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Biotechnological Intervention in Changing Climate for Propagation of Rare and Endangered Medicinal Plants in Gorakhpur Division

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Abstract

Climate change has become increasingly recognized as one of the greatest challenges to humankind and all other life on Earth. The negative impacts of climate change have become much more intense for the rare and endangered medicinal plants as their survival is threatened and also some important medicinal plants are showing changes in their secondary metabolites along with the alterations in their phenologies, adaptation to their habitat and other migratory changes. Such serious issues and challenges are a continuous concern with regard to the survival and genetic integrity. Plant in vitro regeneration is a biotechnological tool that offers a tremendous potential solution for the propagation of endangered and superior genotypes of medicinal plants which could be released to their natural habitat or cultivated on a large scale for the pharmaceutical product of interest. Genomic, proteomic and metabolomic studies are also done to completely understand the adaptations in plants during stress conditions, their coping mechanism and associated production and concentration of metabolites and its pathways. Various Rare and Endangered plants of Terai region had been envisaged with their efficient protocol for micro-propagation and their phytochemicals have also been studied for medicinal uses.

Keywords: Secondary Metabolites; Tissue Culture; Conservation; Metabolomics

Introduction

- Plant species face challenges and threats associated with their rapidly changing
- Environments in terms of alterations in content and type of secondary metabolites, shifting phenologies, allowing invasives to enter in their habitats and compete for resources and initiating migratory challenges [1].
- The high demand of medicinal sp., their value-added products and bio-functional compounds with depleting supply is already creating a burden on the global market of pharmaceuticals, which is in urgent need for conservation and sustainable uses of plants species/ crops [2].
- Micro-propagation/ in vitro culture of Rare/endangered plants for superior genotypes offer a great tool for managing the survival and also extraction of various phytochemicals in the changing climate scenario [3].
- Metabolomics is a helpful technique to analyse secondary metabolites using MS based platforms like GC-MS and LC-MS for separation, identification and scientific validation of Phytochemicals for drug development [4].
- Efforts have been done for sustainable drug delivery for better therapeutic activity, enhanced Bioavailability and conservation of endangered and rare plants of Terai region of Himalaya.

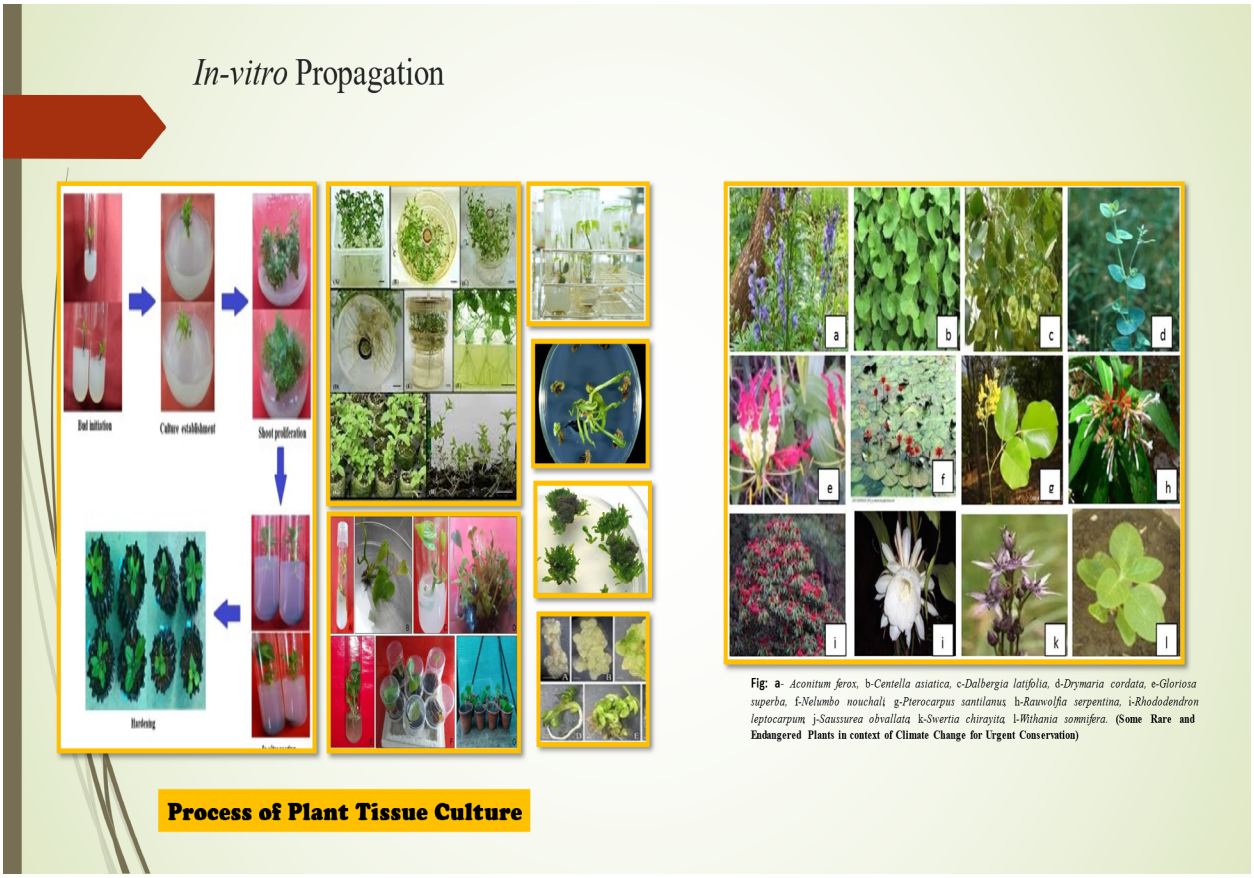

Figure 1: Medicinal Plants in the need for Urgent Conservation.

Plant species	Family	Status/ Use	Explants	Reference
Aegle marmelos	Rutaceae	Vulnerable, Medicinal	Nodal segments and shoot tip	[5,6]
Acorus calamus	Araceae	Endangered, Medicinal	Rhizome tip and Rhizome segments	[7]
Bacopa monnieri	Plantaginaceae	Rare, Medicinal	Leaf segments	
Celastrus paniculatus	Celastraceae	Rare and Endangered, Medicinal	Seeds, Nodal Segments & shoot tip	[8,9]
Commiphora mukul	Burseraceae	Vulnerable, Ornamental, Medicinal, Aromatic	Leaf segments, Apical & Nodal segments	Singh, et al. [10]
Phyllanthes emblica	Phyllanthaceae	Medicinal, edible	Leaf and Nodal segments, seedling	Bhattachryaa, et al. [11]
Dioscorea bulbifera	Dioscoreaceae	Rare, Medicinal, edible	Leaf, tuber	Behera [12]
Ocimum sanctum	Lamiaceae	Medicinal, Religious	Leaf segments	T. Mishra [13]
Prosopis cineraria	Fabaceae	Rare, Medicinal,	Seeds	Kumar, et al. [14]
Boerhaavia diffusa	Nyctaginaceae	Rare, Medicinal	Leaf segments	T. Mishra [13]

Rauwolfia serpentina	Apocynaceae	Endangered, Medicinal	Leaf segments	Goel, et al. [15]
Spilanthes acmella	Asteraceae	Endangered, Medicinal, Ornamental	Nodal and intermodal segments	Yadav, et al. [16]
Stevia rebaudiana	Asteraceae	Medicinal	Apical and Nodal segments	Kumar, et al. [14]
Gloriosa superba	Colchicaceae	Endangered, Medicinal	Apical bud	Hassan, et al. [17]
Terminalia arjuna	Combretaceae	Rare, Medicinal	Leaf and nodal segments	Yadav, et al. [18]
Sapindus Mukorossi	Sapindaceae	Medicinal, Ornamental,	Leaf segments, Apical and Nodal segments	Singh, et al. [19]
Withania somnifera	Solanaceae	Endangered, Medicinal	Leaf segments, nodal	Mishra [20]

Table 1: Some *In vitro* Propagated Medicinal Plants of Terai Region of U.P.

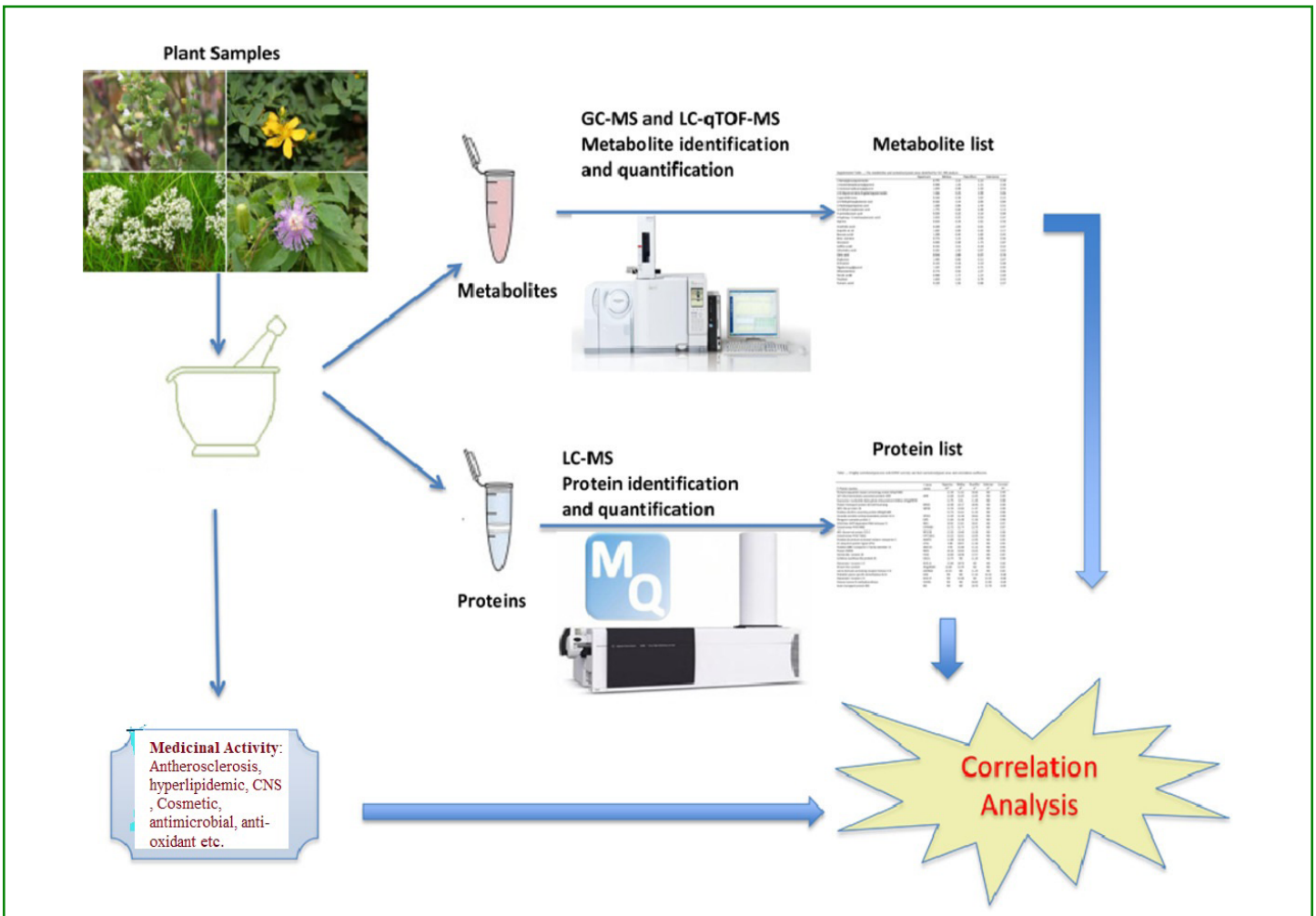

Figure 2: Schematic Representation of the Use of Biotechnological Process for identification and Qualitative Analysis of Medicinal Plants [21-25].

Conclusion

The endemic/rare plant species are considered more vulnerable to climate change and may face high risk of extinction. Changing environment has great effect on Plant secondary metabolite production, hence biotechnological tools must be employed for the enhanced production of these metabolites and help cope up with the ever-demanding plant drug industries and also sustainable crop production. Tissue culture and plant metabolomics provides a comprehensive understanding of spectrum of phytochemical constituents of plants and can be helpful in formulations of herbal drug.

Future Prospects

Biotechnological tools are necessary for the conservation and improvement of the plant species mainly rare and endangered which have importance economically and medicinally. Genetic diversity is important for the survival of the plant species in their natural habitat. However, loss in genetic diversity of the plant may lead to decline its ability to cope with changing environment and demographic fluctuations both in short- and long term. Once plant species are disappeared from their natural habitat, they cannot be regenerated again which is very difficult to reestablish their previous rich diversity. Therefore, these tools should be applied for the conservation and improvement of the various plant species in a number of ways to broaden the genetic diversity of the rare and endangered plants of India and especially of the study area, which is the rich biodiversity area of Terai region of Himalayas. Genomics, Proteomics and DNA banking is also a potential method for the conservation of biological information by preserving the genomic DNA at low temperatures and has been established in few countries. The implementation of such biotechnological tools on rare and endangered plant species of India may help in revival of their previous genes and their products which have been disappeared or inactivated in natural habitat.

References

1. Maschinski J, Haskins KE, Raven PH (2012) Plant Reintroduction in a Changing Climate: Promises and Perils. In: Haskins KE (Ed.), 1st (Edn.), Island Press, Washington, USA, pp: 402.

2. Mounce R, Smith P, Brockington S (2017) Ex-situ conservation of plant diversity in the world's botanicgardens. Nature Plants 3(10): 795-802.

3. Su YH, Tang LP, Zhao XY, Zhang XS (2021) Plant Cell Totipotency: Insights into Cellular Reprogramming. J Integr Plant Biol 63(1): 228-243.

4. Mahran E, Morlock GE, Keusgen M (2020) Guided isolation of new iridoid glucosides from Anarrhinum pubescens by high-performance thin-layer chromatography-acetylcholinesterase assay. J Chromatogr A 1609: 460438.

5. Yadav K, Singh N (2011) In vitro propagation and biochemical analysis of field established wood apple (*Aegle marmelos L.*). Annals of Oradea University, Biology Fascicle 18(1): 23-28.

6. Mishra T (2015) Protocol establishment for multiplication and regeneration of 'Holy Basil' (*Ocimum sanctum* Linn). An important medicinal plant with high religious value in India. J Med Plants Stud 3(4): 16-19.

7. Yadav K, Singh N, Aggarwal A (2011) Influence of arbuscular mycorrhizal (AM) fungi on survival and development of micropropagated *Acorus calamus* L. during acclimatization. Journal of Agricultural Technology 7(3): 775-781.

8. Lal D, Singh N (2010) Mass Multiplication of *Celastrus paniculatus* Willd - An Important Medicinal Plant Under *In vitro* Conditions using Nodal Segments. Journal of American Science 6(7): 55-61.

9. Lal D, Singh N, Yadav K (2010) In vitro studies on *Celastrus paniculatus*. Journal of Tropical Medicinal Plants 11(2): 169-174.

10. Singh N, Garg A, Yadav K, Kumar S (2010) Influence of growth regulators on the explants of *Commiphora mukul* (Hook. Ex Stocks) Engl. under in vitro conditions. Researcher 2(7): 41-48.

11. Bhattacharya A, Chatterjee A, Ghosal S, Bhattacharya SK (2001) Antioxidant activity of active tannoid principles of *Emblica officinalis* (amla). Indian Journal of Experimental Biology 37(7): 676-680.

12. Behera KK (2006) Ethnomedicinal plants used by the tribals of Similipal Bioreserve Orissa, India: a pilot study. Ethnobot Leaflet 10: 149-173.

13. Mishra T (2015) In vitro Studies of *Boerhaavia diffusa* Linn. International Journal of Current Research 7(5): 15563-15566.

14. Kumar S, Singh N (2009) Micropropagation of *Prosopis cineraria* (l.) Druce - a multipurpose desert tree. Researcher 1(3): 28-32.

15. Goel MK, Mehrotra S, Kukreja AK, Shanker K, Khanuja SP (2009) Serpentina using liquid medium, assessment of genetic fidelity of micro propagated plants, and simultaneous quantitation of reserpine, ajmaline, and ajmalicine. Methods Mol Biol 547: 17-33.

16. Singh N, Kaur A, Yadav K (2010) A reliable in vitro protocol for rapid mass propagation of *Sapindus mukorossi* Gaertn. Nature and Science 8(10): 41-47.

17. Hassan SA, Roy SK (2005) Micropropagation of *Gloriosa superba* L. through high frequency shoot proliferation. Plant Tiss Cult 15(1): 67-74.

18. Yadav U, Jaiswal VS (2011) *In-vitro* morphogenetic response of a tropical tree *Terminalia arjuna* L. Indian Forester 137(3): 341-346.

19. Yadav K, Singh N (2010) Micropropagation of *Spilanthes acmella* Murr. An Important Medicinal Plant. Nature and Science 8(9): 5-11.

20. Mishra TA (2022) Marginalised Adaptogen *Withania somnifera* (L.): Efficient Protocol for Conservation. Cutting Edge Research in Biology 1: 11-22.

21. Sanyal R, Nandi S, Pandey S, Chatterjee U, Mishra T, et al. (2022) Biotechnology for propagation and secondary metabolite production in *Bacopa monnieri*. Applied Microbiology and Biotechnology 106(5-6): 1837-1854.

22. Harish BS, Dandin SB, Umesha K, Sasanur A (2012) Impact of climate change on medicinal plants - A review. Anc Sci Life 32(S1): S23.

23. Courtney C (2009) The effects of climate change on medicinal and aromatic plants. Herbal Gram American Botanical Council 2009(81): 44-57.

24. Yapa AW, Pathirana R (2022) Sustainable Agro-Food Systems for Addressing Climate Change and Food Security. Agriculture 12(10): 1554.

25. Zobayed SM, Afreen F, Kozai T (2005) Temperature stress can alter the photosynthetic efficiency and secondary metabolite concentrations in St. John's wort. Plant Physiol Biochem 43(10-11): 977-984.