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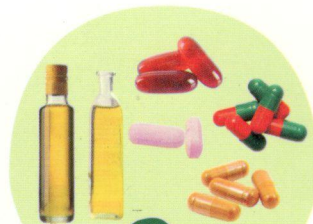
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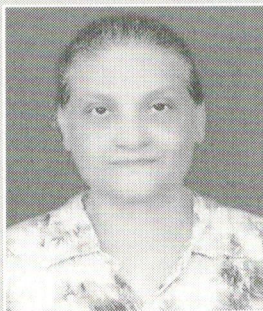
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“ A DISCOVERY PATH FOR NUTRACEUTICALS/AYURCEUTICALS FROM AYURVEDA ”



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“The battle is truly joined to prevent our innovative potential being segmented into specialized niches unable to communicate with each other. Unless the experts in their individual niches tap the knowledge created by their colleagues and which have implications for their own work, there is a risk of information breaking down into unconnected pieces instead of coming together in a potent knowledge spiral.” - *Hans Peter Sigg*

Ayurveda has offered great traditional health wisdom to India and the world for millennia. It has been reported that Charak-Samhita was translated into Greek, by Ktesius of island Cnidos, a contemporary of Hippocrates of island Cos, renowned as the father of allopathy. The scope of Ayurveda is too vast and the potential for discoveries of new health interventions is immense. Ayurveda, as a way of life and habits, is the most ideally suited system to inspire a discovery path for

wellness measures. Charak has defined Ayurveda, “Wherein the beneficial and adverse influences leading to a healthy or a diseased life and their respective modalities - helpful or harmful - are described and measured-that is called Ayurveda.” Sushruta cautions us about the profundity of Ayurveda, “The science of health is fathomless like the ocean and it cannot be exhaustively stated even in millions of couplets”. Hence it is desirable that any scientist, pharmacist or nutritionist interested in R&D in Ayurveda should seek out a master with expertise in Ayurveda and learn and observe bedside benefits as an apprentice. Then and then only the subtle definition of health described in Ayurveda can be comprehended as functionally.

समदोषः समग्रिश्च समधातुमलकियः।

प्रसन्नात्मेन्द्रियमनाः स्वस्थ इत्यभिधीयते॥

“One who has a harmonious balance of Doshas (Vata, Pitta & Kapha), appropriate Agni

(Jatharagni, Dhatwagni and Chidagni) and proportionate Dhatu-Mala processes and one whose self, mind and senses are calm and in good cheer – such a one is called swastha.” The very definition of health suggests a goldmine of Ayurceutical interventions. For harmonious health, the interventions can address the targets of doshas, agni, dhatu, mala, indriyas and mana. Ayurvedic pharmacology- Dravyagunavigyan- describes the properties of foods, spices, plants, minerals and animal products vis-à-vis these targets.

Bharat has been a world leader in the study of health-giving specific properties of foods. Ancient India extended from Babylon to Indo-China. The names of foods, spices etc. spread from India. For example rice from the Greek name Oryza can be traced to the Tamil arisi, piper (L) from pippali in Sanskrit, Camphane (L) from karpur in Sanskrit. sucrose (L) from sharkara in Sanskrit and so on. The western nations like the US and Europe have forgotten this as a heritage from India due to the colonial mindset. They are culturally insensitive to the richness and relevance of Ayurveda for global health. Scientific research in Ayurveda is creating evidence of safety, efficacy and quality of Ayurvedic plants that will convince even mind prejudiced against India and her health wisdom.

Such a new path was already initiated by some pioneers of Ayurvediya. Lokmanya Bal Gangadhar Tilak coined the term- Ayurvediya for integrative health science, with incorporation of the advances in bio-medicine with Ayurveda. This has led to a renaissance of innovative research to transform our millennia-old health tradition. A fresh scientific quest gave a new dignity for a global impact of Ayurveda-inspired health products. Dr R.A. Mashelkar expressed it aptly, “What is important is to blend the vast store of traditional knowledge in our country with new knowledge and then value and protect it through patents.” Ayurvedic nutrients and molecules offered an

uncharted sea to the nutra seafarers.

Ayurvediya Pakashastra

Rama Vaidya once said, “Cooking is an art. Diet is a culture. Nutrition is a science.” Every advanced culture has evolved its own food habits, culinary art and wellness recipes. There are standard Sanskrit texts on dravyagunas of Aharas, their effects on health and ageing and also on the elaborate methods of advanced cooking. Even the types of seasonal health foods, food incompatibilities, sequence of eating and the impact of different tastes on health have been described in great details and advocated currently too. The universe of Ayurvediya Pakashastra can be depicted in a Venn diagram as three major sets and overlapping four subsets (Fig. 1). The books like Kshemakutuhalam and Nala Pakashastra can offer novel procedures and paths to Ayurceuticals.

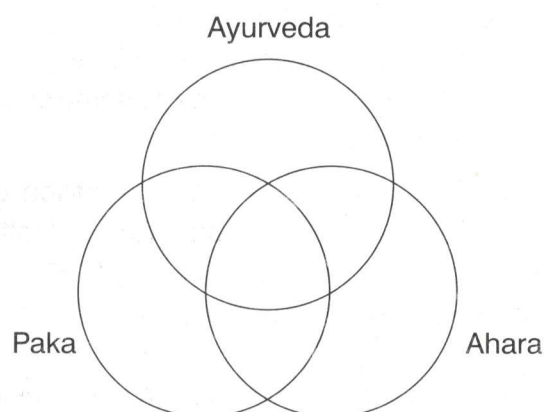


Figure 1: The universe of Ayurvediya Pakashastra- The central subset is Agni.

Ayurceuticals

Those unfamiliar with the epistemology of Ayurveda, based on Indian *darshanas* like Sankhya etc. find it very difficult to grasp the principles underlying health, nutrition, disease and aging need to be first grasped before premature attempts are made to conceptualize Ayurceuticals. For example, *Viruddha Ahara* (incompatible foods), a unique concept described in Ayurveda, has a

multidimensionality that would be mind-boggling for the uninitiated. There are eighteen types of *Viruddha Ahara* described. Significant categories like *desh-viruddha*, *kala-viruddha* and *krama-viruddha* offer unprecedented opportunities for proper geo-nutraceuticals, chrono-nutraceuticals and food sequence-nutraceuticals from Ayurveda. *Viruddha Ahara* can lead to imbalances in dosha, dhatu, mala and subsequent diseases.

Ayurceuticals is a distinct category of nutraceuticals, which cover products, inspired by Ayurveda, with adequate safety, efficacy, and added dimensions of scientific rationales, good manufacturing procedures, quality, purity and user friendly dosage forms. Though FSSAI has dropped the term Ayurceuticals, pressurized by the chauvinists of mere ancestral vain glory, the term has gone viral already. The fact that 400 plants have been included in the Gazette notification by FSSAI speaks volumes for the Herculean efforts put in by V.Prakash, D.B.A. Narayana and some of us, over two decades.

In a recent survey of the utilisation of traditional system in National Rural Health Mission, it was found that 80-100% of population in 14 out of 18 states used Ayurveda and local herbs. There are innumerable Ayurvedic products which failed in the market. Hurriedly evolved Ayurceuticals, without due diligence on the basic principles, processes, imprecise scientific rationale, human studies and insatiable greed are the reasons for such market failures. There should be an active effort to develop a list of Generally Regarded Ayurvedic Safe Plants (GRASP), for India and the US/EU, Such a list with well-defined data on the parts to be used, limits of dose range and duration of therapy etc. will go a long way for the development of globally acceptable Ayurceuticals.

The market potential of Ayurceuticals is

huge. According to market research, the global sales of nutraceuticals, expanding at 7.3% can go from US\$182.6 bn in 2015 to US\$278.95 in 2021. There is a high consumer preference and demand for functional foods and functional beverages, for wellness and personal care. AyurFoods and AyurDrinks can be the sub-categories of Ayurceuticals that can make India a world leader in Wellness foods and beverages.

There is a need of a mindset change in the industry captains in their R&D on nutraceuticals. Rather than being in an imitative copycat mode there is a need to be innovative and entrepreneurial in seeking out the unmet needs and develop Ayurceuticals from the existing Ayurvedic hits and leads, achieved by Reverse Pharmacology. The scope of Ayurceuticals, for the local and the global markets, is humongous. These can provide for the needs of the health-care viz. care of the elderly, metabolic & degenerative diseases, promotion of health & development of children, and complementary therapy in cancer, allergy and immune disorders. The savings in billions/year for delaying some diseases for five years, in the US, are : \$ 50 bn for diabetes mellitus, \$ 69 bn for cardiovascular disorders, \$15 bn for cerebro-vascular stroke, \$10 bn for osteoporosis, \$5 bn for hip fractures and \$5 bn for Parkinson's disease. For each of these conditions, Ayurveda has preventive and ameliorating remedies to offer. The plants which offer such an immense potential are: *Pterocarpus marsupium* for diabetes, *Terminalia arjuna* for cardiovascular disease, *Picrorhiza kurroa* for stroke, *Dalbergia sissoo* for osteoporosis, *Cisus quadrangularis* for fractures and *Mucuna pruriens* for Parkinson's disease. What is needed is a daring leadership that is willing to commit resources for the needed human studies, with state-of-the art, for efficacy and safety. That would revolutionize

the perception and reception of Ayurceuticals. The term Ayurceutical has been coined by me. But Mr Loren and Dr Ayyangar have already made a trademark of it for their company, without even any courtesy of due acknowledgement.

The Paths for R&D in Ayur-foods

From the vast field of Ayurvedic Nutraceuticals there is a scope of several paths to develop products (Fig.2). These paths are not mutually exclusive and can cover several market platforms.

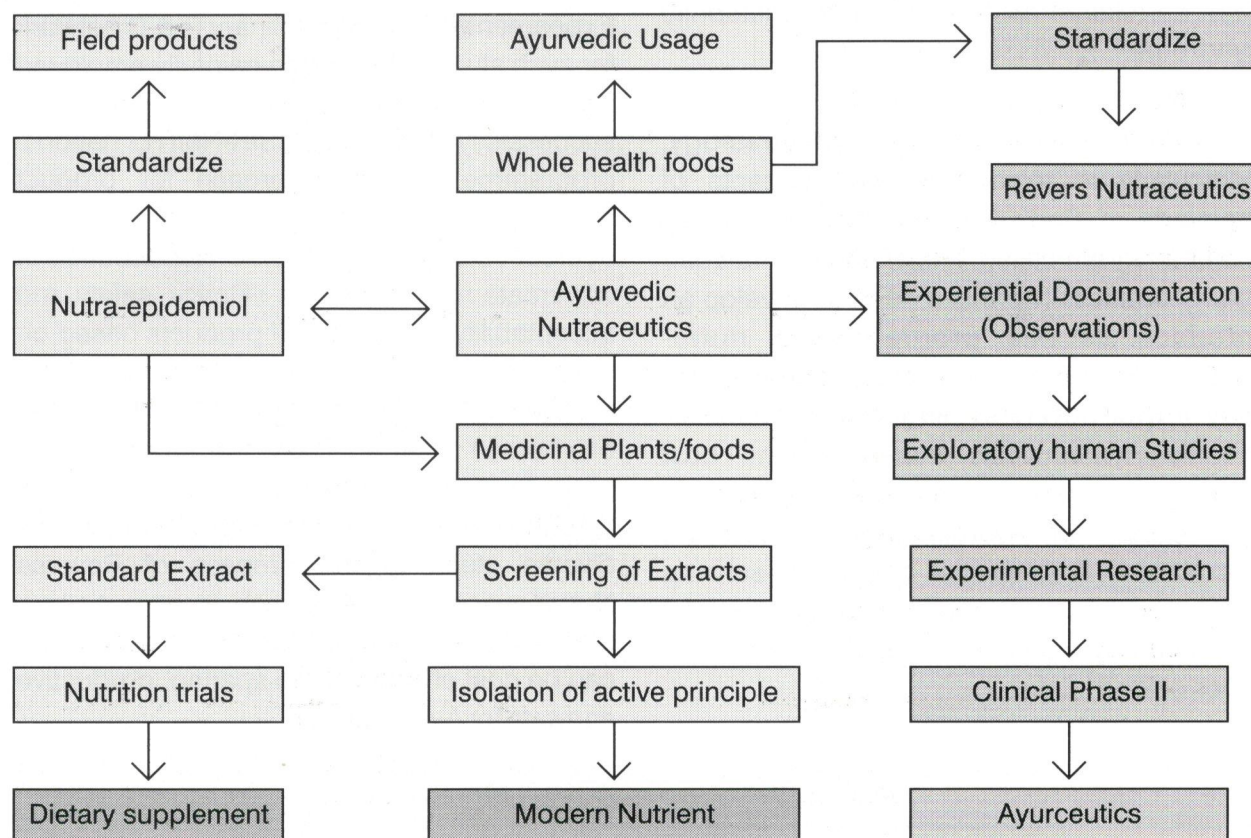


Figure 2: R & D Paths for Ayur-Foods

Ayurvedic Nutra-epidemiology

Gandhiji said, "The world has enough for everyone's need but not enough for anyone's greed." He emphasized the need to address nutrition of people at the bottom of the pyramid. But we need to first ascertain the facts of their food habits and preferences. The immense diversity of India, in terms of its wide ethnicity, regional food patterns and geo-climatic zones, is the greatest challenge to those who insist on uniformity (monotony?) of the western way of life. One can get easily disheartened when it comes to field studies which expect

representative sample size. But truly just like biodiversity nutra-diversity too has been of a stupendous survival value for a nation that is more than five millennia-old. However, barring a few exceptions, we have not adequately documented this regional, urban / rural and cultural food variety, their diverse processes of preparation, impact on wellness, economic benefits etc. It is essential to conduct, robust and adequate Ayurvedic Nutra-Epidemiology of the intake of nutraceuticals, naturals and nutritional. Such a data base would be a rich source of serendipitous discoveries for new products, founded upon centuries of usage.

For Ayurvedic Pharmacoepidemiology, a beginning has been already made and the emerging results in diabetes mellitus and arthritis are most interesting. In view of the changes in the urban food habits, life style and the resultant pandemic of diabetes, there is an urgent need initiate Nutra surveys in schools with correlation with B.M.I. and metabolic syndrome.

Nutrigenomics can be gainfully combined with Ayurveda epidemiology, particularly in relation to the concepts of Ayurveda of *Prakruti* and *Pathya*. CSIR has major program called TRISUTRA for *Prakruti* / Ayurgenomics. There is a need to develop an interface of this program with nutra-epidemiology surveys. The emergent results may provide novel insights to discover *Prakruti*-friendly Ayurceuticals based on the host genome comparable food usage in the field. The impact of Ayurceuticals on the gut microbiome as prebiotics or quorum-sensing gene modifiers is an emergent field that can be enhanced by a conjoint study of gut flora with types of food intake.

Reverse Nutraceuticals

Observational therapeutics and Reverse Pharmacology (RP), in the last two decades, have played a seminal role in drug discoveries from Ayurveda, for arthritis, hepatitis, diabetes and cancer. The path of RP is organised into three stages: Experiential > Exploratory > Experimental. Transdisciplinary R & D network for such studies have been gainfully employed for time-bound deliverables. This was done successfully during the CSIR-NMITLI national programme. Similar approach for product discovery has been applied also for Ayurceuticals called Reverse Nutraceuticals. It will create robust data on efficacy, safety and acceptability of the natural products based on evidence, besides to understand the mechanism of action. This path will be based on human usage. Thus the approach of product development will be from clinic to laboratory than visa-versa. Figure 3 shows the diverse steps in the process of Reverse Nutraceuticals. This approach is essentially a movement from the bedside to the bench and can be cost effective, time-sparing, productive and safe for Ayurceuticals.

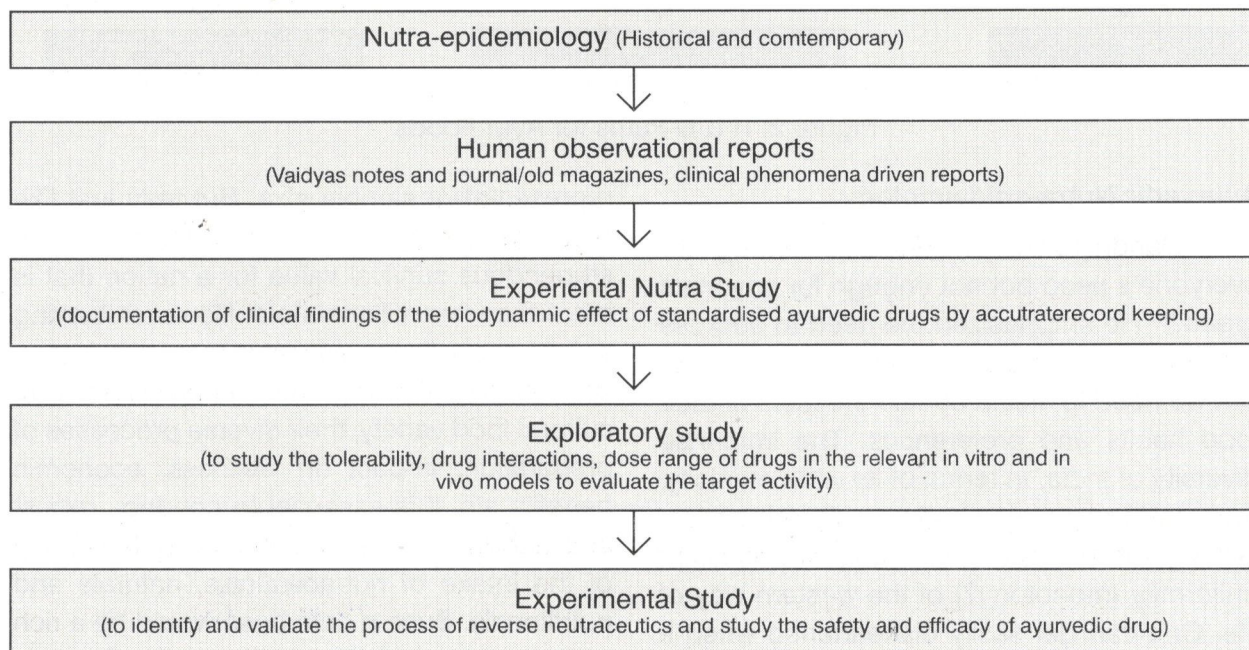


Figure 3: Reverse Nutraceuticals

Major Suggestions for Ayurceuticals

There is a global demand for more natural products for wellness and chronic illness. The toxicity of modern drugs of chemical origin, their soaring R&D costs and high pricing are responsible for increasing pharmacophobia. The resultant alarming rise in morbidity and mortality has brought about a movement of "back to the nature", with an aptitude for 'green medicine'. The health challenges can be managed well in a holistic and an integrative manner. by Ayurceuticals, by their use as nutritional supplement or complementary remedy.

A single plant like *Curcuma longa* (turmeric) can offer a spectrum of products differentiated and formulated for diverse indications. It has been shown to be anti-mutagenic *in vitro* & *in vivo* models, anti-cancer activity in DMBA- induced breast cancer, therapeutic activity in oral sub-mucous fibrosis, hepatoprotective in CCl₄ & NASH model and reducing arthritis. Similarly, *Amalaki-Emblica* officinale too offers such multiple uses. In short, medicinal plants can be used as platforms for many Ayurceuticals, unlike the new chemical entities as drugs or dietary supplements.

There is a need to have a mission mode for a fast-track development of Ayurceuticals by the government, industry and academia. AYUSH, FSSAI and DHR should spearhead such a blitzkrieg.

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