- walled, parenchymatous cells. Surface view of petal shows thin- walled, parenchymatous cells, provided with very few sparsely distributed covering trichomes; transverse section of filament shows epidermis consisting of single layered tangentially elongated cells, covered with a very thick-cuticle; ground tissue consisting of thin walled parenchymatous cells with intercellular spaces, surrounding a central vascular cylinder of spirally thickened vessels. Transverse section of anther shows, single layered epidermis, covered with cuticle followed by several layers of thickened cells, surrounding both the pollen-sacs having numerous pollen grains, roughly tetrahedral with three pores, measuring 12-16 μ m approximately; central region consisting of thin- walled cells embodying vascular bundles¹³.

Chemical Constituents

Stem contains C-glycosidenorbergenin, yield gum, beta-sitosterol.k

Leaes contains Lupeol, betulin, beta-sitosterol, ursolic acid, betulinic acid, woodfruticosin, lawsone.

Flowers contain Woodfordins A- D, oenotherin A.

Leaves and Flowers contain Ellagic acid, cyanidins, beta-sitosterol¹⁴.

Sandhana Dravya (fermentation agents) - To initiate or potentiate the fermentation process in desired direction, varying no. of ingredients are required which serve as natural carriers of the fermenting organism. E.g., *Dhataki puspa, Madhuka puspa, Surabeeja/ Kinwa*, Yeast and rarely *Puga, Badara twak, Babbula twak* are used. *Acharya Vagbhatta* firstly used *Dhataki puspa* for *sandhana*¹⁵. *Acharya Charak* describes properties of *Dhataki*,¹⁶ but *Charak* have not used *Dhataki* for preparation of *Asava-Arishta*. *Acharya Sushurut* mentioned *Surabeeja* or *Kinwa* as *Sandhana dravya*. In *Sharangadhar Samhita* references regarding *Madhuka puspa* and *Dhataki puspa* as *Sandhan dravya* are also found.¹⁷ Now a day, dried active yeast granules can also be used for the purpose of fermentation.

Role of *W. Floribunda* Flowers in *Asava- Arishta*

A special use of flowers of *Dhataki* has been emphasized for the preparation of Ayurvedic "*Asava and Arista*", wherein a decoction of plant materials, sugar (cane sugar, jaggery, sucrose) and dried flower of *W. floribunda* is mixed and fermented in predefined vessels. According to *Sandhan kalpana* (fermentation process) a defined amount of *W. floribunda* are added to initiate the fermentation process. The flowers of *W. floribunda* are generally considered as a source of yeast. Its flowers produce nectar in its tubular flowers, which is known to contain high sugar, an ideal thriving site for osmophilic yeasts. The flowers are bright in colour with tubular corolla. At the base of the stigma a swollen nectoriferous tissue is present, which secretes nectar. Several bees, butterflies, wasps and small birds regularly visit the flowers to collect the nectar, thereby pollinating the flowers. The nectar is sugar rich syrup that sustains and support growth of wild yeast species. Many of the yeast cells are also transferred by pollinating insects from flower to flower in an attempt of collecting nectar. A large variety of yeast and fungi can therefore be expected to be present in the flowers. However till date, there is no conclusive experimental evidence of presence of yeast in these flowers. Moreover, several failed attempts to isolate active yeast in *W. floribunda* flower questioned its role in *Asawa-Arishta* fermentation. It was postulated by *Weerasooriya et al.*, (2002) that presence of endogenous invertase enzyme (beta- fructofuranosidase) (and not yeast) in flowers of *W. floribunda* contribute to the hydrolysis of sucrose, which was speculated to promote alcohol production¹⁸.

Previously Isolated Micro-Flora From *W. floribunda*

Vohra et al., (2004) reported several species of yeast from the flower of *W. floribunda* such as *Pichia anomala*, *Aspergillus niger* and *Saccharomyces cerevisiae*, although, role of these yeast isolates are yet to be explored in the preparation of different *Asawa* and *Arishta*. *Pichia anomala* was isolated from nectoriferous region of *W.*

floribunda, which was used to produce high activity of intracellular cell-bound Phytase; however, this enzyme has no relevance with *Asava Arishta* fermentation.

Kroes *et al.*, (1993) stated that possible biotransformation and secretion of some enzymatic products are introduced into the formulation by microbes coming from flower of *W. floribunda*.

Shastri *et al.*, (1968), Mishra *et al.*, (2010) also asserted that inoculums of yeasts coming from the *Dhataki* flower contain wild species of yeasts.

Khare *et al.*, (2004) reported in their book that *Saccharomyces cerevisiae* was isolated from *W. floribunda* responsible for producing self-generated alcohol.

Manwar *et al.*, (2013) could isolate alcohol producing yeast from these flowers; especially *Saccharomycopsis fibuligera* and *Saccharomyces cerevisiae*. They further reported that *Saccharomyces cerevisiae* produced alcohol more than any other isolated yeast species. Moreover, the ambiguity about *W. floribunda* as source of yeast that useful in fermentation of *Asava-Arishta* is persistent¹⁹.

Further, Das *et al.* showed that the flowers of *Dhataki* contain substantially high concentration of tannins, to the extent of 22%, and such polyphenolic compounds are susceptible to enzymatic conversion to simple phenols and alcohol during anaerobic fermentation of *Arishta* preparations. Perhaps, this justifies the extensive use of *W. floribunda* in *Arishta* preparation, the main purpose of which is to produce alcohol²⁰.

Significance of Sandhana Dravya (Fermentation)

Fermentation acts as a supply depot of microorganism, which initiates the process of fermentation. *Acharya Vagbhata* was pioneer, who made the use of *Dhataki puspa* extensively in the manufacturing of *Asava-Arishta*. A thorough study of ancient literature reveals that following drugs play the role of *Sandhan dravya* (fermentor) in *Sandhan kalpana*.

1. *Dhatki puspa* e.g., *Abhayarishta* (*Ashtanga Hridya chikitsa sthan* 08/66)
2. *Madhuka puspa* e.g., *Kutajarishta* (*Sharangadhar samhita madhyam khand* 10/44-46)
3. *Surabeeja/kinva* e.g., *Sura* (*Sushruta samhita chikitsa sthan* 10/8)²¹.

The effect of addition of yeast (*Saccharomyces cerevisiae*) and *Dhataki pushap* to fermenting media was studied. The study reveals that the onset and completion of the fermentation process in the samples containing yeast were quick, as in these samples, fermentation started on the second day and was completed within one month. However in the group where yeast was not used, fermentation started on the fifth day and was completed in the second month. Fermentation may be delayed because of natural growth and multiplication of yeast cells as well.²²

Another report says that the flowers of *Dhataki* were used as inoculums in the preparation of *Asava-Arishta*. Here attempts have been made to decode its role in alcoholic fermentation. The flowers were screened from micro flora and yeast strain of *S. cerevisiae*. Which was isolated from the flowers and its morphology reported. The flowers of *Dhataki* were found capable to initiate

alcoholic fermentation as normally achieved by the use of pure yeast culture.

Contrary to this belief of Ayurveda specialists the inoculums of yeasts comes from *Dhataki* flower; Das *et al.* have different opinion and findings. They argued that an endogenous invertase (fructofuranosidase) found in *Dhataki* flowers help in sucrose hydrolysis to alcohol. The alcohol production helps in promoting the extraction of biologically active component including gallic acid from plant materials, and absorbs active principles in the gastrointestinal tract. This alcohol in turn, resists the growth of any microorganism in *Arishta* preparation for years together. Increased content of gallic acid, which is otherwise present in traces, if at all, as well as the Ayurvedic process of "self generating alcohol" insinuates a conjecture. Here, the researcher referred earlier have tried to establish that *Dhataki* flower is an essential component of *Asava-Arishta*, not only for initiation of fermentation, but for enhancing clinical efficacy as well²³. This concept was supported by the fact that, in some of these formulations, *Dhataki* is not a compulsory ingredient, so it may be perceived that role of *Dhataki* is not a carrier of the inoculums only²⁴.

Classical Review

Charak Samhita: In *Pureesh sangrahaniya* (Herb used to improve bulk of feces), *Mutra viranjneeya* (Herb used to restore normal colour of urine), *Sandhaneeya* (Herb that is useful for healing bone fractures) *Mahakasaya* (c.s.su 4/5,31,34).

Sushrut Samhita: In *Priyanguvadadi* and *Ambhashtadi Gana* (su.s.su 38/45,46)

Vagbhata: characterized it the same way as that of *Susuruta* (A.h.su. 15/38)

Acharya bhavmishra: in *Bhava prakash nighantu*, placed *Dhataki* in *Haritakyadi varg*

Dhanwantari nighantu: In *Chandnadi varg*

Kaiyadeva nighantu: In *Ausadi varg*

Raj nighantu: In *Pipalyadi varg*

Sushrut nighantu: In *Ambasthadi gana*

Sodhala nighantu: In *Chandanadi varg*

Therapeutic Use of Different Parts of Woodfordia floribunda

Flowers: these are astringent, analgesics and used in diarrhea, dysentery, menorrhagia, derangements of the liver, disorders of the mucous membrane, antibacterial, skin disease, fever, herpes, ulcers, wounds, hemorrhoids and used to add colour and taste in *Asava* and *Arishta*, and juice of its fresh flowers applied on the forehead for reducing the headache.

Leaves and twigs: They are used to produce a yellow dye that is used for printing. Petals of this plant yield a red coloured dye. Juice of leaves is used in bilious sickness.

Bark: It is pungent, acrid, cooling and uterine sedative. It is used for treating various disorders like Laprosy, Erysipeles, Thirst, Dysentery, various disease of blood²⁵ and used as *Lepa* in burn.

A wide range of chemical compounds including tannins (especially those of macrocyclic hydrolysable class), flavonoids, anthraquinone glycosides and polyphenols have been isolated from this species in recent

times. Extracts and metabolites of this plant, particularly those from leaves and flowers, possess useful pharmacological activities.

According to Classical Treaties

Charak - *Lodhra*, *Dhataki*, *Indrayava*, *Karanja* and *Jaiti*-paste should be used in *Kustha* for an ointment and paste. (cs.ci.7.95)

Sushrut - In conjunctivitis caused by *Pitta*, powder of liquid extract of *Dhataki* and *Chandana* mixed with breast-milk should be used as collyrium (ss.u.10.9)

Vagabhata- For child, *Modaka* (sweet bolus) prepared of *Dhataki* flowers, *Sarkara* and parched paddy should be given in diarrhea. (A.H.U.1.39)

Bhavamishra- *Dhataki* and *Badari patra* powder with curd in *Pravahika*.

Vrindmadhav- Powder of *Dhataki* or *Amalaki* 10gm mixed with profuse honey should be used in Leucorrhoea (VM.63.4)

Shodhal- *Dhataki* with *Tandulodak* used in *Swetapradar*.

Chakradatta- *Dhataki* powder used as a *Vrana-ropak*.

Sharangdhar- *Dhataki* kwath in *Balaltisara* (contains *Dhataki* *puspa*, *Belgiri*, *Lodhra*, *Sugandhabala*, *Gajjipali* decoction with honey.)

Pharmacological Properties

Antimicrobial activity

The presence of antimicrobial compound that are therapeutically potent against MDR bacteria was confirmed in *Woodfordia floribunda*. The crude leaf extract showed no host toxicity with human lymphocytes, the n-butanol fraction of the extract was the most suitable bioactive fraction. The terpenes isolated were:

5-methyl-2-(1-methylethyl) phenol, 2-methoxy-4-(2-propenyl) phenol, 2, 6-octadien-1-ol, 3,7-dimethyl-(E)-2,6-octadienal, 3,7-dimethylcyclohexanol, and cyclohexanol, 2-methylene-5-(1-methylethenyl) which were reported to have specifically antimicrobial activity.²⁶

Anti-asthmatic and anti-inflammatory activity

W.floribunda flowers extracts exhibited anti-asthmatic effect by demonstrating bronchoprotection, bronchorelaxation, anti-inflammatory, anti-oxidant and mast cell stabilization ability.²⁷

Anti hyperglycemic activity

The ethanolic extract of *W. floribunda* flowers (250 and 500mg/kg) significantly reduced fasting blood glucose level and increased insulin after 21 days treatment in streptozotocin diabetic rats. The extract also increased catalase, speroxiden dismutase, glutathione reductase, glutathione peroxidase activity significantly and reduced lipid peroxidation. Glycolytic enzymes showed a significant increase in their levels while a significant decrease was observed in the levels of the gluconeogenic enzymes in ethanolic extract treated diabetic rats. The extract has a favourable effect on the histopathological changes of the pancreatic beta-cells in streptozotocin induced diabetic rats. The results suggest that *W.floribunda* possess potential anti hyperglycemic effect by regulating glucose homeostasis and antioxidant efficacy in streptozotocin induced diabetic rats.²⁸

Anti-Fertility Activity

Anti-fertility activity of dried flowers of *Woodfordia fruticosa* is studied with various solvents and

individually with water and aqueous alcohol (50:50). Anti-fertility activity of successive alcoholic, individual aqueous and individual hydro-alcoholic extracts was studied in female albino rats. Among all the three extracts tested, successive alcoholic extract showed maximum abortifacient activity of 43%, which was found to be statistically significant (P < 0.05). Individual aqueous and individual hydroalcoholic extract, though, showed moderate activity of 12% and 20%; however, it was not statistically significant (*Khushalani* et al., 2006).

Anti-inflammatory and Analgesic Activity

Analgesic and anti-inflammatory activity of 95% ethanolic extract of *Woodfordia fruticosa* (WFE) flowers in acute, subacute and chronic models of inflammation was assessed in rats and mice. Oral administration of WFE (250 and 500 mg/kg) exhibited significant anti-inflammatory activity in acute (carrageenin and autocoids induced hind paw edema), subacute (formaldehyde-induced hind paw edema) and chronic (cotton pellet granuloma) models of inflammation (*Verma* et al., 2012).

Anti-tumour Activity

Woodfordin C, isolated from the dried flowers of *Woodfordia fruticosa*, prolonged the lifespan of mice inoculated with sarcoma 180 cells by 160%. One of the five mice survived to the 60th day at a dose of 10 mg/kg. The in vitro and in vivo anti-tumour activity of woodfordin C compared favorably with the topoisomerase- II inhibitors adriamycin and etoposide. Woodfordin C strongly inhibited intracellular DNA synthesis but not RNA and protein synthesis and showed remarkable activity against PC-1 cells although only moderate activity against MKN45 and KB cells. Furthermore, woodfordin C had in vivo inhibitory activity against the growth of inoculated colon 38 cells, suggesting that the mechanism by which woodfordin C exhibits anti-tumour activity may be through inhibition of topoisomerase- II (*Yoshida* et al., 1990). Anti-Viral Activity Methanolic and aqueous extracts of the flowers and leaves inhibited avian myeloblastosis virus reverse transcriptase (RT). No cytotoxicity was observed in the extracts even at concentrations where there was over 90% inhibition of RT activity. Gallic acid exerted anti-herpes simplex virus type 1 and anti-human immunodeficiency virus activity (*Kratz* et al., 2008).

Immuno-modulatory Activity

The contribution of *Woodfordia fruticosa* flowers to the immuno-modulatory activity of the Ayurvedic drug *Nimba arista* was investigated and the preparation was found to inhibit both human complement activity and chemi-luminescence generated by zymosan stimulated human polymorpho-nuclear leucocytes. It was established that the increased biological activity was not due to microbial interference, but to immune-active constituents released from the *Woodfordia* flowers (*Kroes* et al., 1993).

CONCLUSION

Asava and *Arishta* are two popular Ayurvedic formulations which are widely used for therapeutic purpose of various disorders. *Asava* and *Arishta* are considered as one of best formulation in Ayurveda as they possess self-generated alcohol which acts as self-preservative. Medicinal plant is the most exclusive source of life saving drugs for majority of the world's population.

Woodfordia is a long live shrub that has been used for centuries as a wound healer and for other medicinal purposes such as leprosy, burning sensation, skin diseases, diarrhoea, dysentery, fever, headache, hemorrhoids, herpes, internal hemorrhage, leucorrhoea, liver disorders, menorrhagia. The plant contains enormous phytochemical constituents of various properties such as antimicrobial action, anti cancer, antiviral etc. Hence more work should be done on the above plant to reveal the unknown mysteries which would help the need of the present pharmaceutical world.

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