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Aspects of Biotechnology in conservation of Medicinal Plants for Healthy Life

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Abstract: Medicinal plants have been playing an essential role in the development of human culture. Human societies have been in close contact with their environments since the beginning of their formation and used the ingredients of the environment to obtain food and medicine. The Indian sub-continent has a very rich diversity of plant species in a wide range of ecosystems. There are about 17.000 species of higher plants, of which approximately 8.000 species, are considered medicinal and used by village communities, particularly tribal communities, or in traditional medicinal systems, such as the Ayurveda. Products derived from plants may potentially control microbial growth in diverse situations and in the specific case of disease treatment, numerous studies have aimed to describe the chemical composition of these plant antimicrobials and the mechanisms involved in microbial growth inhibition, either separately or associated with conventional antimicrobials. However due to growing population, increasing anthropogenic activities, rapidly eroding natural ecosystem, etc. The natural habitat for a great number of herbs and trees are dwindling. Biotechnological approaches can prove beneficial for the conservation of these important plants. These plants have maintained their existence to date since the epic period and if once lost, they cannot be regained in any realistic time interval. So it is our evolutionary responsibility to conserve these plants for the future generation.

Keywords: Medicinal Plants, Antimicrobial properties, Conservation

Introduction: Nature is always a golden sign to show the prominent phenomena of co-existence .Since time immemorial , man has used various parts of the plants in treatment & prevention of many ailments (Chah *et a*l.,2006) Natural products from plants, animals and minerals are the basis for treating human diseases (Firenzuoli & Gori,2007). Medicinal plants are presently in demand and their acceptance is increasing progressively, plants play an important role by providing essential services & medicinal herbs have constantly acted as an overall indicator of ecosystem health (Singh, 2002). Early humans recognized and exploited the plants around them are used as fuel, clothing, shelter, food & more or less. Medicinal plants have been transformed into one of the oldest sciences in countries such as China, Greece, Egypt and India. In ancient Persia, plants were commonly used as a drug and disinfectant and aromatic agent (Hamilton,2004).

In fact, the use of medicinal plants for the treatment of diseases dates back to the history of human life, that is, since human beings have sought a tool in their environment to recover from a disease, the use of plants was their only choice of treatment (Halberstein,2005). Plant-derived compounds can dramatically improve hard-to-treat illnesses, such as cancer & certain diseases.. The toxicity and adverse effects of conventional and allopathic medicines have also been important factors in the sudden increase in population demands and increase in the number of herbal drug manufactures as well as a reduction in the use of chemical drugs (Hossan, 2012).

More than 50,000 plant species are used in pharmaceutical and cosmetic industries. However, the distribution of medicinal plants across the world is not uniform (Huang,2011; Rafieian 2012), and medicinal herbs are mainly collected from the wildlife population. Indeed, the demand for wildlife sources has increased by 8%-15% per year in Europe, North America and Asia in recent decades (Verma & Singh 2008).

The term medicinal plant refers to a variety of plants that have medicinal properties. These plants are a rich source of compounds that can be used to develop drug synthesis (Hassan,2012). The parts of medicinal plants that may be used are different types of seeds, root, leaf, fruit, bark, flowers or even the whole plant. The active compounds in most parts of the medicinal plants have direct or indirect therapeutic effects and are used as medicinal agents. Plant parts contains, certain materials are produced and stored that are referred to as active compounds (substances), which have physiological effects on the living organisms (Phillipson ,2008). Human is mainly dependent on raw plant materials in order to meet medical needs to maintain health and cure diseases (Jack,1997).

Medicinal plants are used for treatment of various diseases because they have certain properties, including synergistic actions. The constituents of the plant may interact with each other, and this interaction can be beneficial for both or adverse to either of them or eliminate the harmful effects of both. (Hassan,2012)

According to the World Health Organization (WHO), about 80% of the world population still relies mainly on plant based drugs (Bahmani *et al*.,2014). The Medicinal plants have potent phytochemical components which are important source of antibiotic compounds and are responsible for the therapeutic properties (Jeeva *et al*., 2011; Jeeva and Johnson, 2012; Florence *et al*., 2012; Joselin *et al*., 2012 ; Sainkhediya and Ray, 2012; Sumathi and Uthayakumari, 2014).

Medicinal plants are extensively used throughout the world to cure human diseases since from ancient period. In India about 47,000 plant species are distributed in different vegetation zones. India ranking eighth in the world biodiversity. Out of these plants about 8,000 species are known to be medicinal importance. Around 2,500 plant species are used in the Indian Systems of Medicine such as Ayurveda, Unani, Siddha and Homoeopathy (Ganesan *et al*.,2004; Madhan *et al*.,2010). India is rich in biodiversity possess about 8 % of the estimated biodiversity of the world with around 12,600 species. It is one of the 12 mega biodiversity centres with 2 hot spots of biodiversity in the Western Ghats and North-Eastern region. It is also rich in ethnic diversity, there are about 67.37 million tribal people belonging to 537 tribal groups living in different geographical locations with various subsistence patterns (Amuthavalluvan ,2011; Shanmugam *et al*.,2012).

Over the centuries, the use of medicinal herbs has become an important part of daily life despite the progress in modern medical and pharmaceuticals research. Approximately 3000 plants species are known to have medicinal properties in India (Prakasha *et al*.,2010).

Biotechnology approaches for conservation of medicinal plants

Biotechnology is the utilization of living organisms and their products for the production of food, drink, medicine or for other benefits to the human being, or other animal species. Biotechnology existed long before there was a special word for it. Many of the principles and some of the techniques involved in biotechnology are ancient. Biotechnology in one form or another has flourished since prehistoric times. When the first human beings realized that they could plant their own crops and breed their own animals, they learned to use biotechnology. The discovery that fruit juices fermented into wine or that milk could be converted into cheese or yogurt, or that beer could be made by fermenting solutions of malt and hops began the study of biotechnology (Peters, 1993). More recently, cross-pollination of plants and cross-breeding of animals were macro-biological techniques in biotechnology, used to enhance product quality and/or meet specific requirements or standards. Even though, the discovery of microorganisms, antibiotics, causes of infectious diseases, and immunizations could probably be reckoned among significant discoveries; the most modern techniques in biotechnology get their existence to the discovery of DNA and several techniques necessary for gene cloning.

Cryopreservation is the maintenance of living cells, tissues organs and microorganisms at ultralow temperature (usually that of liquid nitrogen, −196 °C). Under cryogenic storage, the biological material can be conserved for extended durations, because at liquid nitrogen temperature, all metabolic activity and cell divisions are stopped and cells will not undergo genetic changes during storage, which may occur when they are maintained by serial subculturing. Furthermore, cryopreserved cells are stored in a small volume, requiring very limited maintenance (topping up storage containers with liquid nitrogen); samples are not continuously exposed to the risks of contamination and operator errors, due to frequent manipulations of the plant material. Cryopreservation is the only technique that ensures the safe and cost-efficient long-term conservation of various categories of plants, including non-orthodox seed species, vegetatively propagated plants, rare and endangered species and biotechnology products. In all cryopreservation processes, water removal plays a central role in preventing freezing injury and in maintaining post-thaw viability of cryopreserved material. There are two types of cryopreservation protocols that basically differ in their physical mechanisms: classical cryopreservation procedures, in which cooling is performed in the presence of ice; and the procedures based on verification, in which cooling normally takes place without ice formation (Arnao *et al*.,2008).

Tissue culture techniques are of great interest for collecting, multiplication and storage of plant germplasm and are very useful for conserving plant biodiversity, including (a) genetic resources of recalcitrant seed and vegetatively propagated species; (b) rare and endangered plant species; and (c) biotechnology products, such as elite genotypes and genetically engineered material. Tissue culture systems

allow propagating plant material with high multiplication rates in an aseptic environment. Following two alternative morphogenic pathways, shoot organogenesis or somatic embryogenesis, tissue culture has been extensively developed and applied for propagation and regeneration of over 1000 different plant species, including numerous rare and endangered species (Fay,1992)

Somatic embryogenesis is an important method for mass production of tree species for forestry and for the development of artificial seeds, making handling and direct planting easier(Sarasan,2006)

Artificial seeds are encapsulated tissues, such as somatic embryos, shoot tips and axillary buds, which can be used for germplasm conservation. Artificial seeds are used for large scale clonal propagation, breeding of plants producing non-orthodox seeds or non-seed producing plants and facilitate the storage and transportation of samples (Ravi & Anand ,2013).

Biodiversity hotspots around the globe are at risk and *in vitro* propagation methods have been used for rescuing and conserving endangered plants, in many countries, including Australia, Malaysia and South Africa. Although standard *in vitro* propagation methods are, in general, accessible, endangered species may have unusual growth requirements and, thus, may need modified procedures for *in vitro* culture. In addition, the limited amount of plant material available from rare and endangered species poses major challenges in the application of *in vitro* techniques. (Ashmore,2011)

Micro propagation allows both rapid and massive clonal multiplication of plants; however, it does not ensure that material will be free of systemic agents, such as viruses, which can be present in tissues without manifesting symptoms and spread during the *in vitro* multiplication. However, among the *in vitro* techniques, shoot tip or meristem culture has been used for many decades to eliminate viruses in many species from vegetatively propagated plants. This is based on the uneven distribution of viruses in the youngest tissues of the shoot apex, as their concentration tends to decrease progressively toward the apical meristem of the stem, where the cells are in constant and rapid division. Since not all cells in a shoot apical meristem are infected with pathogens (e.g., virus, phytoplasmas and endophytic bacteria), it is possible to dissect out a non-infected region and manipulate this explant *in vitro* to produce virus-free plants. As only the meristematic dome and the immediate covering (1st leaf primordia) are usually virus-free, the size of the meristem excised is critical. Therefore, excision and regeneration of tiny meristems might result in plants free of these pathogens. Regeneration ability is positively proportional to the size of the shoot tip, but pathogen eradication is more efficient using small shoot tips (0.2–0.4 mm). Hence, pathogen eradication using meristem culture is challenged by the difficulty of excising very small meristems mechanically to remove the infected tissues and of ensuring the survival and regeneration of the tiny meristems. (Berjak *et al*.,2011)

Meristem culture, in combination with thermotherapy, facilitates obtaining virus-free plants and ensures an easier production of disease-free stocks. Then, *in vitro* culture techniques simplify the quarantine procedures for the international exchange of germplasm because the sanitary status of the plants is safe and because it is easier to transport abundant amounts of a miniaturized material (Normah *etal*.,2008). These techniques have been successfully used for many years in virus eradication. Among woody plants, grapevine, apple and peach are the most frequent targets of sanitation protocols, because their health status is strictly

regulated. Even when thermotherapy represents the preferred method for the host, viruses can also be eliminated with chemotherapy and tissue culture. Tissue culture techniques have been used for virus elimination on woody, as well as herbaceous plants. (Panattoni *etal*.,2013)

Conclusion: Biotechnology has a lot of contribution for the conservation of various medicinal plants. It complements the conventional conservation techniques. Biotechnology can be used for the production of fine chemicals, production of pathogen -free plants, germplasm conservation through in-vitro and cryopreservation, large scale plant propagation which saves time, get uniform quality and disease free plants. Even though, biotechnology has so many advantages and different technologies which can complement conservation of some important medicinal plants .Biotechnological approaches can prove beneficial for the conservation of these important plants. These plants have maintained their existence to date since the epic period and if once lost, they cannot be regained in any realistic time interval. So it is our evolutionary responsibility to conserve these plants for the future generation.

References:

I. Chah, K.F., C.A. Eze ,C.E. Emuelosi and C.O Esimone, (2006). Antibacterial and wound healing properties of methanolic extracts of some Nigerian medicinal plants. J. Ethnopharmacol. 104:164-167.

II. Firenzuoli, F. & L.Gori, (2007) . Herbal medicine today: clinical and research issues. Evid Based Complement Alternat Med ;4(Suppl 1):37-40. doi: 10.1093/ecam/nem096.

III. Singh, J.S, (2002) . The biodiversity crisis: A multifaceted review. Curr Sci. iuu;82(6):638-47.

IV. Hamilton, A.C, (2004). Medicinal plants, conservation and livelihoods. Biodivers Conserv;13(8):1477-517. doi: 10.1023/b:bioc.0000021333.23413.42.

V. Halberstein, R.A, (2005) . Medicinal plants: historical and cross cultural usage patterns. Ann Epidemiol;15(9):686-99. doi: 10.1016/j.annepidem.02.004.

VI. Hossain,Hemayet, and A. F.M.Shahid-Ud-Daulas, Ismet Ara Jahan, I Nimmi, K.M. Rahat and Md. Musfizur Hassan,2012 . Evaluation and Antiinflamatory activity and determination of total flavonoids and tannins content of Lagenaria siceraria Root. International Journal of Pharmaceutial Sciences and Research. Vol.3 (8):2679-2685.

VII. Huang,H, (2011). Plant diversity and conservation in China: planning a strategic bioresource for a sustainable future. Bot J Linn Soc. 166(3):282-300.

VIII. Rafieian-Kopaei, M (2012). Medicinal plants and the human needs. J HerbMed Pharmacol;1(1):1-2.

IX. Verma, S. & S.P.Singh (2008). Current and future status of herbal medicines. Vet World;1(11):347-50. doi: 10.5455/ vetworld.347-350.

X. Hassan,R (2012). Medicinal plants (importance and uses). Pharmaceut Anal Acta.;3:e139. doi: 10.4172/2153- 2435.1000e139.

XI. Phillipson, J.D (2008). Phytochemistry and medicinal plants. Phytochemistry. ;56(3):237-43.

XII. Jack, D.B (1997). One hundred years of aspirin. Lancet;350(9075):437-9. doi: 10.1016/s0140-6736(97)07087- 6.)

XIII. Bahmani, M., M. Rafieian-Kopaei , M. Avijgan , S. Hosseini ,H. Golshahi & Z.Eftekhari , (2012). Ethnobotanical studies of medicinal plants used by Kurdish owner's in south range of Ilam province, west of Iran. Am Eurasia J Agric Environ Sci. ;12:1128–33.

XIV. Jeeva,S .,M.A.Johnson, J.S.Aparna & V. Irdudaraj (2011).Preliminary phytochemical & antibacterial studies on flowers of selected medicinal plants ,int.arom.plants,ISSBN2249-4340,vol.11,no.2,pp107-114.

XV. Jeeva,S.,M. Johnson (2012). Anti–bacterial and phytochemical studies on methanolic extracts of Begonia floccifera Bedd. Flower .Asian pacific journal of tropical biomedicine 2(1);s151-s154..

XVI. Florence, R., D.Gangneux and ld Marie (2012). Clin Microbiol Rev. Apr; 25(2): 264–296.

XVII. Joselin, J., T.S.S. Brintha ,A.R. Florence AR and Jeeva S (2012) Screening of select ornamental flowers of the family Apocyanaceae for phytochemical constituents. Asian Pacific Journal of Tropical Disease, 2.

XVIII. Joselin, J.,T.S.S. Brintha ,A.R. Florence and S. Jeeva , (2013) Phytochemical evaluation of Bignonaceae flowers. Journal of Chemical and Pharmaceutical Research, 5(4): 106-111.

XIX. Sainkhediya, J., and S. Ray (2012) Preliminary study of flowering plant diversity of Nimar region. Bioscience Discovery, 3(1): 70-72.

XX. Sumathi, B.M., and F.Uthayakumari (2014).GC MS analysis of Leaves of Jatropha maheswarii Subram & Nayar. Science Research Reporter, 4(1): 24-30.

XXI. Ganesan, S., N. Suresh and L. Kesaven (2004). Ethnomedicinal Survey of lower Palani Hills of Tamil Nadu, Indian J. Traditional Knowledge, 3(3):299-304.

XXII. Madhan, C., Nisha, and S. Rajeshkumar (2010). Survey of crude drugs from Coimbatore city, Indian Journal of Natural Products and Resources.1 (3):376-383.

XXIII. Amuthavalluvan, V,2011. Ethno medicinal practices and traditional healing system of Kattunayakan in Tamilnadu: An anthropological study. Int Mult Res J;1(7):47-51.

XXIV. Shanmugam, S., K. Rajendran, K. Suresh,(2012). Traditional uses of medicinal plants among the rural people in Sivagangai district of Tamil Nadu, Southern India. Asian Pac J Trop Biomed ;5:429-434.

XXV. Prakasha, H.M ., M. Krishnappa ,Y.L Krishnamurthy and S.V. Poornima ,(2010) . Folk Medicine of NR Pura Taluic in Chikamaglur District of Karnataka . Indian Journal of Traditional Knowledge . 9 (1):55-60.

XXVI. Peters, P 1993. Biotechnology: a guide to genetic engineering: Wm. C. Brown Publishers.

XXVII. Gonzalez-Arnao, M.T., A. Panta , W.M. Roca, R.H. Escobar and F.Engelmann, 2008. Development and large scale application of cryopreservation techniques for shoot and somatic embryo cultures of tropical crops. Plant Cell Tissue Org. Cult. 92, 1–13.

XXVIII. Fay,M.F.,1992. Conservation of rare and endangered plants using in vitro methods. In Vitro Cell. Dev. Biol. Plant , 28, 1–4.

XXIX. Sarasan, V.,R. Cripps,M.M.Ramsay, C.Atherton,M. McMichen, G. Prendergast,J.K. Rowntree, 2006. Conservation in vitro of threatened plants—Progress in the past decade. In Vitro Cell. Dev. Biol. Plant , 42, 206–214.

XXX. Ravi, D. and Anand, P, 2012. Production and applications of artificial seeds: A review. Int. Res. Biol. Sci, 1, 74–78.

XXXI. Ashmore, S.E., K.N.Hamilton, .C.A. Offord, 2011. Conservation technologies for safeguarding and restoring threatened flora: Case studies from Eastern Australia. In Vitro Cell. Dev. Biol. Plant , 47, 99–109

XXXII. Normah, M.N., A.M. Makeen, 2008 . Cryopreservation of Excised Embryos and Embryonic Axes. In Plant Cryopreservation: A Practical Guide; Reed, B., Ed.; Springer: New York, NY, USA, pp. 211–240

XXXIII. Berjak, P.,P. Bartels,E Benson, ,K.Harding, D Mycock, N.W.Pammenter, Sershen,J. Wesley-Smith, 2011. Cryoconservation of South African plant genetic diversity. In Vitro Cell. Dev. Biol. Plant , 47, 65–81.

XXXIV. Panattoni, A.,A.Luvisi, E. Triolo, 2013. Review. Elimination of viruses in plants: Twenty years of progress. Span. J. Agric. Res. , 11, 173–188.