



Short Communication

Ethnobotanical knowledge as booster to Make in India campaign for agriculture and pharma sectors

Shikha Tiwari^a, Bijendra Kumar Singh^b, Vatsala Kishore^c & Nawal Kishore Dubey^{b,*}

^aDepartment of Botany, S.S.S.V.S. Government Post Graduate College, Chunar, Mirzapur 231 304, India

^bCentre of Advanced Study in Botany, Institute of Science, Banaras Hindu University, Varanasi 221 005, India

^cDepartment of Pathology, Heritage Institute of Medical Sciences, Varanasi 221 311, India

*E-mail: nkubeybhu@gmail.com

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India is a mega-biodiversity rich country comprising a vast traditional knowledge on use of plants and their products in ancient agriculture as well as pharmaceutical sectors. The country needs bioprospection of Indian flora and ethnobotanically important plants for novel formulations to be used in agricultural pest management as well as in cure of different human diseases, thereby, boosting green chemicals based substances as an important component under the Make in India campaign.

Keywords: Biopiracy, Bioprospection, Ethnomedicine, Green chemical, Make in India

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The progressive “Make in India” campaign aims to turn the country into a global manufacturing hub, to facilitate the inflow of new technology and capital and creating a large number of jobs. Agricultural and pharmaceutical sectors are two important pillars on which human civilization is built. India is a mega-biodiversity rich country comprising approximately 17000-18000 species of flowering plants in its varied climatic zones, of which 6000-7000 are estimated to have medicinal usage in folk practices. Around 25000 effective plant-based formulations are used in Indian system of medicine and the country enjoys an important position in the global pharmaceutical sector. The article presents ethnobotanical knowledge of the country as a booster in agriculture as well as pharmaceutical sectors under the Make in India campaign.

Plant chemicals in management of agricultural pests

Exploration of phytochemicals is currently gaining momentum in the agriculture sector also so as to formulate some novel plant based green pesticides for the management of agricultural pests. Although the role of xenobiotic synthetic chemicals (grey chemicals) in enhancement of agricultural productivity cannot be denied, but in view of their post application side effects such as pest resistance, residual toxicity, non-biodegradable nature, ozone layer depleting roles,

disruption of ecological balance and interference with the reproduction of non targeted species, most of the synthetics are having nonbiodegradable in nature and their indiscriminate application has been cautioned by the environmentalists. Exploration of different formulations of products of ethnobotanical plants as novel green pesticides is currently gaining momentum all over the globe for sustainable management of agriculture pests¹. Plant-based formulations are chiefly biodegradable, renewable, eco-friendly, with favorable safety profile and are realized as better alternatives to synthetic pesticides in agriculture sector². The most attractive aspect of using such plant chemicals in agricultural pest management is their mode of action as semiochemical or behavior altering effect to inhibit the growth and metabolism of pests without killing them. *Cinnamomum zeylanicum* and *Croton tetradenius* EOs have been reported to affect locomotory behavior of *Sitophilus zeamais* and leafcutter ant *Acromyrmex balzani*, respectively^{3,4}. Such growth regulatory approach in pest control is being more accepted currently. Rotenone (root of *Derris elliptica*), nicotine (leaves of *Nicotiana tabacum*), pyrethrins (flower of *Chrysanthemum cinerariifolium*), azadirachtin (seeds of *Azadirachta indica*), piperine (seeds of *Piper nigrum*), eugenol (clove essential oil) and menthol (*Mentha* sp. essential oil) are some plant-derived commercially available formulations used in agri-food

industries. Traditionally used essential oils and their bioactives such as cinnamon, clove, lemongrass, oregano, thyme, nutmeg, basil, carvone, cinnamaldehyde, citral, eugenol, limonene, menthol, linalool, curcumin etc. are kept in Generally Recognized as Safe (GRAS) category by US Food and Drug Administration (FDA) and Environment Protection Agency (EPA) and are used as preservatives in the United States with wide coverage.

Indian medicinal knowledge in boosting economy of the country and in crisis management in pandemic diseases

Indian ethnomedicinal plants may be revenue generating resources to indigenous people. Although, there are about 25,000 plant-based formulations used in Indian system of medicine only few are properly standardized and scientifically documented. Standardized herbal formulations have tremendous scope for our country to become a major player in global market. Indian economy can be boosted by developing globally demanded herbal formulations based on ethnomedicinal knowledge through reverse pharmacology and new drug development technologies. Different parts of *Carica papaya* i.e., stem, fruits and leaves are reported to be highly effective against dengue fever and thrombocytopenia due to presence of papain and chymopapain as its major bioactive constituents⁵. Recently, the tablets and capsules of *Carica papaya*, 'Caripill' is used widely as effective remedy against dengue when the suitable medicine for the disease is lacking in allopathic system. Similarly, *Rauwolfia serpentina* sold in Indian market as 'Serpina' by Himalaya Drug Company is also a wonderful therapeutant against hypertension and anxiety⁶. Another such example is the Asclepiadaceae plant i.e., *Caralluma fimbriata* based formulation 'Reducta' which is used as promising appetite suppressor and fat burner drug⁷. These are some examples how Indian medicinal knowledge is useful in time of crisis management. Based on our knowledge on Indian medicine, we can develop many wonderful life saving drugs viz., taxol, brahmi, jeevni and reserpine. Incorporation of modern nanotechnology will accelerate bio-efficacy of ethnomedicinal formulations through enhancing its stability and bioavailability leading to enhance their practical applicability. Several nanoformulated phytochemicals i.e., curcumin, artemisinin, eugenol, carvacrol, berberin, *Eucalyptus staigeriana* EO, *Lippia sidoides* EO, *Zataria multiflora* EO have been reported to have enhanced thermal stability, antioxidant and antimicrobial potential^{8,9}.

Conclusion

India comprises a vast traditional knowledge on use of plants and their products in agriculture as well as health sectors. There is a lot of scope for India to achieve global leadership in the field of green pesticides for sustainable and eco-friendly use in agriculture sector. Looking into illegal acts of biopiracy exploiting indigenous traditional knowledge, there is need for bioprospection of traditionally important plants for novel herbal formulations. Boosting green chemicals in agriculture as well as pharma sectors would facilitate the inflow of new indigenous technologies and has immense scope in creating jobs under Make in India programme. The valuable Indian ethnomedicinal knowledge may be a booster to the 'Make in India' campaign making the country a self reliant and global leader by developing novel herbal life saving formulations.

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Conflict of Interest

The authors confirm that they have no any conflict of interest with respect to the work described in the manuscript.

Authors' Contributions

ST: Writing original draft, writing review and editing; BKS: Formal analysis; VK: Formal analysis, Writing original draft; NKD: Supervision, writing original draft, writing review and editing.

References

- 1 Srivani Maddala V K, Green pest management practices for sustainable buildings: Critical review, *Sci Prog*, 102 (2019) 141-152.
- 2 Shivkumara K T, Botanical insecticides; prospects and way forward in India: A review, *J Entomol Zool Stud*, 7 (3) (2019) 206-211.
- 3 Haddi K, Oliveira E E, Faroni L R, Guedes D C & Miranda N N, Sublethal exposure to clove and cinnamon essential oils induces hormetic-like responses and disturbs behavioral and respiratory responses in *Sitophilus zeamais* (Coleoptera: Curculionidae), *J Econ Entomol*, 108 (6) (2015) 2815-2822.

- 4 de Andrade Brito F, Bacci L, da Silva Santana A, da Silva J E, de Castro Nizio D A, *et al.*, Toxicity and behavioral alterations caused by essential oils of *Croton tetradenius* and their major compounds on *Acromyrmex balzani*. *Crop Prot*, 137 (2020) 105259.
- 5 Nouman M, Niaz B, Saeed F, Arshad M U & Anjum F M, Nutritional and bioactive profile of different parts of *Carica papaya* L. in relation to thrombocytopenia, *Int J Food Prop*, 25 (1) (2022) 24-32.
- 6 Paul S, Thilagar S, Nambirajan G, Elangovan A, Lakshmanan D K, *et al.*, *Rauwolfia serpentina*: A potential plant to treat insomnia disorder, *Sleep Vigil*, (2022) 1-10.
- 7 Rao A, Briskey D, Dos Reis C & Mallard A R, The effect of an orally-dosed *Caralluma fimbriata* extract on appetite control and body composition in overweight adults, *Sci Rep*, 11 (1) (2021) 1-9.
- 8 Pandit J, Aqil M & Sultana Y, Nanoencapsulation technology to control release and enhance bioactivity of essential oils, In *Encapsulation Academic Press*, (2016) 597-640.
- 9 Jeevanandam J, Aing Y S, Chan Y S, Pan S & Danquah M K, Nanoformulation and application of phytochemicals as antimicrobial agents, In: *Antimicrobial Nanoarchitectonics-Elsevier*, (2017) 61-82.