Medicinal And Aromatic Plants (maps): A Mini-review

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Abstract

Natural products from medicinal and aromatic plants (MAPs) have lesser harmful effects on human systems. Hence, their specific utility is in chronic and acute diseases. With an increasing usage of herbal preparations internationally, any attempt by academics on MAPs is an effort towards meeting the global demand and a step towards their conservation. Here, an attempt to review various methods for conservation of MAPs is made. In this paper, at least two databases, PubMed and Academic One File-Infotrac, and the internet in general, were searched for articles on MAPs. After distilling the data sources, articles found suitable to the present aim were reviewed. Presented here is a short treatise on MAPs, in general, and various strategies on their conservation in particular. Various approaches are adopted to conserve the MAPs and meet the global demand. However, no single method is sufficient to meet the goals. Hence, multiple strategies have to be adopted.

Introduction

Research and market on medicinal and aromatic plants (MAPs) represents one of the fast growing areas in the field of Biology and allied disciplines. An essay on Biotechnology in MAPs at the Department of Biotechnology (DBT), Government of India website states that with an annual growth of 10-20%, the global market on MAPs is expected to touch US $5 trillion by 2050 [1].

Medicinal plants are defined as those plants, which are popular for their pharmacological properties [2]. Contrary to what has been mentioned in the popular sources, the present article also considers those plants not listed in official pharmacopeia as medicinal, if they are used in traditional or herbal medicines. Thus, for the present medicinal plants are those plants that are used in traditional or herbal medicines irrespective of scientific evidence of their pharmacological properties. Similarly, plants with aroma characteristics are referred to as aromatic plants [3]. Examples in both types are numerous. In reality, approximately anywhere between 50,000 species-70,000 species of plants are known internationally for their medicinal and aromatic properties, with approximately 4000-10,000 species of MAPs being endangered [4,5].

Research in MAPs is vital for various reasons. Firstly, the minimal side-effects observed as a consequence of usage of herbal medicines. Kacharava *et al.*, argue that as a rule, natural complex chemical compounds have less harmful and specific impacts on the human body rather than their synthetic analogues [6]. A probable explanation for this lies in the observation that every somatic cell of the human body has the same genetic content, whereby each of these cells have the capability to express any gene at any given point of time depending upon its requirements. This situation is best illustrated in cancerous phenotype. Thus, upon using synthetic analogues, cells that express the same gene cannot avoid being sensitive to the drug [7]. Herbal or MAPs preparations, and therapeutics in traditional medicine have lesser side-effects for the simple reason; the uncharacterized antagonists are also usually present in the same preparation. As a result, even if the MAPs and traditional medicine do not cure the disease, they at least do not cause harmful effects. Perhaps the words of Cyril P Bryan, English translator of "The Papyrus Ebers", with regard to traditional Egyptian medicine, are worth citing in this context. He says that many of them (*i.e.*, the traditional medicines of Egypt) are harmless even if they do not have any therapeutic effect [8]. Given this scenario, the best use of preparations of MAPs, in particular, and traditional medicine (which uses MAPs), in general, is in chronic and acute diseases [6].

Secondly, greater than 4,00,000 tons of MAPs of approximately 3,000 species are traded internationally. Among these China and India are two of the largest producers and exporters of MAPs [5]. Needless-to-say, approximately 60-80% of the MAPs marketed are collected from the wild [4, 5]. This scenario clubbed with an annual growth, in the MAPs market, of 10-20% and an increasing usage of herbal medicines in the developed countries, prompts us to think considerably about conservation of MAPs. In addition, the scientific fraternity is also burdened to meet the growing demand without exhausting the existing resources.

A number of scientific organisations and

non-governmental organisations (NGOs), both in India and abroad, are involved in research and formulating standards, rules and regulations in the directions mentioned above. Towards achieving the market demands, cultivation of MAPs on a commercial level cannot be taken up for the simple reason this may lead to a loss in the acreage of essential food crops. Thus, this situation necessitates an assessment of available methods towards conservation of MAPs aimed at meeting the insurmountable market demand. The present article tries to review in brief the various approaches in research, recognition and conservation of MAPs.

Data Sources and Overview

In addition to the internet, in general, an online search at various databases, *viz.*, PubMed, and Academic OneFile-Infotrac, with free full text option was carried out initially with combined keywords of "Biotechnological approaches" and "MAPs" This search yielded zero results both at PubMed and at Academic OneFile-Infotrac. To improve upon the results only "MAPs" was used as a keyword and the results narrowed depending upon the suitability of the articles with the present topic. Subsequent look-up of articles is based on the cited references in the initially identified articles. All the papers that surfaced in various searches were identified for their suitability to the headings and subheadings. While arguing the fact that this article overlooks many important publications and approaches, the readers must keep in mind that this article is intended to be a mini-review and every review have their limitations.

The Approach

Approaches to MAPs research and marketing include recognition of MAPs, conservation and achieving the targets.

Recognition

The first effort to any activity in MAPs is in recognising the actual medicinal or aromatic plant. This need arises as a consequence of many plants looking similar to MAPs. Also, it is essential to identify the plant part that is useful for medicinal purposes to avoid destroying the entire plant. Furthermore, as mentioned earlier, presently approximately 60-80% of MAPs are procured from the wild, wherein many similar looking poisonous species may also be present; properly recognising the plant therefore becomes mandatory.

Approaches to recognising the MAPs may be many and varied. In general, they can be grouped as Traditional methods and Modern approaches.

Traditional methods are cost-effective, non-destructive or non-invasive, but rely heavily on skill and expertise of the personnel involved. Modern approaches may be invasive or destructive in the sense that some amount of specimen may be lost during analysis, which may not be recovered.

Traditional methods

Traditional methods of identifying the plants rely on plant characteristics and involve a thorough knowledge of botany (at least undergraduate level). The best method is to compare the MAP in hand with a known specimen in herbaria. At least one digital herbarium is now available on-line [9].

Modern approaches

Modern approaches for recognition of MAPs include Biotechnological and Biochemical approaches. Biotechnological approaches involve extensive usage of databases, genomics and proteomics. One good starting point of information on databases is an article on Medicinal plant information databases found in the Food and Agriculture Organisation FAO document repository [10]. Apart from this, National Institute of Science Communication and Information Resources (NISCAIR) are involved in publishing abstracting services for articles on MAPs [11].

Numerous techniques essentially aimed at identifying the genes of interest in MAPs come under genomics. Mere listing of these techniques itself is beyond the scope of this article as every lab now-a-days is having their own in-house techniques with the invasion of polymerase chain reaction (PCR). Also, with the complete genomes of many plants being available in popular public domains such as the PubMed, the genomics era in MAPs, in general and plants, in particular, can be said to have come of age. Closely coming along with genomics is proteomics, which involves proteins and their sequences. Proteomics, although expensive yields more reliable results.

Somewhat similar to proteomics are the biochemical approaches that involve loss of the sample to a certain extent. Typically, biochemical analysis involves thin layer chromatography. With the advances in chromatographic techniques, the sample loss has been minimized, but till date, biochemical approaches represent the most reliable recognition method of the natural compounds present, and thereby the MAPs. These recognition methods may sometimes lead to the discovery of new useful compounds in plants.

Conservation and achieving the targets

Anders S Barford *et al.*, suggest that the most direct approach for conservation is through trade of MAPs

[12]. The need for conservation arises as a consequence of our enthusiasm to achieve the set targets and goals. Such a mindless passion, as mentioned earlier, has already led to endangering approximately 4,000-10,000 species of MAPs. Thus, conservation of MAPs becomes mandatory. Primary among the conservation approaches include:

Documentation of MAPs

Dahanukar *et al.*, mention that in a span of 5 years more than 13,000 plants have been investigated for their medicinal potential [13]. Further screening of plants for their medicinal and aromatic potential is being carried out at many research institutes in India and abroad. Once identified building the herbaria is also part of the documentation process.

Traditional approaches

Traditional approaches for conservation and achieving the targets include medicinal plant conservation areas (MPCA) within forest or notified areas wherein the plants are allowed to grow in their natural habitats [14]. Similarly, Joint forest management (JFM), an initiative of the Ministry of Environment and Forests, actively encourages participation of communities in rehabilitating degraded forests [15]. Farming and/or cultivation involving high yielding varieties and related studies, typically, taken up by private individuals and companies is yet to gain momentum. Despite this, some private firms are involved in the same. Once taken up, increasing the acreage, *i.e.,* the area of cultivation, can to a certain extent achieve the target. However, the last two options are limited by the observation that (1) They deplete the acreage of essential food crops, a point already mentioned and (2) They may not necessarily provide the same ecological conditions in which the MAPs grow naturally. The popular Noah's ark approach of seed vaults or seed banks or dooms-day vaults preserve the seeds for an unexpected catastrophe. The Svalbard Global Seed Vault is a classic example here [16].

Modern approaches

Modern approaches come into vogue when the set targets cannot be achieved using traditional approaches and when certain MAPs cannot be grown in a different pattern of climatic conditions. The popular modern methods in this category include tissue culture, cloned gene products and chemical synthesis of the medicinal or aromatic compounds. A number of attempts in the mentioned three directions are going on in labs all over the world including India. A specific example of chemical synthesis of medicinal compound is Azadirachtin [17].

Abbreviations

APINMAP: Asia pacific information network on medicinal and aromatic plants
DBT: Department of Biotechnology
JFM: Joint forest management
MAPs: Medicinal and aromatic plants
MPCA: Medicinal plant conservation area
NGO: Non-governmental organisations
PCR: Polymerase chain reaction

Other abbreviations carry their usual significance.

Conclusion

With the increasing demand for MAPs, it may not be possible to meet the targets always. Research in the thrust areas mentioned in this article may lead to measures, which to a certain extent, meet the requirements. However, as mentioned earlier, no single approach will be sufficient to meet the global demand. Thus, taking into account the number of endangered species, one aim of the personnel involved in MAPs research, is to ensure that by 2050, one or two grams of medicinal or aromatic compounds do not cost US $5 trillion.

Acknowledgements

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