



A REVIEW ON THE MICROPROPOGATION OF AN IMPORTANT MEDICINAL PLANT *INULA RACEMOSA* HOOK. F.

¹Prachi Sharma, ¹Anamika Malav and, ^{*2}Prahlad dube

¹Career Point University, Kota (Rajasthan)

²HOD, Department of Life science, University of Kota, Kota (Rajasthan)

ARTICLE INFO

Article History:

Received 29th July, 2017
Received in revised form
04th August, 2017
Accepted 17th September, 2017
Published online 30th October, 2017

Keywords:

Plant tissue culture,
Micropropagation,
Inula racemosa,
Medicinal plants,
MS medium.

ABSTRACT

Medicinal plants have been used indigenously since ancient past as medicines for the treatment of various ailments. Medicinal plants based traditional systems of medicines are playing important role in providing health care to large section of population, especially in developing countries. The global demand for herbal medicine is not only large, but growing. Due to many reasons many plants are becoming endangered or about to extinct. Most of the causal factors currently threatening plant species are anthropogenic in nature i.e. induced or influenced by man. These factors include habitat loss or modification often associated with habitat fragmentation, over-exploitation for commercial and subsistence reasons, accidental or deliberate introduction of exotic species which may compete with native species. *Inula racemosa* Hook. F. is one such plant which is listed as a rare species according to the Red Data Book of Indian plants. Due to the fragile nature of its habitat and exploitation because of its commercial medicinal properties, the species are facing the onslaught of indiscriminate over-exploitation while other reasons include lengthy cultivation cycle, prevalence of small land holdings and continuously fluctuating market prices. So far, this plant has not got the required attention from researchers, hence, except for a few efforts, not much work has been done for its cultivation and conservation. Plant tissue culture offers an attractive and quick method for its multiplication at large scale and further conservation for future generation.

*Corresponding author

Copyright ©2017, Prachi Sharma et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Prachi Sharma, Anamika Malav and Prahlad dube, 2017. "A review on the Micropropagation of an important medicinal plant *Inula racemosa* Hook. F.", *International Journal of Development Research*, 7, (10), 16369-16372.

INTRODUCTION

According to World Health Organization, 2005, currently 80% of the world population depends on plant-derived medicine or medicinal plants for the first line of primary health care for human alleviation because it has no side effects. The global demand for herbal medicine is not only large, but growing (Farnsworth and Soejarto, 1991; Pei 2001). The Ayurvedic system of medicine is widely accepted and practiced by peoples not only in India but also in the developed countries—such as Europe, USA, Japan, China, Canada etc. Plant based therapy are marked due to its low cost, easy availability based on generation to generation knowledge (Meena et al., 2009). In view of the tremendously growing world population, increasing anthropogenic activities, rapidly eroding natural ecosystem, etc the natural habitat for a great number of herbs

(specially medicinal plants) and trees are dwindling and of *per capita* consumption has resulted in unsustainable exploitation of Earth's biological diversity, exacerbated by climate change, ocean acidification, and other anthropogenic environmental impacts (Rands et al., 2010). In order to establish relationship between plant growth and its development plant tissue culture mostly micropropagation has been proved to be a great success. Tissue culture has emerged as a promising technique for multiplying and conserving the medicinally important species within short period and limited space, storage facilities may be established at any geographical location and cultures are not subject to environmental disturbances such as temperature fluctuation, cyclones, insect, pests, and pathogen which are difficult to regenerate by conventional methods and save them from extinction (Bhojwani and Dennis, 1999; Shibli et al., 2006). The plants that possess therapeutic properties or

exert beneficial pharmacological effects on the human body are generally designated as “Medicinal Plants” (Sandhya *et al.*, 2006). Medicinal plants have their values because of the different chemical compounds found in various organs like leaves, roots, stem, seeds, bark etc., these have been determined by their pharmacological action of active principles, which produce specific physiological action in human body (Anon, 2007a). The important bioactive substances (present as secondary plant metabolites) are alkaloids, glycosides, fatty oils, resins, gums, mucilage, tannins, quinines, valuable oils, etc (Srivastava, 2000). Secondary metabolites are often characteristic of *Inula racemosa* Hook. F. It is a tall stout shrub up to 1.5 m, bearing large leathery leaves, rough above, densely hairy beneath, toothed and arranged in a racemose manner that belongs to Asteraceae family. It is an important medicinal plant, its roots expectorant and seeds are aphrodisiac (Jabeen *et al.*, 2007). Due to higher commercial demand of *Inula racemosa* Hook. F., this plant has over-exploited and now it is about to extinct, so for the multiplication and conservation of this plant several plants tissue culture techniques are used among which micropropagation has been proved to be a great success.

Introduction of the plant

Inula racemosa Hook. F., commonly known as “Pushkarmoola” of family Asteraceae is distributed from temperate to sub-alpine belts, is a well documented Indian medicinal plant. Pushkarmoola is one of the herbs mentioned in all Ayurvedic scriptures. It possesses various synonyms like kasari an enemy of cough, sulahara – pain killer, svasari – an enemy of breathlessness, kasmira – grows abundantly in Kashmir, sughandhika – fragrant etc. The great sage Charaka has categorized it as hikka nigrahana – stops hiccup and svasahara – hana – stops hiccup and svasahara – alleviates the breathlessness, asthma. It is also as the best medicament for pleurisy along with cough and asthma. Pushkarmoola is highly acclaimed to be the drug of choice for pleurisy (parsvasula) (Pal, 2010).

Description

The Plant *Inula racemosa* Hook. F. belongs to the class Magnoliopsida, order Asterales which falls under the family of Asteraceae.

Synonyms

Kasmira, Padmapatra, Pouskara, Kustha, Bheda, Ciram, Jiham, Tirtha, Dhira, Padma, Puskarahava, Brahmatirtha, Mulam, Vatahva, Phala Patraka, Viram, Swasari, Sugandhikam, Mula, Pushkarjata (Shukla and Tripathi, 2006; Shastry, 2010).

Distribution

Inula racemosa Hook. F. (Asteraceae), usually known as Pushkarmoola, found almost in all parts of the India ascending to an altitude of 4,200 m from the sea level. The plant *I. racemosa* distributed from temperate to sub-alpine belts. *I. racemosa* is an important traditional drug in Indian system of medicine (Ayurveda), Chinese Traditional Medicine (TMC) and Europe (Okuda, 1986). *Inula racemosa* Hook. F. (Manu), is a critically endangered medicinal herb, was studied in terms of its uses and cultivation practices and problems in the cold desert environment of the Lahaul valley in the North Western

Himalaya. Energy and monetary efficiencies of *I. racemosa* were characterized by output/input ratios of 0.69 and 5.91, respectively. A survey was conducted to establish reasons for the extinction of the plant which results as in, the roots of *I. racemosa* has higher medicinal values which gives it a great economic importance due to the large demand by the pharmaceutical industry which comes out to be a great reason of its exploitation. Also it is a critically endangered species due to the fragile nature of its habitat the species is facing the onslaught of indiscriminate over exploitation, habitat destruction and competition while the other reason faced is, decline in the cultivation of *I. Racemosa* as it has lengthy cultivation cycle, prevalence of small land holdings and continuously fluctuating market prices were the main constraints stated by the interviewed farmers (Rawat and Everson, 2011 and Sharma, 2014).

Morphology

I. racemosa is a tall stout shrub up to 15 m, bearing large leathery leaves, rough above, densely hairy beneath, toothed and arranged in a racemose manner. Lower leaves are narrowed to a winged leaf stack. Upper leaves are lanceolate and stem clasping. The flower heads are many, 3.5 - 5.0 cm in diameter, yellow in colour and arising in terminal racemes, large, shady yellow daisies produced in mid to late summer. Fruits are slender achenes, 0.4 cm long, and beard with 0.75 cm long reddish pappus hairs. Roots are about 15 cm long and 0.5 to 2.0 cm in diameter, cylindrical, straight or somewhat curved. Surface of the root is rough due to longitudinal striations and cracks, scars of lateral rootlets and rhytidoma present. Fractures of the root are short and smooth (Kirtikar *et al.*, 1991 and Chopra *et al.*, 1956). Inflorescence is 4–5 cm in diameter. Its root is thick tuberous, horny, with a slight orris-camphoraceous smell (Chunekar and Pandey, 1969).

Medicinal Properties and Uses

Pusharmool has been used in the indigenous system of medicine for a long time. Pushkarmool has been reported in the texts of Ayurveda as possessing Tikta, Katu and Ushna Virya and beneficial for the diseases of heart, throat. It is also used in Ayurveda as an expectorant and resolvent in indurations. Considered a ‘Rasayana’ (rejuvenator, immunomodulator) by Ayurvedic physicians, the drug according to Bhavaprakasha is bitter and pungent in taste. Its administration mitigates Vatakapha Jvara (fever caused by Vatapitta imbalance), Sotha (swelling), Aruchi (anorexia), Svasa (breathlessness) and Parsvasoola (pain in the sides of the chest). This plant is used by ethnic groups for the treatment asthma, chronic bronchitis, pulmonary disorders, tuberculosis, skin diseases, cardiac disorders, obesity, diabetes, lung cancer etc. Major phytochemical compounds reported from the roots of *I. racemosa* belong to sesquiterpene lactones, which have a wide range of biological activities. Pharmacological activities reported for the plant *I. racemosa* are anti-inflammatory, analgesic, antifungal, antibacterial, hepatoprotective, anti-allergic, antioxidant, anti-asthmatic, adaptogenic, adrenal beta blocking, hypoglycemic and cardio protective activity (Singh *et al.*, 2016). The liniment is externally used for relieving pain. The root of *Inula racemosa* is an important ingredient of several polyherbal formulations those are for cardiac disease and inflammatory conditions of spleen and liver. The root is medicinal and considered as specific remedy for cough, dyspnoea, asthma, pleurisy, tuberculosis and chest pain,

especially pre cordial pain. The aqueous extract of the fresh or dry roots is given orally in rheumatic pains and liver problems. Externally a paste or liniment is used for relieving pain. The root is also used in veterinary medicine as a tonic. The root forms an important ingredient of several polyherbal formulations for heart diseases and inflammatory conditions of spleen and liver. The root has been traditionally used for the treatment of gonorrhoea; the flower is used in jaundice and ophthalmic afflictions in folklore. Leaves are extensively used for the affections of the respiratory tract such as chronic and acute bronchitis. The dried leaves are smoked as cigarettes in asthma and the juice of fresh leaves have been used for diarrhoea and dysentery and also used as valuable antiseptic, antiperiodic and anthelmintic. Besides these compounds of *I. racemosa* root and Comiphora mukul called Pushkar Guggulu is a popular anti obesity, hypolipidemic is indicated in cardiac ailments (Sharma, 2014).

Micropropagation

Medicinal plants constitute a very important bioresource in India because it has one of the richest plant based ethnomedical traditions in the world. The global market for medicinal plants and herbal medicines is estimated to be worth US \$80 billion a year. International export trade in medicinal plants from India is 32600 tonnes a year. The demand for medicinal plants has increased globally due to the resurgence of interest in herbal medicines standardized plant extract, culinary herbs natural therapeutic essential oil and phyto-pharmaceuticals (Shawl and Qazi, 2004). Most of the demand is being met through collection of large quantities of these plant species and their parts from wild populations. The methods of extraction employed are almost crude and unscientific. As a consequence, the rates of exploitation may exceed those of local natural regeneration. The Indian Himalayan Region (IHR) is a rich reservoir of biological diversity in the world. High value medicinal plant species are threatened, their status ranging from low-risk, near threatened to critically endanger. There is thus an urgent need to develop and implement regeneration and propagation of medicinal plants include seed based clonal and micropropagation methods (Jabeen *et al.*, 2007). *Inula racemosa* Hook.F. is an important medicinal plant and the species has been categorized as rare according to the Red Data Book of Indian plants (Nayar and Sastry 1988). The restricted distribution range of the species in its natural habitats (in the higher altitudes of Himalayan region) coupled with its unsystematic exploitation due to its several medicinal properties it has high demand in pharma sector and the reduction and fragmentation of plant populations have threatened this species towards extirpation and has been included in the list of endangered species of India (Wani *et al.*, 2006).

In-vitro propagation of plants holds tremendous potential for the production of large number of high quality plant. From the point of view of biotechnology micropropagation is considered as a practice often to produce clones of a particular plant under sterile conditions. Micropropagation is the term which best conveys the message of the tissue culture technique most widely in use today. Micropropagation allows the production of large number of plants from small pieces of the stock plant (plant cell, tissue, and organs) in relatively short period of time. The primary advantage of micropropagation is the rapid production of quality disease free uniform planting material. The plants can be multiplied throughout the year under

controlled environment irrespective of the season. In this regard the micro-propagation holds significant promise for true to type, rapid and mass multiplication under disease free conditions (Chang *et al.*, 1994). For the conservation of this valuable medicinal plant a rapid *in-vitro* regeneration protocol for induction of multiple shoots from nodal segments of *Inula racemosa* Hook. F. was developed by Jabeen *et al.* In the investigation, the leaf and nodal segment were inoculated on MS medium containing different concentration of Benzylaminopurine (BAP) either alone or in combination with Napthalene Acetic Acid (NAA) or Indole Butyric Acid (IBA) growth hormones. MS medium supplemented with BAP (0.25 mg L⁻¹) induced maximum number of shoots (20.7±0.8). The shoots were rooted on half strength of MS medium either alone or supplemented with (IBA) Indole butyric acid (1.0 mg L⁻¹). Direct rooting from leaves has also been developed from cultured plants. *In vitro* raised plantlets were acclimatized in green house and successfully transplanted to the field with a survival of 80% (Jabeen *et al.*, 2007). Kaur *et al.*, 2010, developed an effective procedure for the micro-propagation and *in vitro* conservation of *Inula racemosa* Hook. F. by vitrification. *In-vitro* propagation using aseptically grown seedlings and *in-vitro* conservation via vitrification were standardized. The *in vitro* conserved material could be retrieved and multiplied normally on MS (Murashige and Skoog, 1962) medium fortified with 1.00 mg l-1BA (benzyl adenine) which has been recorded as the best performing medium for *in vitro* shoot multiplication. The conserved shoots showed normal *in vitro* propagation and after retrieval from vitrification platelets were hardened and successfully established in the experimental fields under Nauni (Solan, HP) conditions at an elevation of around 1275 meters above mean sea level.

According to Nawchoo *et al.*, 2010, *I. racemosa* is an important and critically endangered medicinal plant with tremendous potential as an important natural resource. The development of conservation and commercialization technique is at his priority at present. To assess this, rhizome splitting as a means of vegetative propagation and seed germination for sexual propagation were evaluated for mass multiplication of this potent medicinal herb of North Western Himalayas. Split rhizome cuttings treated with varying concentrations of IAA, IBA and GA3 showed 88.89±0.95% sprouting and 77.78±1.42% of rooting in 100ppm of IAA. The studies undertaken on the seed germination of *I. racemosa* as a means of mass multiplication revealed that seeds show a broad range of pre-chilling requirements. Highest germination percentage-90.00±0.30% were recorded when scarification and GA3 (100ppm) were applied together. Mean germination time declined with higher concentrations of GA3 applied to scarified seeds and also with increased duration of stratification (Nawchoo *et al.*, 2010).

Conclusion

Plant tissue culture especially micropropagation is an important technique for propagating and conserving the medicinal and aromatic plants which are either threatened or at a risk of becoming threatened in near future due to overexploitation of their important bi-products. *I. racemosa* Hook. F. is listed as an 'endangered' medicinal herb of North Western Himalayas and hence efforts were made for its propagation as well as conservation to make the plant material available to the pharmaceutical industries as this medicinal

plant has proven to be an abundant source of biologically active compounds, many of which have been the basis for new pharmaceuticals. At sustainable basis, these studies will further help in future for mass propagation, multiplication and had laid foundation for *in vitro* conservation of the plant species that is presently endangered due to over-exploitation and fluctuation from its natural habitat.

REFERENCES

- Anonymous 2007. Medicinal, Culinary and Aromatic Plants in the near East-Medic. <http://www.fao.org/dorep/x5402e16.htm>.
- Bhojwani, S. S. and Dennis, T. 1999. *In vitro* conservation of plant genetic resources. *Botanica*, 49:47-52.
- Chang, W. D., Huang, W.W., Chen, C.C., Chang, Y.S. and Tsay, H. S. 1994. The production of secondary metabolites from Chinese medicinal herbs by suspension cell and tissue culture. In: Proc. 7th Int. Cong. SABRAO WASS, Taipei, Taiwan: Academia Sinica: 535-540.
- Chopra, R. N., Nayar, S. L. and Chopra, I. C. 1956. Glossary of Indian medicinal plants, CSIR, New Delhi: 141.
- Chunekar, K.C., Pandey, G.S. 1969. Bhavprakash Nighantu (in Hindi). Chowkhamba Vidya Bhawan, Varanasi, India.
- Farnsworth, N. R. and Soejarto, D. D. 1991. Global importance of medicinal plants. In: Akerele O., Heywood V. and Syngé H. (eds). *The Conservation of Medicinal Plants*. Cambridge University Press, Cambridge, UK. 25-51.
- Jabeen, N., Shawl, A. S., Dar, G. H., Jan, A. and Sultan P. 2007. Micropropagation of *Innula racemosa* Hook. F. - A valuable medicinal plant. *International Journal of Botany*, 3(3):296-301.
- Kaur, R., Kashyap, A., Majeed, S., Chauhan, N.S. and Bhardwaj, S.B. 2010. *In Vitro* Propagation and Conservation of *Inula Racemosa* Hook. F. an Endangered Medicinal Plant of Temperate Origin. *Journal of Advanced Laboratory Research in Biology*, 1 (1): 67-70.
- Kirtikar, K. R. and Basu, B. D. 1991. Indian medicinal plants. B. Singh, M.P. Singh, International Book Distributors, Dehradun. 1351-1352.
- Meena, A. K., Bansal, P. and Kumar, S. 2009. Plants-herbal wealth as a potential source of Ayurvedic drugs. *Plants-herbal wealth as a potential source of Ayurvedic drugs / Asian Journal of Traditional Medicines*, 4 (4).
- Murashige, T., Skoog, F. 1962. "A Revised Medium for Rapid Growth and Bio Assays with Tobacco Tissue Cultures". *Physiologia Plantarum*, 15 (3): 473-497.
- Nawchoo, J. A., Shabir, P. A. and Wani, A. A. 2010. Development of vegetative and sexual multiplication protocol for commercialization of *Innula racemosa* Hook. F. - A critically endangered medicinal plant of North West Himalaya. *Nature and Science*, 8(10).
- Nayar, M.P., Sastry, A.R.K. 1988. Red Data Book on Indian Plants, Vol II. Botanical Survey of India, Calcutta.
- Okuda, T. 1986. Encyclopaedia of natural medicine. Hirokawa Publishing Company, Tokyo, Japan.
- Pal, H.C. 2010. Evaluation of *Inula racemosa* Hook.f. (Roots) and *Sida acuta* Burm.f. (Aerial Parts) for their Anticancer Potential (published doctoral thesis). Guru Nanak Dev University, Amritsar.
- Pei S. 2001. Ethnobotanical approaches of traditional medicine studies: some experiences from Asia. *Pharmaceutical Botany*, 39: 74-79.
- Rands, M. R., Adams, W. M. and Bennun, L. 2010. Biodiversity conservation: challenges beyond Sci. 3: 329-1298.
- Rawat, Y. S. and Everson, C.S. 2011. *Inula racemosa* Hook. f.: A potential medicinal crop in the cold desert agroecosystem of North Western Himalaya, India. 5(26): 6218-6223.
- Sandhya, B., Thomas. S., Isabel, W. and Shenbagarathai, R. 2006. "Ethan medicinal Plants Used by the Valaiyan Community of Piramalai Hills (Reserved forest), Tamil Nadu, India. A pilot study. *African Journal of Traditional, Complementary and Alternative Medicines*, 3: 101-114.
- Sharma, A. 2014. Medicinal value of *Innula racemosa* Hook. F. (Pushkarmoola). *Unique Journal of Ayurvedic and Herbal Medicines*, 2(2):11-13.
- Shastri, J. L. N. 2010. Illustrated Dravya guna Vigyan. Chaukhambha Orientalia, Varanasi. Edition 2:298.
- Shawl, A. S. and Qazi, G. N. 2004. Production and trade of medicinal plants in India- *A review Skuast.J.Res.*, 6:1-12.
- Shibli, R. A., Shatnawi, M. A., Subaih, W. S. and Ajlouni, M. M. 2006. *In-vitro* conservation and cryopreservation of plant genetic resources: a review. *World J. Agric. Sci.*, 2:372-82.
- Shukla, V. And Tripathi, R. D. 2006. Charak Samhita. Chaukhambha Sanskrit Pratishthan Delhi Reprint. 1:75-76
- Singh, N. K., Sharma, V., Hem, K., Sharma, D., Singh, V. P. 2016. Ethanopharmacology, phytochemistry and pharmacology of *Innula racemosa* Hook. F. *Journal of Natural Products' and Resources*, 2(1): 40-46.
- Srivastava, R. 2000. Studying the information needs of medicinal plant stakeholders in Europe. TRAFFIC Dispatches 15: 5. Standardization and conservation. *Herb. Med.*, 4:39-43.
- Wani, P. A, Ganaie, K. A., Nawchoo, I. A., Wafai, B. A. 2006. Phenological episodes and reproductive strategies of *Inula racemosa* (Asteraceae) - a critically endangered medicinal herb of North West Himalaya. *International Journal of Botany*, 2(4):388-394.
