

2. BIRAC-type models in all sectors of innovation.
3. Grand challenge initiative for the nation.
4. National mission on scientific instrumentation, including medical instrumentation.
5. Guidelines for valuation of pre-revenue companies.
6. Procurement/tender policy modifications to accommodate incubated companies just as cooperatives.

Ministry of Human Resource Development

1. Creation of technology – social science interface.
2. Commercialization funds for social innovation.
3. Incorporation principles of sustainability in products and practices.
4. Enabling ESCROW accounts in all social sectors.
5. Academic rewards for entrepreneurs.

6. Technology business incubators in all institutions.
7. Legal system to nurture innovation.
8. Statutory framework for sharing of ownership, technology, royalties.

Ministry of Science and Technology

1. Interactive website – a window for problems and solutions.
2. Innovation in entrepreneur education.
3. Showcasing products and entrepreneurs in national and international forums.
4. Common centres for prototyping.

Ministry of Corporate Affairs

1. Corporate Social Responsibility funds for technology commercialization in rural India

Epilogue

India is at the threshold of translating socially relevant research to engines of

social transformation. Many of these innovations may be frugal, but they have a huge scope, as our requirements are varied. Our institutions and human resource have to be prepared to absorb the scattered research results available across the country to tackle these varied necessities, and systems have been created to channelize the laboratory findings to economically viable and socially relevant innovations. The recommendations captured here as a result of a discussion meeting among technologists, academic-turned entrepreneurs, incubatees, administrators and like-minded individuals based on their experience in seeding and nurturing incubation culture, if implemented consciously, have the potential to transform the entrepreneurial landscape of our country.

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MEETING REPORT

Traditional ethnomedicinal knowledge of Indian tribes*

According to the Government of India 2011 census data, schedule tribe population in India is about 8.6% of the total population. This population is subjected to abject poverty and economic backwardness, often lacking in proper education and healthcare facilities. For healthcare, they mainly rely on traditional medicines that solely depend upon the supply of native medicinal plants. Their knowledge of tribal medicine (also known as ‘folk’ or ‘indigenous’ medicine) is mainly verbal, usually passed on from one generation to another without any written script, making documenta-

tion and record-keeping almost impossible. Studies suggest that the tribal and ethnic communities in India as part of their healthcare systems use more than 8000 species of plants and approximately 25,000 folk medicine-based formulations.

India harbours a rich repository of untapped medicinal plants, with plenty of associated knowledge that needs to be appropriately utilized. A conference on traditional medicinal knowledge was organized recently, which was attended by 80 participants, representing 12 states of the country. During three technical sessions, the following issues were discussed – the rising need to preserve the traditional medicinal knowledge of the country, legal protections (i.e. IRP-related issues) available to traditional healers, conservation of medicinal resources, cultivation of medicinally important plants, and translation of the traditional knowledge into drug development programme.

More than 1.5 million traditional medicinal practitioners in India use medicinal plants for preventive, promotional and curative purposes. About 65% of the Indian population relies upon traditional medicine for its healthcare needs. In his inaugural address, Palpu Pushpangadan, (formerly at National Botanical Research Institute, Lucknow) presented an in-depth analysis of the ethnobiological knowledge of the Indian tribes and possibilities of translating this knowledge in marketable pharmaceutical drugs. He mentioned that scientific validation, subsequent commercialization through patenting and licensing, and sharing of the benefits with stakeholders are crucial to the popularization of traditional medicinal knowledge. JEEVANI, an anti-ageing and anti-depressive drug developed from the Arrogypacha (*Trichopus zeylanicus*) plant was an outcome of the traditional knowledge of the Kani tribes of Kerala. Therefore, the earnings from the drug

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were shared with the tribal people for their educational and socio-economic developments. Cultivation of medicinally important plants, especially by local tribal people, is another important step. This will not only protect plants from over-exploitation, but will be an added source of income for the local people. Universities and research institutions should play an important role in ensuring that local populace of a region gets maximum benefits from the medicinal wealth of its nearby area.

Rajiv Rai (Tropical Forest Research Institute, Jabalpur) highlighted various measures that have been adopted to popularize traditional medicinal knowledge amongst the tribes of Madhya Pradesh (MP) and Chhattisgarh (CG). He emphasized that well-focused extension education programmes are needed to increase awareness among the tribal people.

Increasing population, incidence of side effects of synthetic medicines and our inability to provide modern medicines to a vast section of the population living in rural and remote areas of the country (availability, accessibility and affordability) have been the prime reasons for the growing popularity of alternative medicines amongst rural and remote population, and neo-rich people in the developed countries. The World Health Organization (WHO) has reiterated that the goal of 'health for all' cannot be accomplished without herbal medicines. Natural products could be useful in the treatment of serious diseases like cancer. S. K. Trigun (Banaras Hindu University, Varanasi) presented his work on modulation of carcinogenesis by fisetin (a natural flavonoid) in aflatoxin-B1-induced hepatocellular carcinoma. It has been observed that more cancer patients die due to treatment than non-availability of drug. Use of natural flavonoids could be effective in cancer treatment without causing toxicity. Thus, traditional medicinal knowledge and associated plants could play a central role in the drug development programme. Herbal products or constituents could be used directly as curative agents as well

as through isolation of lead molecules as a part of new drug discovery programmes.

Over-exploitation and increasing urbanization may lead to the substantial loss in diversity of medicinally important plants from their natural habitats. It is, therefore, relevant to think about their preservation and conservation. Majority of these plants are still gathered and collected from the wild and relatively few are cultivated in farmlands. Therefore, cultivation practices should be developed in order to meet the demands of the industries. Apart from lessening the exploitation, this will also create jobs and promote economic well-being of the stakeholders. A shift from collection to cultivation of medicinally important plants will further ensure the purity, authenticity and sustainable supply of raw drugs. Climatic and edaphic factors could play a crucial role in cultivation of medicinal plants. For example, rising environmental pollution could have detrimental effect on the quality of natural medicinal products. Sudhir Kumar Pandey (Guru Ghasidas University, Bilaspur) analysed the impact of foliar transfer of airborne toxic metals in selected medicinal plants of Bilaspur district, CG. His study suggests that the amount of different heavy metals accumulated in the leaves of the exposed plants could be well above the permissible level recommended by FAO and WHO. This presents a greater threat to the health of consumers.

Since rural and tribal/ethnic people are major stakeholders of the traditional medicinal knowledge, attempts should be made to protect their rights (e.g. Intellectual Property Rights (IPR)). The relationship between traditional medicinal knowledge and IPR is intricate, and is related to the equitable sharing of benefits arising out of the commercial exploitation of such knowledge.

In his deliberation on intracellular parasitic protozoan *Leshmania donovani*, Ambak Kumar Rai (Motilal Nehru Institute of Technology, Allahabad) highlighted the importance of different

metabolic pathways to understand the probable action sites of drugs. To test the efficacy of the natural drugs, we need to choose appropriate animal models. Akash Gautam (Center for Neural and Cognitive Science, University of Hyderabad) discussed the neuroprotective potential of Ashwagandha leaves in scopolamine-induced amnesia (responsible for memory loss) in mice brain. Nishi Prakash Jain (Sagar Institute of Research and Technology, Bhopal) provided an insight on the formulation, dose determination and *in vitro* evaluation of drugs citing an example of using vesicular delivery system of capsicum extract in hydrogel to treat psoriasis.

Tribal people have evolved their unique way of identifying medicinal plants and using them to treat a particular disease. Commercial exploitation of local medicinal plants by natives is often constrained by the lack of suitable marketing strategies. S. P. Singh (Indian Institute of Forest Management, Bhopal) presented an account of various strategies to be adopted for successful commercialization of medicinal plants. The quality of active principle often gets destroyed under improper storage conditions. Therefore, maintaining a stringent quality control measure is of utmost importance to get maximum business.

Demand for medicinal plants is growing all around the world, which itself testifies the popularity and belief of people in herbal medicines. This presents before us a great opportunity to utilize our plant wealth and traditional medicinal knowledge in the service of humanity with concomitant promotion of economic growth of the country. Overall the conference was a good initiative to bring together the important components of ethnomedicinal research in the country.

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