Zanthoxylum armatum DC.: AN IMPORTANT MEDICINAL PLANT OF UTTARAKHAND

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Abstract

Zanthoxylum armatum DC (Local name- 'Timur', Family-Rutaceae), an endangered medicinal plant of the Indian Himalayan region is largely used in the Indian system of medicine as carminative, stomachic, toothache, fever, dyspepsia and expelling roundworms. The different parts like leaves, fruits, stem, bark, seeds and roots of the species contain a wide variety of chemical compounds including alkaloids, flavonoids, sterols, triterpenoids, which have been reported to possess antioxidative, antitumor, anti-inflammatory, analgesic, antimicrobial and insecticidal/larvicidal activity. The volatile oil present has been reported to be effective in the treatment of different diseases. Thus the increasing demand in pharmaceutical and cosmeceutical industries has led to its reduced availability in its natural habitat. The present report focuses on the current status, importance of the species, its biological activities and approaches for promoting conservation.

Key words: *Zanthoxylum armatum*; Endangered; Medicinal plant

Introduction

Zanthoxylum armatum DC. (Locally known as Timur; Family: Rutaceae), an important medicinal tree, is distributed worldwide from tropical to temperate areas. There are 200 species of *Zanthoxylum* found worldwide and comprise of deciduous or evergreen woody plants (shrubs or trees). About 15 species are distributed in the temperate region of East Asia and North America; out of these, 11 are found in India, namely: *Zanthoxylum budrunga, Z. oxyphyllum, Z. ovalifolium, Z. acanthopodium, Z. planispinum, Z. armatum, Z. nitidium, Z. rhesta, Z. simulans, Z. avicennae* and *Z. limonella. Amongst* these, six species occur in the Indian Himalayan region (Kala *et al*., 2005) and 4 species, namely *Z. armatum, Z. oxyphyllum, Z. budrunga* and *Z. acanthopodium* have been reported from Uttarakhand. It has been reported that harvesting of *Z. armatum* is more in Kumaun region because of its intense pungency compared to ones found in Garhwal (Kala *et al*., 2005).

Z. armatum has been shown to contain high amounts of linalool (Jain *et al*., 2001), a compound used commercially in preparation of soaps, detergents, insecticides, and as a precursor for the production of vitamin E, and therefore, the species may have commercial potential beyond spice production. *Z. armatum* is clearly recognized as having economic, domestic and medicinal qualities. The pungent odour of plant parts of *Zanthoxylum* is due to several bioactive compounds amongst which linalool is a major constituent; it is a monoterpene reported as major component of essential oil in various aromatic species. The increasing demand for natural products in the sectors of food, cosmetics, wellness and medicinal ingredients possess major ecological and social challenges and *Z. armatum* is one such species which fit best in this category. However, high pressures on current and expanding commercial harvest of wild resources can threaten the survival of populations and *Z. armatum* is no exception. The present report thus focuses on the current status, importance, harvest, biological activities and approaches for promoting conservation of this valuable species.

Current Status

Over exploitation and habitat destruction are the two major causes in placing the species in the endangered category. Population density and degree of consistency (occurrence) was used to allocate the status of any species. Since *Z. armatum* is not a fast growing species, its population is low in nature (Kala, 2010). The proliferation of woody weeds such as *Lantana* and its subsequent profuse invasion across larger area may out compete native species like *Z. armatum* among others. Since the plant has high cultural value and considered as sacred by the local people, and is in constant use in traditional health care and condiments, along with recent commercial applications in pharmaceutical and cosmetic products, this has resulted in unsustainable harvesting of above ground plant parts causing tremendous pressure on its existing populations and regeneration in the wild (Kala 2010). Currently *Z. armatum* is categorized as 'endangered' (Samant and Pal 2003), however, a detailed investigation on its ecological investigation is warranted.

Traditional Uses

Z. armatum is known as an important plant because plant parts like leaves, stem, bark, fruit, seed and root possess medicinal properties and used in indigenous medicine preparation against various diseases. The different plant parts of *Z. armatum* are used as vermicide and pesticides (Adesina, 2005). The major socio economic and ethno botanical properties attributed to this plant species is relief of dental problems, treatment of malaria, snake bite remedy, gastrointestinal disorders, aphrodisiac, analgesic, action against various skin diseases, anti hemorrhagic, anti-cancerous, stomachic, anti-convulsive and tonic stimulant use in animals and humans. In addition, different parts of the species are used in the preparation of pesticides, and treatment of common cold, cough, fever and toothache. During dental trouble/pain a fresh or dry fruit is pressed over the affected tooth and is kept in position till it loses its pungency; young shoots of the plant are used as tooth brushes (Anonymous, 1976). The local people also use wood stick for worship of God (Kala, 2010).

Commercial Value

Z. armatum is one of the commercially important species and this is reflected by its demand in pharmaceuticals industries. This demand has certainly affected the market price, which has increased from Rs. 45-200 per kg (Kala et al., 2005). The species is currently used for preparing toothpowder and paste by the pharmaceutical industries, namely Dabur India Ltd (Dabur Lal Paste and Powder), Patanjali Ayurved Ltd. (Dantkranti Tooth Paste), Mahashian Di Hatti (MDH; Tooth Powder) and other cosmetic companies.

Chemical Constituents

The seed pericarp of *Zanthoxylum* mainly contain an essential oil linalool. Other chemical constituents like alkaloids, sterols, phenolics, lignins, coumarins, terpenoids, flavonoids and their glycosides and benzenoids, fatty acids, alkenic acids, amino acids have been reported from other plant parts (Negi et al., 2011). The bark, leaf and roots have been reported to contain zanthonitrile and berberine (alkaloid), L-asarin, L-sesamin and L-planinin. Volatile constituents namely linalool, limonene and methyl cinnamate have been found in seeds, leaf, bark and roots (Ramidi and Ali 1998). Gas chromatography-mass spectrometry (GC-MS) analysis revealed that essential oil of seeds contains 22 different components (Waheed et al., 2011). Bisht and Chanotiya (2011) analyzed the essential oil of *Z. armatum* leaf by capillary gas chromatography (GC-FID) and GC/MS and reported 2-undecanone as major compound for the first time, although linalool was reported as major component in several previous studies on *Z. armatum* oil (Yoshihito *et al*., 2000).

Biological Properties

The species has been reported for a number of biological activities. The fruits are used as digestive appetizer, to cure asthma and bronchitis, eliminate pain and to treat heart diseases, piles, diseases of mouth, teeth and throat disorder, dyspepsia and diarrhea (Medhi *et al*., 2013). *Z. armatum* shows different biological activities and some of them are summarized as follows:

a) Antioxidant Activities

The essential oil of the fruits of *Z. armatum* was evaluated for its antioxidant activity. The ethanolic and methanolic extract of *Z. armatum* fruits shows 2,2-diphenyl-1-picrylhydrazyl (DPPH) radial scavenging activity in *in vitro* system in albino rats. The studies reported that the extract can be used as a good source of antioxidant (Batool *et al*., 2010; Upadhyaya and Ashok, 2010).

b) Larvicidal Activities

Z. armatum oil was tested against three mosquito species Culex quinquefasciatus, Aedes aegypti and Anopheles stephensi for larvicidal activity and found that the larvae of the three mosquito species were susceptible to the essential oil composition (Tiwary *et al*., 2007). Such findings would be useful in promoting research aiming at the development of new agents for mosquito control based on bioactive chemical compounds from indigenous plant sources as an alternative to chemical larvicides.

c) Antipyretic and Central Nervous System Activity

Root extract of *Z. armatum* was reported useful in antipyretic and central nervous system stimulating activity. The study

indicated that the antipyretic activity of petroleum ether and ethanolic extract of *Z. armatum* roots was useful in Brewer's induced fever and considerable CNS stimulant activity determined by actophotometer (Singh *et al*., 2011). This indicates that the species has the potential and can be used to develop new agents for antipyretic and other nervous system related diseases.

d) Skin Sensitivity

Skin sensitivity activity of the Z. armatum extract has been reported. For example, a lipophilic extract prepared from fruits of Z. armatum and diluted with oleyl alcohol yields a cosmetic ingredient is endowed with a remarkable soothing effect based on inhibition of sensory irritation from shaving, sun bathing, depilation, insect bites, chemical treatments, etc. (Guglielmini and Cristoni 2002). Also, the extract has been found to be helpful in reducing cutaneous thermal sensitivity and soothing the scalp during hair dyeing treatments (Cristoni and Artaria 2007).

e) Antitumor Activity

Z. armatum has the potential to be used as anticancer drug because the crude extract of leaves and fruits exhibit cytotoxicity properties. The monoterpene, lupeol present in the species are reported to act as therapeutic and chemopreventive agent for the treatment of inflammation and cancer (Francesco *et al*., 2011; Barkatullah *et al*., 2012).

Propagation

The natural regeneration of *Z. armatum* has been reported to be poor. Germination of several other *Zanthoxylum* species is also very poor (Bonner, 1974; WAC, 2005). In *Z. gilletii*, Okeyo *et al*., (2011) reported that seeds washed with soap solution removed oil from the seed coat and improved germination capacity up to 29% with a mean germination time of 8.5 weeks. Reports on seed germination and vegetative propagation using stem cutting in *Z. armatum* from India have not been reported, however only one study on *in vitro* propagation using leaf explants and subsequent regeneration of shoots through callus is available (Bisht and Bhandari 2007). Considering the importance of the species for different purposes, mass multiplication through different approaches would be highly desirable.

Conclusion and Future Directions

Z. armatum is well known for its benefits in different systems of medicines, which play an important role in the field of safer herbal care. The low population size coupled with poor seed germination has put pressure on its natural population and further reduced the availability of raw material for the pharmaceutical industries. Hence, it is necessary to take steps towards multiplication and conservation of this valuable plant through various approaches. This would also ensure income generation for large number of people of the Himalayan region. In this context, the extracts of the plant and its constituents can be used for the preparation of various modern medicines. The species, at present is being indiscriminately collected from the wild to fulfill the raw material need of pharmaceutical companies and hence the species should also be cultivated. Only limited information is available on cultivation of this species; therefore, agro-technologies also need to be worked out. Moreover, the active constituents are known to vary with clones and location, hence it is necessary that quantification of active compounds be taken up for regular monitoring as well as for the selection of elite clones for mass scale propagation for commercial purpose.

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