IJBPAS, October, 2023, 12(10): 4362-4381

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

NUTRACEUTICALS AND NUTRIGENOMICS- AYURVEDIC PERSPECTIVE OF *PATHYA APATHYA* AND *PRAKRITI*

ROMAN SU* AND KADU SS

1: Prof.-KriyaSharir, Ph.D Scholar, Dr. D.Y.Patil College of Ayurved and Research Centre, Dr. D.Y.Patil Vidyapeeth, Deemed to be University, Pimpri, Pune 18 Maharashtra, India; Orcid ID-0000-0002-2223-1139

2: Prof. and H.O.D. KriyaSharir, Dr.D.Y.Patil College of Ayurved and Research Centre, Dr. D.Y. Patil Vidyapeeth, Pimpri, Deemed to be University, Pune -18Maharashtra, India

***Corresponding Author: Dr. Sheetal U Roman: E Mail: sheetal.roman@dpu.edu.in**

Received 10th Sept. 2022; Revised 6th Oct. 2022; Accepted 17th Feb. 2023; Available online 1st Oct. 2023

https://doi.org/10.31032/IJBPAS/2023/12.10.7269

ABSTRACT

Nutraceutical a term introduced in 1989 by Stephan De Felice has two words nutrition and pharmaceutical. The term executes nutritional as well as pharmaceutical properties and hence useful in management of chronic disorders. Awareness about nutritious as well as healthy diet among general public has revolutionized the need for nutraceuticals. Though the deaths due to malnutrition status have been successfully reduced by the green revolution and the prevailing condition due to improper nutrition that deprives health is being managed still the surge of lifestyle disorders or Non-Communicable Diseases (NCD) such as obesity, diabetes, cancer, etc. is increasing in the India as well as across the world affecting the overall health scenario.

Medicinal plants showcase multiple target strategy. Drugs like *Shatavari* (*Asparagus Racemosus*), Amla and *Ashwagandha* (*Withania somnifera*) have promosing potentials and gained popularity as nutraceuticals in very short span. They exhibit their potentials by boosting immunity, improving metabolism, anti-inflammatory action and disease inhibiting modes. The typical daily diet of Indian population includes types of leafy vegetables, spices, herbal delicacies, legumes, fruits and seeds which impart palliative, preventive and modulatory role as nutraceuticals in health maintenance alone or in synergistic combinations.

Herbs like ginger, garlic, curcumin, cumin, cardamom and Tulsi are the traditional dietary ingredients and are rich in phytonutrients, carotenoids, phenols, polyphenols, alkaloids, flavonoids. Evidence of these being antioxidant, immune-modulators, memory enhancers and their revitalizing effect is also observed. They have been linked to reduce severity of many diseases, including cancer, Rheumatoid Arthritis, Cardiac ailments and other debilitating conditions, metabolic disorders, stroke etc.

Keywords: Immunomodulatory, Chyawanprash, pathy-apathya, prakriti, ayurgenomics, non-communicable diseases

INTRODUCTION

Nutraceuticals (bioceutical) is a non-toxic nutritional food ingredient that demonstrates health improvement, involving elimination of disease and its prevention **[1]**. They range from food supplements, herbal preparations, probiotics and prebiotics, medicated foods meant for prevention and treatment of disease **[2]**. Products can be single essential nutrient like Vitamin C or they can be dietary supplements such as a multiple vitamins/minerals combined together. A nutraceutical can also be a food supplement which is artificially designed as per need. Standardization of the functional component of the food in the nutraceutical product is mandatory and product development should be under good manufacturing practices.

Most ailments arise due to the wrong dietary practices and culinary habits. Concept of personalized medicine for balance between three humors i.e *Vaat, Pitta* and *Kapha* as per one's own constitution needs to be planned for getting relief from *doshik* ailments **[3]**. Ayurveda emphasizes on positive health which includes physical, mental, social, moral and spiritual well-being and this holistic ancient science seeks three important factors while dealing with the health and disease i.e. *Oushadha* (medication and therapies), *ahara* (food and nutrition) and *vihara* (daily routine) Out of the three *upasthambhas* (supports of life), i.e. *ahara* (diet), *nidra* (sleep) and *brahmach-arya* (observance of celibacy); the first one has been given more importance and considered to be the best in Ayurveda. A proper, optimum and skillful use of these triads, human body to maintain its integrity, being enriched with *bala* (physical and immunological strength), *varna* (complexion) and *upachaya* (growth of nourishment), till full length of life, provided the person concerned does not get involved in the regimen detrimental to health **[4]**. Among these, diet (ahara) plays key role as per

literature of Ayurved. *Pathya-vyavastha* (planning of diet- dietetics) in a very scientific and holistic way is unique feature of Ayurved **[5]**. *Pathya* (right dietary choice) keeping in mind one's own constitution can be defined as the diet plan which keeps the individual healthy and maintains normal body functions **[6]**.

AIM AND OBJECTIVES

To highlight the nutraceutical concept in Ayurvedic literature is the aim of present review. *Pathya-Apathya ahara* is the key feature of Ayurvedic dietary concepts. Right choice of diet as per body constitution is *Pathya ahara* (helpful for healthy status and a wholesome diet) and unhealthy dietary choices and practices are *Apathya Aahar*(unsuitable dietary choice or unwholesome food)which are considerably explained in Ayurved. To correlate the concept of nutraceuticals with *Pathya* , *Apathya* and *Rasayana* for propagation of health in society is the objective.

MATERIALS AND METHODS

Literature review of nutraceuticals from scientific publications available online and Pathya, Apathya advocacies from Ayurved compendia and published scientific literature. Available data mainly explains the pursuit of Nutraceuticals and its importance in today's scenario. Critical correlation of Ayurvedic Dietetics with nutraceuticals is the intended approach.

DISCUSSION

In the 21st century most promising medicinal herbs have entered in mainstream healthcare as more number of people seek relatively safe remedies and approaches to healthcare from alternative medicine branches **[7]**. Nutraceutical products can be considered non-specific biological therapies used to promote general well-being, control symptoms, and prevent malignant processes. Exigency for herbal- formulations, health products, pharmaceuticals, nutraceuticals, food supplement and herbal cosmetics etc. has increased PAN India as well as the other parts of the world as they are looked upon as non-toxic in nature, low side effects, compatible nature with physiological flora and available at affordable price **[8]**. However, Ayurveda integrates diet (*Pathya* or *Ahara*) and medicine (*Ausadha*) alongside the idea of treatment modalities, to harmonize the Doshas (Biological Humours) or physiological factors as per individual variation or *Prakriti* (Constitution) and other environmental factors.

A herb that is consumed as a food or a spice, having occupied important space among Indian kitchens such as turmeric or *Haridra* (Curcuma longa), is also directed in

different disorders ranging from skin problems, Gastro intestinal tract (GIT) ailments and cancerous conditions. Thus, nutrition holds important role in Ayurvedic treatment methodology, which is predominantly emphasizing personalized approach i.e. constitution (Prakriti). Some foods like *Ghrita* (cow-ghee) and *Takra* (buttermilk) play medicinal role, while others when mixed with medicinal herbs come under umbrella of medicated foods. An example of traditionally prepared delicacy is a recipe of rice and moong-daal (green gram) called as khichadi, prepared in proportional format of ingredients and luke warm water by adding combination of three herbs known *Tri-katu* (a mixture of dry ginger, black pepper and piper longum) powder and rock salt. It is a remedial measure for various kinds of fevers or in conditions where improved digestion is expected to be achieved gradually, as a nutritional support instead of the normal diet of the person **[9]**.

Wholesome and Unwholesome Food (Pathya and Apathya)

Ayurved samhitas have showcased so many examples of wholesome ingredients in food under the umbrella of Pathya and Apathya in relation to disease treatment.. For example, pomegranate, amla (Indian gooseberry), buttermilk, etc. are mentioned as suitable (***pathya ahara)*** in the management of iron-deficiency anemia **[10]**. Processing a food substance in modified manner may invariably change the potency and effect it would produce in the body. In many *dosha* related imbalances curd consumption is unwholesome. Yogurt consumption should follow a specific pattern of day time and particular season when it is beneficial for body and avoided at night or in spring, summer or fall **[10]**. As per the Ayurved texts the tastes cause disease manifestation if consumed in excess hence need to be avoided while treating those ailments **[11]**.

Curd, a unwholesome ingredient, can become a healthy drink when churned and the butter is removed the buttermilk thus becomes a wholesome food for the gastrointestinal system especially in conditions such as hyperacidity, irritable bowel syndrome, fissures, hemorrhoids, and certain types of diarrhea and dysentery exploring Ayurvedic knowledge on Food and Health for providing innovative solutions to contemporary healthcare **[12]**. Similarly, for indigestion - water boiled with cinnamon, coriander and carom seeds is advised to solve digestion related issues. Also *Shadang Paniya* a decoction prepared by adding six different herbs in proportion to water and used in

febrile conditions serves as nutraceutical **[13]**. Modern nutritionists point out that consistent consumption of preserved foods, like cookies, baked products etc. that use salt, sugar, trans-fats and other preservatives, negatively impact the human biological system **[14]**.

Rasayana as a Nutraceutical- It deals with rejuvenation and revitalization of human body. *Rasayana* therapy strives to improve physical, mental and moral qualities. It prevents old age, restores youthfulness, improves the complexion and the voice, increases the physical strength and immunity and it also strengthens the memory and intelligence **[15]**.

Many of the rasayana drugs have nutraceutical action **[16]**. The drug *amalaki rasayana* is used as traditional medicine since time immemorial for their unique properties like anti-ageing etc. **[17]**. So we can say *rasayana* drugs act at the sub cellular level. This can be compared with anti-oxidant, regenerative, immune-modulatory, and adapto-genic actions in modern parlance

Phytochemicals are compounds found in plant origin foodstuffs (Phyto means plant in Greek) such as fruits, vegetables, whole grains, nuts, seeds and legumes. They impart color, flavour, appearance, texture and aroma. It's thought that there are thousands of different phytochemicals, and scientists are just starting to discover the different roles these substances may play. Promising evidence indicates that phytochemicals may have the potential to:

1. Aid the function of the immune system.
2. Protect cells and DNA from damage that may lead to cancer.
3. Reduce inflammation.
4. Slow the growth rate of some cancer cells.
5. Help regulate hormones **[18]**

The concept of *Aajasrik Rasayana* (general rejuvenation) deals with food products, so that their daily consumption shall improve life quality as like Amala Rasayan which shows promising effects in reducing stress levels by offering protective action and serving as stress buster **[19]**.

Commonly used Rasayana's of Ayurveda include the following those having value of neutraceutics:

1.***Chyavanprash***–Boosts immunity by promoting health and prevents ailments of respiratory system. Delays aging as helps in restoring the life force (*ojas*), detox the systems and strengthening effect, improves stamina, vigor and vitality. *Chyavanprash* is reported to have rich vitamin, protein, dietary

fiber, energy contents, carbohydrate, low fat contents and carotenoids that act as micronutrients for health-invigorating purposes **[20]**. It also provides several essential phyto-constituents, namely, flavonoids, alkaloids, saponins, antioxidants, piperine, phenolic compounds, etc. **[21]**. The rich nutritive composition and antioxidant biomolecules of this nutraceutical act both singly as well as synergistically for immuno-modulation, body building, health restoration, and prevention of oxidative damage (a leading cause of several degenerative diseases) **[22]**.

2**.** ***Brahma Rasayana***–Relieves stress of mind. It is formulated by mixing herbs that show anti-oxidant, cognition and memory enhancer effects. It acts as immune-modulator. *Brahma Rasayana* contain both endogenous and exogenous antioxidant properties **[23]**. It rejuvenates the body, improves intelligence, boosts memory, and augments the immune mechanism. It is beneficial for promoting mental clarity and improved cognition whilst improving resilience to mentally demanding lifestyles. Its unique blend of herbs helps improving focus and concentration **[24]**.

3. ***Arjuna Ksheerpaka*** -*Terminalia arjuna* (Roxb.). It is helpful in treating hypertension, angina, myocardial infarction, hypercholesterolemia and hyperlipidemia. As it is astringent in nature and its dryness causing quality can lead to symptoms like mild constipation, flatulence in some people. So *Chakradatta* explains importance of milk as a vehicle along with Arjun bark powder to promote cardiac health and nullify other unwanted effects. It pacifies increased *Kapha* and *Pitta* and improves heart health **[25]**. The therapeutic potential of T. arjuna is well defined in the traditional literature and also validated as an adjunct therapy to prevent and ameliorate coronary artery disorder via its anti-inflammatory and cardioprotective effects. The free radical scavenging activity was seen due to this nutraceutical formulation. The milk protein, casein present in AKP may contribute to sustained bioavailability of active phyto-constituents ***in vivo***, while whey proteins like α-LA and LF and lipids like capric, lauric and conjugated linoleic acid might also enhance its anti-inflammatory potential post-digestion **[26]**.

4.***Shatavari Ghrita*** and ***Shatavari Kalpa***- For general health of women during various physiological states like during pregnancy, postpartum period, lactation period. *Shatavari* (Asparagus Racemosus) helps in treating numerous hormonal problems and also maintains hormonal levels within the

blood, strengthens the female reproductive organs and enhances maturation of the eggs into follicles. Being a powerful uterine tonic, regular use of this formulation or consuming foods that improve fertility may be very helpful when an individual is trying to conceive **[27]**. *Shatavari* is also anti-ulcergenic and antisecretory activity. It is also proven to be an adaptogen and antidepressant **[28]**.

Lyophilized aqueous extracts obtained from the roots of *A. racemosus*, *Chlorophytum borivilianum***,** and rhizomes of Curculigo orchioides were studied for sexual behavior effects in male albino rats and compared with untreated control group animals. The rats were evaluated for effect of treatments on anabolic effect. Seven measures of sexual behaviors were evaluated. The results, therefore, support the folklore claim for the usefulness of these herbs and provide a scientific basis for their purported traditional usage **[29]**.

5.***Rasona Ksheerpaka***-. Garlic is pungent in taste and a decoction of same is prepared with milk in specific proportion to help aid in proper functioning of heart **[30]**. *Lashuna*, due to *Madhura Rasa, Madhura Vipaka* and *Rasayana* property help to strengthen the body immumity.

Kashyapa Samhita explains the indication, contraindications, therapeutic benefit, dose, duration of *Lashuna* as a *Kalpa* **[31]**. *Lasuna* can be compare with Atervostatin and it releases the hydrogen sulfide in obese and hyperlipidemic patients. Pooled data from numerous randomized trials suggest that garlic lowers total cholesterol concentrations by approximately 10% and favorably alters HDL/LDL ratios. Randomized trials also support garlic's effectiveness as a mild antihypertensive which lowers blood pressure by 5-7% (iosr journal of pharmacy) **[32]**.

6.***Ashwagandha powder*** - The nutritive value study of the three capsule formulations, included proteins, fats, fibre, carbohydrates and calorific value. Considerable amount of proteins, fats and carbohydrates, in all the three (*Ashwagandh, shatavari* and Amla capsule formulations, imparts dietary value to them **[33]**. *Withania somnifera* is categorized as an anti-inflammatory,2,3,4 antioxidant herbal supplement. These hypothesized healing properties lead to widespread use of WS in Ayurvedic medicine **[34]**. One study has examined the effects of a standardized WS extract on chronic stress in rats exposed to a shock procedure; the researchers concluded that the rats treated with WS extract responded better

to the induced chronic stress symptoms **[35]**. After experiencing a series of anxiety-producing events, WS generated analogous effects compared with lorazepam in rats and it was found that herbal supplementation is similarly effective in the management of anxiety as are standard prescription drugs, without the harmful adverse effects, in a rodent model **[36]**.

The activity of main withanolides, withaferine A and withanolide A Composed of heterogeneous alkaloids, *Withania somnifera* is full of nutrients such as with anolides, acyl steryl glucosides, anferine, iron, lactones, nitrate, potassium, somniferine, sominine, tannins, tyrosine. Ashwagandha, also known as Indian ginseng has health benefits which are as follows such as it controls cholesterol levels, treats erectile dysfunction, increases fertility in men, reduces anxiety, relieves stress, fights diabetes, controls hair fall and hinders, treat osteoporosis and rheumatic arthritis, treats cancer, stimulates the thyroid gland, boosts immunity, increases blood production, prevents seizures, aids in muscle growth, reduces ocular diseases, anti-tumour, antiinflammatory and antibacterial properties.

The *Ashwagandha* root powder (2%) added in the baked products such as flat bread and thepla (a gujrati receipie) and reported the lower down glycemic index which also lowers down the diabetes mellitus **[37]**.

7.***Amla powder***- In Ayurveda, it is classified as a rasayana, i.e.drugs which promote longevity and delay ageing. *Āmla* fruit is one of the richest sources of Vitamin C (478.56 mg/ 100 ml). Studies have revealed the presence of several biologically active substances with scientifically proven effects as anti-oxidant, anti-ageing, immuno-modulatory, memory enhancing, protective towards vital organs such as liver, heart kidneys; anti-depressant, anti-cancer and many more beneficial effects **[38]**. Amla has a number of cardiovascular effects including anti-atherogenic, vasodilatory, anticoagulant, antioxidant, anti-inflammatory, antiplatelet, anti-dyslipidemic, anti-hypertensive, and lipid deposition inhibitory effects **[39]**. Research work has already been done and published on above mentioned Bioceutics which is summarized as follows,

Sr.no	Name of Bioceutic	Tissues on which it acts	System that is benefitted	Pharmacological activity of nutraceutical
1	Chyavanprash	It also improves muscle tone by enhancing protein synthesi It also improves muscle tone by enhancing protein synthesi It also improves muscle tone by enhancing protein synthesi Cardiotonic, nootropic aphrodisiac	CVS,RS,CNS, Reproductive	Antioxidant, immunomodulatory [40]
2	Brahma Rasayana	Neurotonic,	RS, CNS,Reproductive	Antioxidant, anti-stress, anti-bacterial immunomodulatory [41]
3	Arjuna Ksheerpaka	Cardiotonic,	CVS	Antioxidant,Anti-inflammatory, Cardioprotective [42]
4	Shatavari Kalpa	Ovarian tissue, Breast tissue	Reproductive	Phytoestrogenic action, anti-ulcergenic Aphrodisiac antisecretory adaptogen and antidepressant [43]
5	Rasona Ksheerpaka	Cardiac tissue	CVS	Anti-hypertensive, Hypolipaedemic,Anti-oxidant,Anti-ageing, Cardioprotective, Cardiovascular depressant [44]
6	Ashwagandha Ksheerpaak/Powder	Nervous tissue	CNS	Anti oxyiolytic,adaptogen Antidepressant,antidaibetic, immunomodulator [45]
7.	Amla powder	Cardiac tissue,lungs,nervous tissue	CVS, CNS	nootropic anti-oxidant neuroprotective [46]

Nutraceuticals according to Prakriti (Constituition)-

Ayurveda as an ancient science of life evolving around the concept of preventive approach and personal medicine care. This is achieved by balancing and harmonizing the three biological humours known as *Tridoshas*, namely, *Vata*, *Pitta*, and *Kapha*. The holistic outlook of Ayurved keeping in mind the concept of "*Purushampurusham Veekshya*" (Every individual is unique) towards personalized diet and medicinal preparation , assimilates and elaborates mental, physical and soul energies to get charged and also its other strata to get benefitted **[47]**.

Prakriti(constitution) is the unique physical, physiological and mental built-up of every individual as per dominance among *Tri-doshas* (three fundamental humours in body) and it varies in all individuals. The food that one consumes should be of opposite qualities of the predominant Doshas. Studies on etiologies of most of NCDs show a high association between improper choice of diet by the patients, as *prakriti* examination is missed and lack of its knowledge. In routine life one has to face many health related minor complaints, which majority of the

times are due to intense attributes of predominant doshas. Having understood the type of constitution and the *dosha* predominance, the daily diet as per the six tastes (*shadrasas*) can be planned to keep the balance among the *Tri-doshas* **[47]**.

Prakriti –A key factor for Planning of Personalize Diet Regimen

An individual's *prakriti* plays key role in determining systemic effect of food consumption. Dietary restrictions as per prakriti guidelines are a necessity to balance intense dosha imbalances in body.For example, based on inclination towards different tastes, individuals are classified as *vata* predominant (having affinity for sweet, sour, and salty tastes); *pitta* predominant (with liking for sweet, bitter, and astringent taste), and *kapha* predominant (for pungent, bitter, and astringent tastes). Whereas these tastes tone down any untoward effects of the inherited constitution, incorporation of tastes in the reverse order can cause imbalance in the body. For example, if a *vata* constitution person consumes pungent, bitter, and astringent tasting foods recurrently, it could hasten the aging process and degenerative changes in the body can be triggered. *Kapha* pre dominant prakriti person should avoid consuming madhura substances (excess sweet taste)). As the taste may qualitatively increase the *Kapha Dosha* to pathological limits. For *vaat* predominant individuals a preparation including *Madhura* (sweet) and *snigdha* (unctuous) properties like rice pudding in cow ghee or sweet daliya (delicacy prepared from half grinded wheat, cow ghee and jaggery) will help to gain weight **[48]**.

Neem (*Azadirachta indica*) formulation when consumed as nutraceutical by a *Vata-Pitta* predominant person will cause dryness in lower part of alimentary canal and apart from being useful can cause constipation that may lead to other health issues. Similarly, curcuma product for a Pitta-predominant individual can cause burning sensation of mucosa, epistaxis or others issues if used for longer duration. But neem and *haridra* are suitable for *kapha dosha* dominant individual. So there is definitely a lot of room to formulate and schematize nutraceuticals based on constitutional differentiation among individuals. Studies on the concerned fields demonstrate that the bioactive compounds and extracts of neem have a regulatory effect on several biological mechanisms. It has been unveiled that extensive research is carried out on limonoids such as nimbolide and azarirachtin. It is evidenced by different studies that neem extracts potentially can

scavenge free radicals and reduce ROS-mediated damage to cells. Neem can be used to normalize lipid peroxidation and minimize ROS-mediated cell death. Besides, neem extracts can significantly reduce the release of pro-inflammatory cytokines and elevate the count of CD4 + and CD8 + T-cells. This review indicates the pivotal roles of *A. indica* in the regulation of different biological pathways **[49]**.

Nutri-genomics is a branch that states interactions between nutrients and other bioactive dietary molecules at molecular level in harmony with genomic and the functional sequences in gene expression. Keeping in mind that every individual is unique entity and hence personalized methodology of nutrition provision through nutri-genomics can be said to be parallel with the Ayurvedic concept of food intake as per individual's *prakriti*, the seasonal period of that year and phase of that day **[50]**.

Pharmacogenomics and nutrigenomics are concepts that traverse each other in different ways as we humans consume food ingredients more than medicines. Food substances are easier for the digestive system to assimilate as compared to medicines which need to acted upon by kidneys and Liver as well.

Concept of Ayurgenomics- Ayurgenomics depicts approach that is personalized in the prognostic, preventive, and curative facets to attain health and aims to study variations among individuals as a result of genetic variability in humans to assess vulnerability, and establish diagnostic and prognostic methods keeping in mind the constitution or type of person's Prakriti. Clinical examination is done in patients to select correct pattern of diet that will help to overcome the disease early, medication and regime of the day by focusing on *Prakriti*. *Prakriti* is analogy of the comparative portions in proportionate way of three entities, i.e., *Tridoshas*, namely, *Vata, Pitta*, and *Kapha*. This is not only genetically determined by sperm and ovum qualities (*Shukra Shonita*), but also swayed by environmental factors (*Mahabhuta Vikara*), mainly by mothers eating habits in pregnancy and her diet and regime (*Matura Ahara Vihara*), and the age of the parental counterparts (*Kala Garbhashaya*). Ethnicity (*Jati*), familial characteristics (*Satmya*), as well as place where individual belongs (*Desha*) can also considered to influence the development of Prakriti inspite previously mentioned personal factors **[51]**.

Metabolic variability has been correlated with CYP2C19 genetic variability and

Human Leukocyte Antigen (HLA) gene polymorphism to elucidate the concept of pharmacogenomics with the Prakriti types .Observations carried out on correlations between CYP2C19 genotypes and Prakriti with fast and slow metabolism being one of the major characteristics likely to cause significant impact on phenotype-genotype correlation, drug discovery, pharmacogenomics and personalized medicine **[51]**.

Transcriptional profiles studied in pooled RNA from *Vata, Pitta* and *Kapha* showed upon different findings in core biological processes between the *Prakriti* groups that overlapped with the biochemical pathways and biochemical profiles, signifying the existence of genetic variations and their cellular manifestation, as told by Ayurveda.

Heading toward the "omics" age of science, notable parallelism is found with the thoughts of our ancient scientific lineage, including Ayurveda. At that time, they also felt the necessity of correlating nutrition with differences in biological phenotypes, which is the expression of individual genome or variome. We find the concept of Ayurgenomics and then Ayurnutrigenomics back at the time of Ayurveda quite novel and contemporary even today **[52]**.

The origination of the term "Ayurnutrigenomics".is a result of integrating Ayurgenomics with the traditional concept of *Ahara Kalpana* and *Pathya Kalpana*. It is an organized combination of nutritional practices as per Ayurveda in accordance with *Prakriti* of an individual, which merges facts from genomics, proteomics, and metabolomics proposed to deliver a solid evidence-based scientific foundation for the encroachment of custom-made nutrigenomic dietetics(individual approach). The use of metabolome-standardized foods or nutraceuticals with different biochemical components may influence novel therapeutics where drugs can alone never prove useful or serve as a preventive measure in a susceptible population **[52]**.

This Ayurveda-enthused perception of personalized nutrition is a novel concept in the scenario of nutrigenomic research arena for developing personalized functional foods and nutraceutical that can suit to one's own genetic framework. The perception that diet and medicines interconnect holds true considering their effects according to the genetic constitution (*Prakriti*) of a person at systemic level **[52]**.

It may prove to be very useful as personalized holistic food substances

designed from traditional aspect inspire human health care and advance preventive applications.

Advantages of nutraceutical application in Ayurveda

1. Enhancement of bioavailability
2. Sustained drug delivery system.
3. Improved social acceptance.
4. Life style disease prevention (potential nutrients, safety and therapeutic effects **[53]**.

In a study it was found that when biochemical and molecular correlates of prakriti were observed, they differed significantly in processes that are linked to intermediate patho-phenotypes, known to take different course in diseases. We also observe a significant enrichment of the highly connected hub genes which could explain differences in prakriti, focussing on EGLN1, a key oxygen sensor that differs between prakriti types and is linked to high altitude adaptation. Integrating such observations with the current literature, we demonstrate how EGLN1 could qualify as a molecular equivalent of tridosha that can modulate different phenotypic outcomes, where hypoxia is a cause or a consequence both during health and diseased states. Our studies affirm that integration of the trisutra framework through Ayurgenomics can guide the identification of predisposed groups of individuals and enable discovery of actionable therapeutic points in an individualized manner **[54]**.

Conclusion: Integrated analysis of phenomic and genomic variations by various studies would not only allow identification of clinical and genomic markers of Prakriti for application in personalized medicine but also its integration in drug discovery and development programs for ultimate benefit of the society **[55]**.

In recent years, more and more researchers have studied the bioefficiency, safety, and toxicity of nutraceutical-enriched foods. The key stage of nutraceutical bioefficiency is oral bioavailability, which involves the following processes: the release of nutraceuticals from food matrices or nanocarriers in gastrointestinal fluids, the solubilization of nutraceuticals and their interaction with other components of gastrointestinal fluids, the absorption of nutraceuticals by the epithelial layer, and the chemical and biochemical transformations into epithelial cells.

These processes are endogenous factors that greatly influence the bioavailability of nutraceuticals. In addition to endogenous factors, the bioavailability of nutraceuticals is also affected by exogenous factors, such as:

physicochemical properties of nutraceuticals, food matrix, food processing and storage, and so forth. Functional foods design must account for the interaction with other food components that may influence nutraceuticals' stability throughout their residence time in the GI tract and altering their intended bio-accessibility, bioavailability and bioactivity. So prakriti specific nutraceuticals can be designed by merging this concept **[56]**.

From a pharmacological perspective, bioavailability is the rate and extent to which the bioactive compound or a drug is absorbed and becomes available at the site of action. From a nutritional perspective, bioavailability is the fraction of a given food that the body can utilize, and is therefore a matter of nutritional efficacy. Bioavailability addresses several processes such as liberation from a food matrix, absorption, distribution, metabolism and elimination phases (LADME) **[57]**. Although the concept of nutraceuticals and its boom has gained momentum recently, it already has its roots in Ayurveda. The classical texts of Ayurveda signify scattered references of implementation of food products as medicine in various ailments. The *Aahar Chatuska* of *Charaka Samhita* has four chapters dedicated for food to be used as medicine. This review expresses conceptual, theoretical yet multi -dimensional screening of nutraceuticals, which already is the backbone of Ayurved therapeutics for betterment of health standard. *"Tat cha nityamprayunjeet svasthyam yen anuvartate. Ajaatanam vikaranam anuttpattikaram cha yat"* **[58]**.

REFERENCES:

[1] https://dravyagunatvpm.files.wordpress.com/2010/10/nutraceutical.pdf

[2] https://www.researchgate.net/publication/267566878_Nutraceuticals-Ayurveda's–Perspective

[3] https://core.ac.uk/download/pdf/82145807.pdf

[4] Dhanya S., Ramesh N V & Abhayakumar Mishra._Traditional methods of food habits and dietary preparations in Ayurveda—the Indian system of medicine, *Journal of Ethnic Foods* **volume 6**, Article number: 14 (2019)

[5] Dr. Brahmanand Ttripathi. Dipika hindi commentary of Sarangdhar Samhita, 2020, Chaukhamba Surbharati Pratisthan, Purva khand chaturth adhyayashlok no 13 page no 49.

[6] Acharya JT, Sushruta Samhita Ed, Kavyatirtha, Chaukhamba Orientalia, Varanasi, 2002, pp.498-499.

[7] https://www.nutraceuticalsworld.com/issues/2014-07/view_columns/Ayurceuticals-a-new-

era-in-healthcarehttps://www.nutraceuticalsworld.com/issues/2014-07/

[8] https://www.news-medical.net/health/What-are-Nutraceuticals.aspx

[9] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4624353/

[10] Tripati B. *Pathyapathyanirnayah*. Delhi: Chaukhambha Sanskrit Pratishtan; (1998). p. 2–4,39. [Google Scholar] [Ref list]).

[11] Rastogi S, Chaudhari P. In: Rastogi S, editor. Convalescent Food Practices in Ayurveda in 'Ayurvedic Science of Food and Nutrition. New York: Springer-Verlag; (2014). p.67–80. [Google Scholar] [Ref list]

[12] Unnikrishnan Payyappallimana and Padma Venkatasubramanian, Front Public Health. 2016; 4: 57.Published online 2016 Mar 31.

[13] Dutta C. Jvaradhikara. In: Dwivedi R., editor. Chakradatta of Shri Chakrapanidatta with the Vaidyaprabha. 2nd ed. Chaukhambha Sanskrit Sanstha; 1994. p. 28. [Tripathi I, Trans.] [Google Scholar

[14] https://www.nuffoodsspectrum.in/article/pdf/1651. Nutraceuticals and Functional Foods in Ayurvedic Perspective Chapter. February 2016.

[15] Gupta OP.Hand book of Ayurvedic Medicine.1st Edn.Varanasi; Choukhamba Pub2005.p.24

[16] https://www.researchgate.net/publication/294086679

[17] Vinita Tiwari and Gyan Chand Kr. Morya. A conceptual study on nutraceuticals in ayurvedic perspectives w.s.r. to rasayana, Journal of Global Biosciences. Volume 7, Number 1, 2018, pp. 5350-5357 Website: www.mutagens.co.in

[18] https://www.mdanderson.org/publications/focused-on-health/phytochemicals-and-cancer-what-you-should-know.h10-1591413.html

[19] https://healthdocbox.com/91921008-Herbs_For_Health/Review-article-issn.html

[20] Agte V.V., Mengale S.S., Akkalkotkar M., Paknikar K.M., Chiplonkar S.A. Antioxidant and trace element potential of Chyavanpraash and some Ayurvedic preparations. *Indian Journal of Traditional. Knowledge.* 2003; 2: 215–223. [Google Scholar] [Ref list]

[21] Elliot J.G. Application of antioxidant vitamins in foods and beverages. Journal of *Food Technoogyl.* 1999; 53: 46–48. [Google Scholar] [Ref list]

[22] *Das L, Bhaumik E, Raychaudhuri U, Chakraborty R* Role of nutraceuticals in human health, *Journal of Food Science*

and Technology. 2012 Apr; 49(2):173-183.[PubMed] [Ref list

[23] Manoj DashGovt Ayurveda college Raipur Namrata Joshi Banaras Hindu University. Critical review of Brahma Rasayana W.S.R to its immunomodulatory activity January 2018 International Journal of Green Pharmacy 12(1):S37-S45Project: Pharmaceutical

[24] Banamali Das, Bhagwan Sahai Sharma, Rohit Kumar Ravte, G Venkateswarlu, Purnendu Panda, Debajyoti Das, Shashidhar H Doddamani, Pradeep Dua, Shruti Khanduri, Rakesh Rana, Richa Singhal, Narayanam Srik, Clinical Efficacy and Safety of Brahma Rasayana in Apparently Healthy Elderly Persons: A Prospective Multicenter Open-label Study, JRAS January 2018 , 217-224.

[25] Sharma PV, editor, (5th Ed.). Chakradatta of Chakrapani, Varanasi: Chaukhambha publishers, 1998.

[26] Nivedita Dube, Chetan Nimgulkar, and Dinesh Kumar Bharatraj, Validation of therapeutic anti-inflammatory potential of *Arjuna Ksheera Paka* – A traditional *Ayurvedic* formulation of *Terminalia arjuna* ⋆ Published online 2016 Dec doi: 10.1016/j.jtcme.2016.11.006 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5634724/

[27] https://www.netmeds.com/health-library/post/shatavari-benefits-uses-formulations-ingredients-method-dosage-and-side-effects

[28] Pratibha Ramchandani, Sunita Suman Department of Prasuti Tantra, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India- A clinical study on the effect of shatavari churna and shatavari taila uttarbasti in atyartava,
International Journal of Green Pharmacy • Oct-Dec 2018 (Suppl) • 12 (4) | S938

[29] NS, Bhargava S, Dixit VArch Sex Behav, Thakur M, Chauhan. A comparative study on aphrodisiac activity of some ayurvedic herbs in male albino rats. 2009 Dec; 38(6):1009-15.[PubMed][Reflist]

[30] Abhishek Biswas ,PronabHaldar.Concept of nutraceuticals in Ayurveda w.s.r to rasayanas.International Ayurvedic Medical Journal : Volume 6, Issue 7, July – 2018,Pg.No.1491-1495

[31] Srisatyapala Bhisagacharya, Kashyap Samhita, Vidyotini Commentary, Chaukhamba Pratishthan, 2000, Kalpasthana,, Chapter-5, Pg.174

[32] Dr. Rajimunnisa Begam Shaik. M.D (Ayu) Dr. D. R. Sunil Kumar, Dr. S.

Ramalingeswara Rao M.D (Ayu), Dr. J.Srinivasulu M.D (Ayu), Critical Analysis of Lasuna (Role of Lasuna in Different Branches of Ayurveda), IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS Volume 11, Issue 5 Ver. I (Sep. - Oct.2016), PP 46-80.

[33] Rane Rajashree1 ,Gangolli Divya2 , Patil Sushma3 and Ingawale Kanchan4 Piramal Health Care Ltd., Goregaon, Mumbai, Maharashtra, INDIA- Amla, Ashwagandha and Shatavari Formulation as Herbal Medicines and Nutraceuticals,
Research Journal of Pharmaceutical Science- Nov (2012 ISSN 2319 – 555X Vol.1(3),10-15.

[34] Morgan A. Pratte, BS,1,2 Kaushal B. Nanavati, MD,1 Virginia Young, MLS,3 and Christopher P. Morley, An Alternative Treatment for Anxiety: A Systematic Review of Human Trial Results Reported for the Ayurvedic Herb Ashwagandha (*Withania somnifera*). The Journal Of Alternative And Complementary Medicine Volume 20, Number 12, 2014, pp. 901–908. Mary Ann Liebert, Inc. DOI: 10.1089/acm.2014.0177

[35] Bhattacharya S., Muruganandam A. Adaptogenic activity of *Withania somnifera* : an experimental study using a rat model of chronic stress. Pharmacol Biochem Behav 2003; 75:547–555.

[36] Bhattacharya SK, Bhattacharya A, Sairam K, Ghosal S. Anxiolytic-antidepressant activity of *Withania somnifera* glycowithanolides: an experimental study. Phytomedicine 2000; 7: 463–9.

[37] Role of Ashwagandha Incorporated Functional Foods for Betterment of Human Health: A Review https://www.researchgate.net/publication/332402696

[38] Mohammad Fazil1and Sadia Nikhat. Nutraceutical and Pharmacological Appraisal of Amla (*Emblica officinalis* Gaertn.): A Review, European Journal of Medicinal Plants 30(3): 1-13, 2019; Article no.EJMP.52964ISSN: 2231-0894, NLM ID: 101583475.

[39] Hashem-Dabaghian F, Ziaee M, Ghaffari S, Nabati F, Kianbakht S. A systematic review on the cardiovascular pharmacology of Emblica officinalis. Journal of Cardiovasc Thorac Res. 2018; 10(3): 118-2

[40] Milind Parle, N. Bansal. Traditional medicinal formulation, chyawanprash-A review January 2006 Indian Journal of Traditional Knowledge 5(4):484-488.
https://www.researchgate.net/publication/291981905

[41] Milind Parle Guru Jambheshwar University of Science, 5(4):484-488 http://www.greenpharmacy.info/index.php/ijgp/article/view/1599 Brahma rasayan

[42] S Prakash Sanjay, Dwivedi K.N, Lecturer, Department of Dravyaguna, Govt. Ayurvedic College & Hospital, 2Professor, Department of Dravyaguna, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University Varanasi, Uttar Pradesh, India http://www.iamj.in/posts/2015/images/upload/1618_1623.pdf

[43] Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Plant profile, phytochemistry and pharmacology of Asparagus racemosus (Shatavari): A review. Asian Pac J Trop Dis., 2013; 3(3): 242–251

[44] Dr. Rajimunnisa Begam Shaik. M.D (Ayu), Dr. D. R. Sunil Kumar, Dr. S. Ramalingeswara Rao M.D (Ayu), Dr. J.Srinivasulu M.D (Ayu), Critical Analysis of Lasuna (Role of Lasuna in Different Branches of Ayurveda) IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 11, Issue 5 Ver. I (Sep. - Oct.2016), PP 46-80 www.iosrjournals.org DOI: 10.9790/3008-1105014680 www.iosrjournals.org 46 | Page

[45] S K Bhattacharya. Anxiolytic-antidepressant activity of *Withania somnifera* glycowithanolides: an experimental study *et al*. Phytomedicine. 2000 Dec. https://pubmed.ncbi.nlm.nih.gov/11194174/#

[46] Rajendra Sandur V, department of pharmacology, krupanidhi college of pharmacy, bengaluru, karnataka -an updated review on herbal drugs: nootropic activity and possible mechanisms. Asian Journal Of Pharmaceutical and Clinical Research - Vol 12, Issue 6, 2019 (19-26)

[47] Sharma PV, editor. *Caraka Samhita*. (Vol. 1). Varanasi: Chaukhambha Orientalia; (2001). p. 5–9,190,228,375–6. [Google Scholar] [Ref list]

[48] *Dey S, Pahwa PJ*- Review. Prakriti and its associations with metabolism, chronic diseases, and genotypes: Possibilities of new born screening and a lifetime of personalized prevention. *Ayurveda Integr Med. 2014 Jan; 5(1):15-24.*[PubMed] [Ref list]

[49] V. S. Neeha and Priyamvadah Kinth,Published online 2012 Jul 19. Nutrigenomics research: a review JFoodSciTechnol. 2013 doi: 10.1007/s13197-012-0775 PMCID: PMC3602567PMID: 244257 Jun; 50(3): 415–428

[50] Subendu Sarkar, Rajender Pal Singh, Gorachand Bhattacharya· Exploring the role of *Azadirachta indica* (neem) and its active compounds in the regulation of biological pathways: an update on molecular approach. https://pubmed.ncbi.nlm.nih.gov/33927969/

[51] Yogita Ghodke, Kalpana Joshi, Bhushan Patwardhan, Traditional Medicine to Modern Pharmacogenomics: Ayurveda Prakriti Type and CYP2C19 Gene Polymorphism Associated with the Metabolic Variability. 2011; 2011: 249528. 10.1093/ecam/nep206. Epub 2011 Jun 8. Evidence-Based Complementary and Alternative Medicine Journal. https://pubmed.ncbi.nlm.nih.gov/20015960/

[52] Subhadip Banerjee, P. Debnath, P. Debnath- Ayurnutrigenomics: Ayurveda-inspired personalized nutrition from inception to evidence https://pubmed.ncbi.nlm.nih.gov/26587393 Medicine Journal of Traditional and Complementary Medicine 2015

[53] Dr. Arun R, Dr. Shivkumar, Dr. Dipuram K.P, Dr. Ashwin A. Nutraceutical Application. In Ayurvedic Dietics And Nutrition. International Ayurvedic Medical journal. Volume 4; Issue 9. September 2016.

[54] Bhavana Prasher , Greg Gibson, Mitali Mukerji, Genomic insights into ayurvedic and western approaches to personalized medicine 2016 Mar; 95(1): 209-28. doi:10.1007/s12041-015-0607-9. https://pubmed.ncbi.nlm.nih.gov/27019453/

[55] Bhavana Prasher, Binuja Varma, Arvind Kumar, Bharat Krushna Khuntia, Rajesh Pandey, Ankita Narang, Pradeep Tiwari, Rintu Kutum , Debleena Guin, Ritushree Kukreti, Debasis Dash, Ayurgenomics for stratified medicine: TRISUTRA consortium initiative across ethnically and geographically diverse Indian populations. Journal of Ethanopharmaology. TRISUTRAAyurgenomicsConsortium; https://pubmed.ncbi.nlm.nih.gov/27457695/

[56] Bioavailability of nutraceuticals: Role of the food matrix, processing conditions, the gastrointestinal tract, and nanodelivery systems March 2020, Comprehensive Reviews in Food Science and Food Safety 19(1)DOI:10.1111/1541-4337.12547 https://pubmed.ncbi.nlm.nih.gov/33331687/

[57] Maarit J. Rein, Mathieu Renouf, Cristina Cruz-Hernandez, Lucas Actis-Goretta, Sagar K. Thakkar, and Marcia da Silva Pinto. Bioavailability of bioactive food compounds: a challenging journey to bioefficacy. Br J Clin Pharmacol. 2013 Mar; 75(3): 588–602. Published online 2013 Feb 5. doi: 10.1111/j.1365-2125.2012.04425.x

[58] Pandey, K.N. and Chaturvedi G.N. (Eds.) Charak Samhita. Su.5.13, Chaukhamba Bharti Academy, Varanasi, 2009.