



First NABS- International Conference
on

“Life Sciences: Contemporary approaches in
Biological Sciences for Food, Health, Nutrition
Security and Conservation of Biodiversity”

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Chairman of Special Lecture : **Dr. D. J. Bagyaraj**
session

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28th August, 2021 at 10 to 10.40 am

Special Lecture Topic:

**Functional Food and Nutraceuticals and
Development of Special Diet for enhancing health**

Delivered by

Prof. Dr. Palpu Pushpangadan

***Dr. A.P.J. Abdul Kalam Memorial NABS-Life Time
Achievement Award Laureate &
Padma Shri Awardee***

**Director General of Amity Institute for Herbal and Biotech Products
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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 neighborhood. 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 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 acupuncture, 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 potential of ethnomedicine is largely unnoticed because of the dominant western medicine. 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.

Historical Background

Search for the best nutritious food to have a healthy and disease free long life has always been both a desire and incessant effort of humankind ever since his evolution as Homo sapiens (= means Man the wise). This has resulted in the selection of a large number of food and medicinal items by various human communities in different parts of the world. Early humans began to combine instinct with indulgence and selected more and more food items initially from flora and later from the fauna. He has also added more foods by watching the animals and at times by intuition. Countless members from various human communities who spread to the different parts of the world thus continued to enlarge the food basket. It was by a process of trial, error, experimentation or by empirical reasoning or intuition etc. that the early humans tested and selected plants and animals for new source of food, nutrition and medicine. Hundreds of them might have died while doing the test eating poisonous plants during such clinical trials. It is believed that almost 99.9% of the time of human life since his evolution about 1.5 million back, he spent it in the forests. It was during this long period that the ancient progenitors of humans tested the articles around him, mainly plants for his food and nutrition.

Humans as a forest dwelling organism probably struggled hard to live among the hundreds of other wild animals particularly many animals which predated the humans. It was with his growing intelligence that helped him to survive in the forest and also that enabled him to tests plants, animals and other natural objects for enlarging his food basket and also his medical kits. It was only about 12,000 years back that for the first time humans began to lead a settled life with the discovery of domestication of plants and later organized its cultivation. With the cultivation of plants there emerged the dawn of the human culture and civilization. Soon human communities established closely knit families and clans societies and began to live together in a locality for protection and that finally evolved into social organizations. Division of labour also gradually evolved which ultimately resulted into various functional groups/castes and ultimately established civilizations.

In 6000 BC there came up well-established civilizations in different parts of world. Well known among them include, the ancient Babylonian, Sumerian,

Egyptian, Chinese, Indian and South American civilizations. By 3500 BC we find a highly advanced and well organized city civilization emerged at Mohanjo daro and Harappa in the Indian sub-continent. All these civilizations were built by agriculture societies who got more leisure time that stimulated them to build material culture and civilization. But by the turn of the 10th century human communities in the world over have been fed by over 10,000 plant species for his food. These included many grains, millets, tuber and rhizomes which formed his main energy source and lentils, pulses, nuts, fruits, leaves of many plant species of many plant species formed the nutritious part that provided him the proteins, fat, vitamins. In fact the brain development of human was perhaps associated with the consumption of certain specific proteins/amino acids and fatty acids. Communities who settled in a particular ecosystem soon made definite choice about their food and developed dietary habits and the same is referred now as traditional food and diets or ethnic foods. It was with colonization of the western countries, which started in 16th century that led to globalization of food and diets. By the turn of 18th and 19th centuries the colonial powers of the West who reached the biodiversity rich South countries began to introduce or exchange many plants, which initially were edible plants and later included those plants of industrial importance. This intercontinental exchange or globalization of food and nutrition had its advantage as well as disadvantages. Most undesirable outcome of the globalization of food was the narrowing down of the food basket by the world population. The whole world humans are now fed by 20 edible plants against over 7,000 or more species that provided food and nutrition to the humans till the turn of the 18th century. The prevalence of many physiological disorders and diseases known as the life style diseases today are outcome of such change in foods and nutrition. With the increasing scientific knowledge and understanding on the food and nutrition, it is now well known that the location specific and climate specific food are best suited to humans.

Food, Nutrition & Health

All organisms need food for their growth development and maintenance of health. The food must contain various nutrients to build up and maintain healthy cells, tissues and organs of the body so as to perform the life function. The efficiency and ability to lead a productive life of humans depends upon the nutrition contained in the food consumed by Dietitians defined food as "that which eat or drink or absorbed for the growth, repair

and maintenance of life whereas health is defined as general conditions of body and mind, as to vigour and soundness". Food, therefore has a vital role in the maintenance of healthy and productive life. From the very formation of embryo and its further growth into fetus in the womb all it is the quality of food that determines the fate of the new borns. Any fault in development and deficiencies in development apart from the genetic background therefore depend on the quality of food consumed by the pregnant women. Human communities in the world over have perfected their own food by selecting the food articles found around them the pattern of its consumption, which probably they modified time and again by succeeding generations.

Role of Food in Health

It is now well understood that there exist a strong connection between what we eat and our health. A better understanding of the same has indeed led to the development of alternate mode of healthcare through the right choice of food and nutrition. Vegetables and fruits constitute the health protective and health promotive components of our food. They contribute to the requirement of essential minerals, vitamins, and other phytochemicals that enable us to adjust and adapt in different agroclimatic conditions and seasons as well as for people of different constitution and age groups. The fruits and vegetables of tropical regions have powerful antioxidants and other elements that help in protecting us from harmful radiations, combating free radicals/super oxides and in providing better immunity from many tropical diseases. In 3rd millennium, humankind is equipped with most powerful tools of technology; the human communities of today are becoming knowledge-based societies. It enables even an ordinary person to get access to information from any part of the world. Therefore it is of great importance to create well-balanced scientifically sound knowledge and make it available in the internet so as to enable the laymen to choose the right food that will be beneficial for his healthcare. People with average education are now familiar with a variety of molecular and chemical terms in food and nutrition and the concept of personal health care would be of much significance in the next century. Food and nutritional supplements would be recommended, after studying the constitutional nature of the individual, which would enable him to lead a healthy and agile life. Such a situation will revolutionize the healthcare in this 21st century. It will also cut down substantially the expenditure on health sectors both by the individuals as well as by the governments.

Traditional Foods

Almost all ancient human civilizations developed their own food habits pattern and medicine known as traditional food and traditional medicines. These traditional food/diet the traditional communities developed from the local resources and time and again perfected by adding new valuable information. The choice of food thus developed was perhaps best suited to the local environment and it became a tradition. India is a treasure trove of traditional food. Blessed with such a diverse geo-agro climatic conditions with associated cultural diversity, there evolved numerous traditional food and dietary patterns in different parts of India. Before the coming of the colonial powers the local people in different regions used to have their own unique food items and dietary patterns which used to be season specific, age specific and even constitutional specific as to enable the individuals for leading a very healthy and productive life This diversity in traditional food also known as ethnic food. The nutritional value of many ethnic foods is now well known. Traditional diet and articles of food or drinks have their regional and seasonal variations. In the past there used to be a clear-cut change in the diet particularly in the vegetables and fruits consumed in the winter and summer in most north Indian states. Take for example the use of Tamarind.

Traditionally, tamarind is consumed in one form or the other by the people all over India. In South India, tamarind is used throughout the year in the form of various preparations like Curry, 'Sambhar', 'Rasam', and 'Chutney'. In North India, especially in summer, Tamarind water blended with 'jeera' or other spices are taken along with the wheat preparation 'Golguppa' or consumed as 'chutney'. Raw mango drinks, barley water with lemon or tamarind or black carrot preparations in the form of cold drinks are also widely used in summer. There are number of cucumbers pumpkins and berries specially consumed raw or cooked in summer. Many of us, perhaps, are not aware of the health protective role played by these foodstuffs in summer. Scientific investigations have shown that tamarind and raw mango contain some proteins and glycolipids that bind with fluoride and thus protect us from fluoride poisoning. It also contain power antioxidants and minerals required to make up the loss of the same made due to excessive sweating in hot summer. Traditionally, the source of our drinking water is mainly from wells and ponds. It is now well known that well water is rich in fluoride content, particularly in Southern parts of India, it is very high. However in north India, when the water level of the wells goes down in

summer, fluoride content in the water goes high. Consumption of tamarind or raw mango has been shown to protect us from fluoride poisoning. This fact was discovered after an incident of heavy fluoride poisoning in a place in south Andhra Pradesh, sometime in late 1980s. The people of this region, sometime in early 1980s found the cultivation of tomato more lucrative and began to use tomato as a substitute for tamarind and in due course tamarind was altogether eliminated from their food. The result was disastrous. An unidentified serious disease – some neurotic problems afflicted almost the entire population of the region and many became paralyzed. It became so serious that the doctors and medical authorities were very much perplexed. After detailed investigations, it was finally discovered that this abnormal disease was due to heavy fluoride poisoning. The people of the region were taking drinking water from wells from time immemorial. Then how comes suddenly this problem arose? Indeed high fluoride content in well water is found in almost all other regions of South India, but the people of these regions were not facing any such fluoride poisoning. The search finally led to the discovery that the elimination of tamarind from the food by the people of the affected region probably caused fluoride poisoning. Tamarind also contains certain compounds that lend protection from solar radiation and protect us from the damages caused by the free radicals and super oxides.

The lesson that we learn from this incident is, that tamarind and similar traditional items of food articles used in different seasons were indeed protecting our health. Tomato is a good vegetable rich in vitamins, minerals etc. but does not contain those precious components that protect us from fluoride poisoning or from harmful radiations. There are many similar cases. Another similar case we may discuss here is about the consumption of cabbage. Cabbage was introduced in India particularly in North India some 150-200 years back from the Mediterranean region. Traditionally it was used in North India as a winter season. But with the introduction of fast transportation means and storage facilities, many such winter vegetables are becoming available in all season and all over the country. The result is the great harm that is causing on the health of people. The increasing incidence of stones in kidney and gall bladder, thyroid problems and many undiagnosed disease manifestations are now attributed to such use of unseasonal fruits and vegetables. Cruciferous plants in general, cabbage in particular, is now best known to selectively accumulate/assimilate high amounts of minerals and metals including the toxic metals from soil and

store them in the leaves. Cabbage is indeed recommended as agent for phytoremediation of soils contaminated with toxic metals. When we consume cabbage in winter it does not cause any harm because of the urination in a diluted form, which flush out all minerals and metals. On the other hand in summer the urine gets concentrated due to the heavy loss of water by sweating causing the crystallization of minerals leading to the formation of stones in kidney and gall bladder. Sometimes, toxic metals get back into the bloodstream causing damage to the thyroid gland, liver and such vital organs.

The above examples clearly demonstrate the important role of seasonal vegetables and fruits in protecting our health. We have to take the right kind of vegetables and fruits that are best suited to adjust and adapt to the given climate. We have to learn thus a lot from the traditional wisdom of our people. There is an urgent need to have fresh look at our traditional dietary habits and revive the use of all those food articles that promote and protect health. Realizing the folly of the fast food culture, the western world are now turning to traditional diets or ethnic foods and converting this knowledge system of the traditional communities to value added forms such as functional foods and nutraceuticals and thus making a good market for such products. India with such a diverse traditions in food habits must take best advantage of this situation and strive to become a leader in global market of functional foods and nutraceuticals.

Nutraceuticals in Ayurveda

The Acharyas of ancient Indian codified systems of medicine namely Ayurveda and Siddha seemed to have an indepth 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 practiced 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 ('Vayasthapanam'), 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*, *Embllica officinalis*, *Asparagus racemosus*, *Piper longum*, *Commiphora mukul*, *Semicarpus anacardium*, *Centella asiatica*, *Curcuma longa*, *Chlorophytum borivilianum*, *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.

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. This is particularly true for phytochemicals that are well documented for their pharmacological

activity, such as alkaloids, phenylpropanoids and terpenoids whose levels often increase by two to three orders of magnitude following stress or elicitation. 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 makeup 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. 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 (Verpoorte *et al.*, 2005)

Functional Foods, Designer Foods, Pharmafoods / Nutraceuticals etc.

In the present century, very soon there will be more of dieticians than physicians. The responsibilities of government, primarily in providing correct information on health and nutrition so as to help the people to differentiate between facts and fiction in matters of food and health. Responsibilities of the government should also be in ensuring clean air to breathe, unpolluted wholesome water to drink, and nutritionally balanced safe food as well as in providing the right information about the vital link between food and health. A general awareness about the same has been increased during the last one-decade or so. Nations of the world may establish a network on Human Nutrition Information Service (HNIS) to compile, evaluate and provide the right information to public on all matters related to food, nutrition and health.

New range of health foods under the names, viz. functional foods, designer food medicinal foods, pharma foods or nutraceuticals are now becoming very popular in the developed countries are entering international markets.

Indeed, we are witnessing a new paradigm shift in our approach to health and medicine. It is something like that we are moving from a crisis intervention based health care model to preventive healthcare model in which the food we eat will be given a special attention. Selection of specific food articles particularly the vegetables and fruits could effectively prevent diseases and disorders or help in promoting good health. In India, it was tradition to have specific dietary regimes in different seasons that varied from region to region. The Indian tradition, particularly the traditional system of medicines like Ayurveda, gives a detailed account on the type of food to be taken by people of different age groups in different seasons and in different agro-climatic conditions. The ancient Ayurvedic masters like Charaka, Sushruta and Vagbhats observed that the organisms are products of what it eats. The overall performance and behavioral pattern of an organism, more particularly the humans will depend on what they eat. Charaka also said that organisms have to continuously adjust and adapt with the changing environment and therefore prescribed diets suited to different region climate/season and even to the different age group of humans. It also recommends various do's and don'ts in the selection and combinations of food articles. For example, Ayurvedic masters recommend consumption of vegetables like bottle gourd, lady's finger, snake gourd, spinach and red pumpkin and avoid sunflower, drumstick, gourd, brinjal *etc.* in Hemant season (Dec-Jan). Similar restrictions and recommendations are also given in case of fruits.

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