

## Ethnomedicine, Health Food and Nutraceuticals-Traditional Wisdom of Maternal and Child Health in India

Palpu Pushpangadan<sup>1\*</sup>, Varughese George<sup>1</sup>, Thadiyanparambil Ijinu<sup>1</sup>, Manikantan Ambika Chithra<sup>1</sup>

<sup>1</sup>Amity Institute for Herbal and Biotech Products Development, Thiruvananthapuram, Kerala; palpuprakulam@yahoo.co.in (P.P)

**Abstract:** Food and medicine are indispensable companions of humans since the very beginning of his existence. The early man explored his surroundings to locate materials of natural origin for food and medicine. He continued his search in the plant and animal kingdoms to expand his food basket, to heal his ailments and discomforts. The desire to attain vitality and longevity also prompted the early man to experiment with whatever available in his immediate neighbourhood. By a process of trial and error, observation and empirical reasoning and inference the early man made conscious selections of a variety of biological materials to enhance his health, to alleviate pain or to treat other physical and mental ailments. The knowledge thus gathered was passed on to succeeding generations. Creative members of the succeeding generations incrementally improved and even added new knowledge to this body of traditional knowledge system. This traditional wisdom has come down to us from our ancestors and we now term it as traditional knowledge or ethnic knowledge. We find this knowledge system getting perpetuated through folklore, local health traditions, tribal knowledge system, family and community based knowledge systems etc. All ancient cultures and civilizations of the world had thus evolved their own traditional food, nutrition and medicine from their ambient biological wealth. The Ayurvedic Masters of ancient India had a clear understanding of the delicate cellular mechanism of the body and the deterioration of the functional capacity of human being. To arrest such deterioration of the functional efficiency and to revive and revitalize the body system, the Ayurvedic masters developed an elaborate rejuvenation therapy known as 'Rasayana' therapy. 'Rasa' in Sanskrit means the essence and 'ayana' means to circulate in the body without any obstruction. 'Rasayana' is one of the eight clinical specialities of Ayurveda that is aimed for the rejuvenation and geriatric care. Rasayana is not a drug therapy, but a specialized procedure practiced to cleanse the body from the toxic and other microbial substances. In Rasayana Therapy, with the help of special diet and nutritional agents comprising of highly powerful antioxidants, the body is rejuvenated by providing greater immunity, vitality, longevity and by improving all faculties to attain youthfulness of the whole body.

**Keywords:** *Ethnomedicine, Ayurveda; Siddha, Unani, Amchi, Nutraceuticals, Rasayana.*

### 1. Introduction

The centuries old traditional wisdom using plants for medicine for the prevention and treatment of diseases by ethnic communities is known as ethnomedicine. The ethnomedicine of India functions through two social streams. One is local folk stream which is prevalent in rural and tribal villages of India. The carriers of these traditions are millions of house wives, thousands of traditional birth attendants, bone setters, practitioners skilled in acupressure, treatment of eyes, snake bites etc. and the traditional village level herbal physicians "the vaidyas" or tribal physicians in the tribal areas. These local health traditions thus represent an autonomous community supported system of health delivery at the village level which run parallel to the state supported system. The second level of traditional health system is the scientific or classical systems. This consists of the codified and organized medical wisdom with sophisticated theoretical foundations and philosophical explanations which are expressed in thousands of classical and regional manuscripts covering treatises on all branches of medicine and surgery.

Systems like Ayurveda, Siddha, Unani, Amchi, Tibetan etc. are the expressions of this stream. The Ethnomedicine may be mostly oral but have a documented system like Ayurveda, Siddha and Unani which is of course practiced by the elite in the society in the past.

### 2. Materials and Methods

Ethnic foods are mostly location specific and best suited to local climate and environment. The advances made in biological sciences contributed to the rapid development of food habits and medicine in 20<sup>th</sup> and 21<sup>st</sup> centuries. In 21<sup>st</sup> century natural drugs especially of plant origin play a major role in health care programme of mankind. The data were collected from villagers by interviewing. The materials are locally collected and used.

### 3. Native Cultural Tuning in India

A battery of do's and don'ts, acquired from the collective wisdom of ancient times, regulated human life in various ethnic groups of India. Rural societies in various regions and different socio-cultural settings had their own systems. The socio-religious sanctions as spelt out in the time honored 'Shodasa Samskaras' of India provided the guidelines for conducting a healthy life. Right from conceiving a child, *Garbhadharanam*, the right ambience and other precautions, mental states and herbal medications, on to the rituals of the third month, *Pumsavanam*, and another in the fourth, *Seemantham*, with appropriate dietary supplements, spell out the procedures to be adopted for a healthy child. Stages like *Brahmacharya*, celibacy for the young adult, *Grihasthasrama*, the householder's way, *Vanaprasta*, partial retreat from active life and *Sanyasa*, total renunciation of worldly life, were designed in keeping with the needs of the individual and society. This has suffered in recent times with the homogenization of culture due to the western influence.

#### 4. Importance of Ethnic Food and Medicine

Ethnic food and medicine are mostly location specific and is best suited for the local climate and environment. Such systems of food and practices are deep rooted in the communities' social, cultural and religious values. For centuries these practices of food and medicine helped the people to lead a healthy, holistic life, free from most of the modern day diseases. That is the reason why WHO recognized the intrinsic importance of such traditional food, nutrition and medicine particularly in primary healthcare practices. WHO also emphasized the strategic role of medicinal plants in ensuring the primary healthcare needs of the people particularly those in the rural sector.

The revival of interest in plant based drugs and the other herbal products is mainly because of the widespread belief that 'green medicine' is healthier than the synthetic products [1]. This is mainly due to the increasing evidences of the health hazards associated with the harmful side effects of many synthetic drugs and the indiscriminate use of modern medicines such as antibiotics, steroids etc. The preference for green food and medicine has resulted in the rapid growth of plant based drugs, pharmaceuticals, nutraceuticals, functional foods and even cosmeceuticals. In 1980s this led to the rapid spurt of demand for health products like herbal tea, ginseng and products of traditional medicine. The health promotive and disease preventive strategies in treatment, prevalent in oriental systems, especially the Indian (Ayurveda, Siddha, Unani and Amchi) and the Chinese systems of medicine are finding increasing popularity and acceptance all over the world. Because of this sweeping "green wave" a large number of herbal drugs and plant derived herbal products are sold in the health food shops all over the developed countries. According to some healthcare experts, there will be more dieticians rather than physicians in coming years, as many diseases can be prevented and better health can be maintained if one takes right food containing plant products with specific functional attributes.

Grains, like Bengal gram, green gram get enriched when sprouted after soaking in water. This is a common technique traditionally used in India. The protein assimilated by the body goes up by 10 to 60 percent when the grains are soaked and sprouted. From the nutrition angle this helps provide various enzymes which can get easily absorbed by the digestive system. The sprouted grains are normally given to pregnant and lactating mothers. There are other common practices among rural people in South India like consuming rice fermented overnight. In traditional society farmers who went out to the fields for work ate 'pazhankanji' or previous day's rice. Rice when fermented overnight becomes rich in various anti-oxidants and this helps the farmers working in the hot sun have a protection. Vitamins B6, B12, etc. have been isolated from fermented rice. However, this has lost out in prestige in recent past and the use is now limited.

The disappearance of healthy food technologies from the rural areas have also led to nutritional loss. There have been procedures for drying and preserving seasonal foods for the whole year till the coming of canned foods. Thus during the season of mangoes and jack fruits, there was a rural traditional of drying the fruit pulp in the sun, applying layer after layer on herbal mats every day. This, when dry, was kept in sealed containers with native herbal preservatives. It served as an unadulterated source of supplementary nutrition to the young and old. There were also ways of preserving raw mangoes in salt, dried jack fruit seeds in containers etc. These cheaply available and highly nutritious food items have almost disappeared, leaving no alternative models behind. Thus, large quantities of surplus seasonal food now get wasted.

The introduction of modern medicine in 19<sup>th</sup> century began to exert a negative influence on the traditional healthcare sector. The advances made in biological sciences, chemistry, pharmacology, microbiology etc contributed to the rapid development of modern medicine in the 19<sup>th</sup> and 20<sup>th</sup> centuries. These developments in modern medicine and food processing caused a rapid decline in ethnic food and medicine. However, by the end of the 20<sup>th</sup> century there had been an unprecedented revival of interest in ethnic food and medicine. In the 21<sup>st</sup> century natural drugs, especially of plant origin, are expected to play a major role in the healthcare programme of mankind.

#### 5. Special Food for Mother and Child

Child bearing and propagation of culture through the generations are central to any society. In the agrarian society preparations for this began very early and the birth of a child, particularly the girl, was an important event. Offering prayers to beget a girl was common place, like performing ritual arts like 'theyyam' in Malabar. The girl child had many privileges and her attaining puberty was another occasion to celebrate. Family and friends brought choice food items meant to give her the much needed nutrition at that stage. A girl was to take rest during her periods and eat specific foods which are no longer possible in the fast-paced modern life. Traditional social support systems like the compound families took care of the various needs. Proper pre-marital counseling is a requirement in modern society where plain ignorance leads to far too many complications and diseases. Earlier, elderly women used to advice and counsel. Respect and knowledge empowerment of the girls gave them honor, confidence and courage. The traditional practices continue in many regions and in the Gangetic plains of India, scenes of girls attaining puberty being carried in bullock carts with music and dance could be seen till recently. Of late this takes place only in remote villages. Majority in the country now consider sexuality and reproduction a private matter, perhaps after the spread of western values when everything related to these are considered sinful and secretive.

In traditional societies the crucial phase of pregnancy-care starts the moment pregnancy is confirmed. The expectant mother is advised to conform to a series of customary behaviors with almost every elder family member or villager monitoring her. The woman receives special care in all day to day activities what is now lost in the modern life styles. The treasures of native wisdom on this subject are opened to the new mother-to-be. Certain foods were taboo for pregnant women while some others were mandatory. Do's and don'ts were all part of folk wisdom. Thus it was mandatory for those in advanced stages of pregnancy to do specific house hold chores like sweeping the floor, where many others were barred. Such natural exercises enabled easy child birth and are endorsed by modern obstetricians now. Many of the preparations of this tradition remain unwritten, kept alive by being passed on from one generation to the next.

Pregnant women are normally not allowed to stray outside during the night in most villages. They have restrictions in visiting sick people and witnessing traumatic events. In several families there are also stipulations that these women listen to music, pray and read epics like *Ramayana*. These point to an acute awareness of the latest findings in psycho-somatic linkages, that is, mind-body connections. It is now known that turbulence in the mother's mind, fear or extreme anxiety, affects the unborn child. The traditional Indian science of Yoga has postures for various stages of pregnancy which makes child birth easy and natural. There are also *asanas* and exercises for post-natal stages which restore the body tone before delivery. Together with this there are herbal preparations like medicated oils and herbal nutrients.

#### 6. Two People in One Body

Advanced stages of pregnancy is the time when people in some parts of India tell that the 'lady has two hearts.' The growing child needs a range of nutrients and minerals and when this is in low supply, the expectant mother reacts. Pregnant women are known to exhibit weird behaviors and show an urge to eat peculiar food items, even strange things like mud. Since the tissue formation of the child like bone development, brain development etc. takes place at various periods of growth, there are nutrition requirements for specific growth processes. The routines of native folk medicine, like specific *kashayams*, from the

stage of conception till delivery, perhaps fulfill these requirements. Month wise preparations in Ayurveda and the folk traditions, taking specific herbal and non-herbal potions every month, assure the mother and child with adequate nutrition. This is particularly important for brain development as once the foundation is laid, the bricks cannot be replaced with future nutrition supplements. To improve India's mother and child health Yoga can play a major role and needs to be promoted as state policy under primary health.

### 7. Child Health–Native Approaches

A separate branch of Ayurveda deals with the intricate procedures in traditional Indian child care, just like pediatrics in modern medicine. In south India, there is a practice of giving 'ora marunnu' to the new-born, a mild paste of various herbal ingredients like plant roots, dry fruits etc., in some places mixed with mother's milk. Interestingly these are all part of the ancestral wisdom of the elderly women in the house that require no physician. 'Ora Marunnu' can be taken as a kind of vaccination in modern medicine. It is understood now that it prevented various childhood diseases, at the same time enabling better brain activity. The fact that modern medical facilities are able to co-exist with such native practices in south India even today is proof of the complementary nature of the two streams. Various other practices which were part of the native culture, making carrying mothers listen to music and religious discourses, putting children to bed with lullabies, were part of the native idiom which catered to mind and body alike.

Breast-feeding is a very important ingredient in baby care in Indian culture. Mother's breast milk is also given as medicine, used as eye drops and used in assorted ways for baby care. Breast milk is considered to have all the nutrients and antibodies what the child needs. It is a sharing of love and the mother child bondage is cemented at the time. Those receiving long term breast feeding have been shown to be more resistant to various diseases. Many herbs such as Brahmi (*Bacopa monnieri* (L) Pennel,) commonly used by native healers and considered stimulants. There are also specific animal based potions that are given to children at later years. Since the foundation of health is laid in child health traditional healing gives great importance to child care. More and more people are now turning to herbal and traditional approaches in child care as the toxins and chemicals, say in cosmetics, are proving to be damaging.

### 8. Nutraceuticals and Functional Foods

The role of food and nutrition is now fairly well understood. With the advancement in science, molecular biology and genetic engineering, our ability to understand and manage health at molecular level is manifold increased. It is now scientifically demonstrated that it is possible for one to achieve a high level of health and well being if one takes right food and nutrition that suits one's genetic constitution. Molecular biologists are now busy in designing individualized food, customized food based on one's genetic makeup called 'nutrigenomics'. It has become very clear that traditional food and nutritional recipes, now called ethnic food are best suited for the people living in that particular locality or in similar agro climatic conditions. Towards the end of the 20<sup>th</sup> century, this understanding led the health scientists and nutritional experts to scientifically investigate on the traditional foods and that has led to the discovery that the traditional food and other traditional nutritional recipes can be best suited for maintaining a healthy life. It has also led to the development of designer food that suited different groups and also different categories of people suffering from what is now called life style diseases like diabetes, obesity, cancer, arthritis, hypertension etc. Functional foods or medicinal food or pharma food or nutraceuticals are the best treatment regime for curing or managing such diseases. In future, one may first go to genomic expert who will make a genomic profile and based on the genomic profile the dieticians will prescribe a new diet regime or a 'Rasayana' therapy of Ayurveda or advise for a proteomic therapy or a gene therapy.

### 9. Traditional Diets and Nutraceuticals

The key to the development of health foods/pharma foods or nutraceuticals lies in the value addition in the traditional natural diets. India has over 5000 years of heritage of health science wherein food has been given an important role in maintaining healthy life. People living in different agroclimatic regions of the country had experimented and made a variety of food and diet and health care products, which is now termed as ethnic foods and ethnic nutritional diets. Ayurvedic medicine as explained earlier deals with a unique system of management called 'Rasayana' which is essentially a combination of food and medicinal herb recipes intended to rejuvenate the whole body system and make it fully healthy and functional.

Phytonutrients/ phytochemicals have tremendous impact on the health care system and may provide health benefits including prevention and treatment of diseases and physiological disorders. Polyphenols are one of the most widely distributed groups of phytochemicals that are responsible for the health promoting effects of nutraceuticals. They range from simple phenols to highly polymerized tannins. They protect plants from oxidative damage and they also play the same role in humans protecting the tissues from oxidative decay there by acting as antioxidants. The outstanding feature of these phytonutrients is their ability to block specific enzymes that cause inflammation. They also modify prostaglandin pathways and thereby protect platelets from clumping.

Another class of nutraceuticals is represented by the polyunsaturated fatty acids (PUFAs) especially of those n-3 and n-6 fatty acid (FA) families. Current interest is devoted to the so called fish oils containing a high share of n-3 FA (eicosapentaenoic acid [EPA] and docosahexaenoic acid (DHA)). It is claimed that these particular FA exert a positive effect on the development of cardiovascular and inflammatory diseases and the beneficial effects of fish oil supplementation in many other chronic diseases have been advocated. Many recent observations suggest a potential role of fish oils in the treatment of atopic dermatitis and psoriasis. There are also indications that premature infants have limited dietary support of the n-3 FA required for normal composition of brain and retinal lipids.

### 10. Nutraceuticals in Ayurveda

The Acharyas of ancient Indian codified systems of medicine namely Ayurveda and Siddha seemed to have an in-depth knowledge and understanding about the delicate relationship between food, nutrition and health. They also had a clear understanding of the delicate cellular mechanisms of the body and the deterioration of the functional capacity of human beings. These ancient medical masters had developed certain dietary and therapeutic measures to arrest/delay ageing and rejuvenating whole functional dynamics of the body system. This revitalization and rejuvenation is known as the 'Rasayan Chikitsa' (Rejuvenation therapy) in Ayurveda. It is specifically adopted to increase the power of resistance to disease (enhance immunity) and improve the general vitiation and efficiency of the human being. 'Rasayana' therapy is done for a particular period of time with strict regimen on diet and conduct. Rasayana drugs are very rich in powerful antioxidants, hepatoprotective agents and immunomodulators. Rasayana is one of the eight clinical specialities of the Indian classical Ayurveda, aimed for the rejuvenation and geriatric care. Rasayana is not a drug therapy, but is a specialized procedure practised in the form of rejuvenation recipes, dietary regimen (Ahara Rasayana) and special health promoting conduct and behaviour ie. 'Achara rasayana'. Sushruta while defining rasayana therapy says that it arrests ageing ('Vayasthapam'), increase life span

(‘Ayushkaram’), intelligence (‘Medha’) and strength (‘Bala’) and thereby enable one to prevent disease. There are over 30-35 medicinal plants mentioned in different treatise of Ayurveda and Siddha having rasayana properties. The important among them are *Sida cordifolia*, *S. cordata*, *Abutilon indicum*, *Tinospora cordifolia*, *Acorus calamus*, *Ocimum sanctum*, *Withania somnifera*, *Emblca officinalis*, *Asparagus racemosus*, *Piper longum*, *Commiphora mukul*, *Semicarpus anacardium*, *Centella asiatica*, *Curcuma longa* *Chlorophytum borivillianum*, *Chlorophytum tuberosum* and *Dactylorhiza hatagirea* etc.

In ‘Ayurveda’ the term ‘Rasayana’ therapy thus refers to the use of plants or their extracts as rejuvenators or as an elixir to enhance longevity, to improve memory, intelligence, good health, promote youthfulness, improve the texture and luster of the skin/body, improve the complexion and voice, promote optimum strength of the body and sense organs. Rasayana materials can be special foods/nutritional items, medicinal herbs or a combination of all these three. Thus the use of the medicinal plants as a source of dietary supplement or as a nutraceutical is well documented for centuries.

Ayurveda considers that an individual with advancing age accumulates waste and toxic substances and declines in vitality and loss of resistance/immunity;

- **Dhatu Kshaya** weakening of the functional dynamics of the cell or tissue system of the body.
- **Ojas** the state of excellent health expressed in general strength, vitality and luster of the individual – with ‘Bala’ = immunity against diseases.
- **Dhatuvidhi** i.e. rejuvenation of the whole tissue system is done by ‘Ojasvardhaka Dravyas’- the substance that improves the functional efficiency and immunity of the individual. This therapeutic process is known as ‘Rasayana Chikitsa’ – Rejuvenation therapy.

The ancient Ayurvedic physicians treated every individual as unique. According to them, normally there cannot be two individuals with same constitutional nature. That they referred as ‘Prakruti’ and therefore, the treatment is prescribed only after diagnosing the constitutional nature of the individual. This constitutional nature of the individual is based on the ‘Tridosha’ philosophy. The various permutation- combination of the ‘dosha’ in conjunction with ‘triguna’-the qualitative nature could offer countless variation in the constitutional nature of the individual and an experienced physician can very well diagnose it. Interestingly, the modern molecular geneticists also now speak a language similar to this i.e., genomic composition – i.e., DNA finger print is unique to an individual and we are now talking about gene profiling to understand the genetic predisposition and then suggest treatment to correct it, either by proteomic therapy or using other substances that can alleviate the defects or even the genomic therapy- proteomics, metabolomics and genomic methods for correcting disorders or treating diseases and nutrigenomics, genetically designed nutrition or food items. The ancient Ayurvedic masters had advised to consume specific food that suit to the constitutional nature of the individual whom they have categorized into 7 major groups. They have insisted certain dos and don’ts with regard to food and nutrition according to the constitutional nature of the individual (Prakruti). Modern molecular biology and genetic engineering is offering genetically modified nutrition/food that suit to the constitutional/genomic background of the individual or designer drug suited to the individual – known as Nutri genomics and pharmacogenomics respectively. With the perfection of technology of mapping the human genome, it is now possible to get the DNA profile of individuals and then develop customized nutrition and treatment regimen.

Pharmacogenomics is the study of the hereditary basis for differences in response of populations to a drug [2]. The same view was expressed by the ancient Ayurvedic master Charaka, some 4000 years ago. Charaka observed that ‘Every individual is different from another and hence should be considered as a different entity. As many variations are there in the universe, all are seen in human beings referred it as the Ayugenomics and explained that it has quite clear similarities with the pharmacogenomics that is expected to become the basis of designer medicine [3].

An “in-depth study and analysis” of the constitutional concept of Ayurveda namely ‘Prakruti’ with that of the modern genotype will yield highly valuable insight in understanding the functional dynamics of the human health and can lead to the development of a customized treatment regimen. Less than 20% of the plant species have been evaluated chemically or biologically [4] Approximately 21,200 alkaloids have been isolated and described out of which hardly 70% have been evaluated in a single bioassay. Out of about 5000 compounds which enter advanced pharmacological development only one will become a drug [5]. It is also now a well established fact that drug discovery for a single entity drug is an inefficient and extremely expensive process and the best choice is to develop phytomedicine or pharmacomedicine which involve activity guided isolation of fractions of selected traditional polyherbal formulations and their various permutation combinations. This way one could develop effective therapeutic remedies gaining increasing acceptance and popularity. Such an approach could lead to the development of evidence based herbal formulations. Automation and application of nanotechnology, proteomics and metabolomics may further advance nutraceutical research and development.

A review of some exemplary evidence based research and approaches now resulted in wider acceptance of Ayurvedic medicine [6]. National Botanical Research Institute jointly with Deenadayal Research Institute, Chithrakoot organized a National workshop in 2003 that led to the development of a ‘Golden Triange’ approach [7]. ‘Golden Triangle’ refers to the converging of Ayurveda, modern medicine and modern sciences to form a real discovery engine (Figure 1) that can result in newer, safer, cheaper and effective therapies.

New technologies are constantly being developed to isolate and identify the components responsible for the activity of these plants. But these technologies should consider and possibly use the fact that the biological activity of plant extracts often results from additive or synergistic effects of its components. Another possibility is the qualitative and quantitative variations in the content of bioactive phytochemicals, which are currently considered major detriments in its use as a medicine. Different stresses, locations, climates, microenvironments and physical and chemical stimuli, often called elicitors, qualitatively and quantitatively alter the content of bioactive secondary metabolites. Enzymatic pathways leading to the synthesis of these phytochemicals are highly inducible[8]. This is particularly true for phytochemicals that are well documented for their pharmacological activity, such as alkaloids [9] phenylpropanoids [10] and terpenoids [11] whose levels often increase by two to three orders of magnitude following stress or elicitation [12]. Thus, elicitation-induced, reproducible increases in bioactive molecules, which might otherwise be undetected in screens, should significantly improve reliability and efficiency of plant extracts in drug discovery while at the same time preserving wild species and their habitats. Molecular biologists and genetic engineers are currently engaged in designing food and medicinal plants with desired genetic make up so as to make custom made nutritional composition food or therapeutically desirable agents in plants –known as nutrigenomics and pharmacogenomics or proteomic approach to healthcare. Another emerging research area in medicinal plants is the metabolomics and system biology. Metabolomics is considered as a key technology in the system biology approach to study the mode of action in the therapeutic activity of traditional medicine and medicinal plants [13], [14], [15]. By measuring the activity of living organisms (which can be anything from a cell culture, animals to patients) for extracts with different composition, possibly one may identify a compound or a combination of compounds that correlate with the activity. This system biology approach is a major challenge for the coming years in studying medicinal plants [16].

## 11. Conclusion

Bioprospecting Traditional knowledge helps mobilizing funds to conserve biodiversity in both protected and unprotected wilderness areas, value addition and assigning economic value to biodiversity; enhance human resource development, capacity building in chemical and gene prospecting and other relevant biotechnologies; protection of IPRs, Farmers Rights, Traditional Resources rights of local and ethnic communities; economic development of the country – particularly the rural and tribal communities by improving their source of income and living standards through location specific production and processing technologies based on local biogenetic resources; and to evolve environmentally friendly policies and programs on biodiversity conservation and bioprospecting.

## Acknowledgements

The authors express their sincere thanks to Dr. Ashok K Chauhan, Founder President, RBEF and Amity Group of Institutions & Dr. Atul Chauhan, Chancellor, Amity University, Uttar Pradesh for facilities and encouragements.

## References

- [1] P. Pushpangadan and R. Govindarajan, "developing protocol for collection/cultivation and quality parameters of medicinal plants for effective regulatory quality control of herbal drugs," in *Proceedings International Conference on Botanicals, Kolkata, India*, 2005.
- [2] B. Patwardhan, A. D. Vaidya, and M. Chorghade, "Ayurveda and natural products drug discovery," *Current Science*, vol. 86, pp. 789-799, 2004.
- [3] B. Patwardhan, "Ayugenomics: Integration for customized medicine," *Indian Journal of Natural Products*, vol. 19, pp. 16-23, 2003.
- [4] G. A. Cordell, "Discovering Our Gifts from Nature Now and in the Future. Part II," *Chemistry Magazine*, vol. 17, no. 1-2, pp. 3-15, 2003.
- [5] G. A. Cordell and M. D. Colvard, "Some thoughts on the future of ethnopharmacology," *Journal of Ethnopharmacology*, vol. 100, no. 1-2, pp. 5-14, 2005. <https://doi.org/10.1016/j.jep.2005.05.027>
- [6] A. Vaidya, *Reverse pharmacology approach*. CSIR NMITLI Herbal Drugs Development Programme, 2002.
- [7] R. Mashelkar, *Chithrakoot declaration*. Chitrakoot: National Botanical Research Institute & Arogyadham Convention, 2003.
- [8] J. Ebel and E. Costa, "Elicitors of plant defense responses," *International Review of Cytology*, vol. 148, pp. 1-36, 1994.
- [9] P. J. Facchini, "Alkaloid biosynthesis in plants: biochemistry, cell biology, molecular regulation, and metabolic engineering applications," *Annual review of plant biology*, vol. 52, no. 1, pp. 29-66, 2001.
- [10] R. A. Dixon and N. L. Paiva, "Stress-induced phenylpropanoid metabolism," *The Plant Cell*, vol. 7, no. 7, p. 1085, 1995. <https://doi.org/10.1105/tpc.7.7.1085>
- [11] S. Trapp and R. Croteau, "Defensive resin biosynthesis in conifers," *Annual Review of Plant Biology*, vol. 52, no. 1, pp. 689-724, 2001.
- [12] A. G. Darvill and P. Albersheim, "Phytoalexins and their elicitors—a defense against microbial infection in plants," *Annual Review of Plant Physiology*, vol. 35, no. 1, pp. 243-275, 1984. <https://doi.org/10.1146/annurev.pp.35.060184.001331>
- [13] G. Roos, C. Röseler, K. B. Büter, and U. Simmen, "Classification and correlation of St. John's wort extracts by nuclear magnetic resonance spectroscopy, multivariate data analysis and pharmacological activity," *Planta Medica*, vol. 70, no. 08, pp. 771-777, 2004. <https://doi.org/10.1055/s-2004-827210>
- [14] C. V. Rao *et al.*, "Antiulcer activity of *Utreria salicifolia* rhizome extract," *Journal of Ethnopharmacology*, vol. 91, no. 2-3, pp. 243-249, 2004. <https://doi.org/10.1016/j.jep.2003.12.020>
- [15] Mei Wang *et al.*, "Metabolomics in the context of systems biology: Bridging traditional Chinese medicine and molecular pharmacology," *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, vol. 19, no. 3, pp. 173-182, 2005. <https://doi.org/10.1002/ptr.1624>
- [16] R. Verpoorte, Y. H. Choi, and H. K. Kim, "Ethnopharmacology and systems biology: A perfect holistic match," *Journal of Ethnopharmacology*, vol. 100, no. 1-2, pp. 53-56, 2005. <https://doi.org/10.1016/j.jep.2005.05.033>