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Overview of Some Functional Foods in India: A mini–review

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***Abstract* – Functional food defined a food which influences specific functions in the body that may provide added health benefits or remedy from some diseased condition following the addition/concentration of a beneficial ingredient, or removal/substitution of an ineffective or harmful ingredient. In many developing countries, the lack of availability of a balanced diet leads to micronutrient deficiencies. Functional foods let consumers eat augmented foods close to their natural state, instead of consuming dietary supplements manufactured in liquid or capsule form. The lifestyle in India, particularly in urban areas is westernizing rapidly and has been associated with an alarming increase in the incidence of lifestyle-related health problems. The Indian consumer is now looking for the food products that provide value beyond nutrition. In this review, we looked briefly into the common functional foods usage in India.**

***Keywords* – Functional Food, Medicinal Plants, Functional Food Ingredients.**

I. INTRODUCTION

The very concept of food is changing, from a past emphasis on health maintenance to the promising use of foods to promote better health and prevent chronic illnesses. The advent of functional foods may allow us to improve public health. "Functional foods" are those that provide more than simple nutrition; they supply additional physiological benefit to the consumer [1]. Broadly "Functional food" may be defined as a food which influences specific functions in the body that may provide added health benefits or remedy from some diseased condition following the addition/concentration of a beneficial ingredient, or removal/substitution of an ineffective or harmful ingredient. Foods might inherently possess these supposedly beneficial qualities, or they may be functional/modified and/or genetically altered [2]. In many developing countries, the lack of availability of a balanced diet leads to micronutrient deficiencies. Antioxidants are important micronutrients in this context. Some of the other ingredients that make a food functional are dietary fibers, vitamins, minerals, oligosaccharides, essential fatty acids like omega-3, lactic acid bacteria cultures and lignins [1].

Functional foods let consumers eat augmented foods close to their natural state, instead of consuming dietary supplements manufactured in liquid or capsule form. Functional foods are either enriched or fortified which restores the nutrient content in a food back to similar levels from before the food was processed. Health Canada defines functional foods as "ordinary food that has components or ingredients added to give it a specific medical or physiological benefit, other than a purely nutritional effect [2]. The lifestyle in India, particularly in urban areas is westernizing rapidly and has been associated withalarming increase in the incidence of lifestyle-related health problems such as cardiovascular diseases, diabetes, obesity and hypertension [3]. Because dietary habits are specific to populations and vary widely, it is necessary to study the disease-preventive potential of functional micronutrients within the context of regional diets [4].

India has been recognized all over the world for spices and medicinal plants. Both exhibit a wide range of physiological and pharmacological properties. Current biomedical efforts are focused on their scientific merits, to provide science-based evidence for the traditional uses and to develop either functional foods or nutraceuticals [5]. The Indian food industry is no different from the western counterparts in its response to the growing need for healthy food. With the fast changing socio-economic indicators, the Indian consumer is now looking for the food products that provide value beyond nutrition. This value may be the specific health benefits, the disease risk reduction ability. But still, the functional foods in India have a long way to before establishing as a mature market offering [6]. Plant products have been used for food and fiber throughout history. In India, they have also been used to cure and prevent diseases, as stated in many traditional Indian systems of medicine [7].This basic concept has existed in the ancient Vedic scripture, the Ayurveda, and has been practiced in Indian traditional medicine for many centuries. Apart from Ayurveda, there are other established systems of medicine, such as Siddha and Unani prevalent in India that also have similar approaches. Among these, the Ayurveda system of medicine is the most popular [8].Below were reviewed some medicinal plants and foods with properties function and some of the ingredients used in the manufacture of functional foods in India.

II. INDIAN MEDICINAL PLANTS

Indian medicinal plants are rich sources of substances that have several therapeutic properties such as being cardioprotective and chemopreventive, among other effects [9]. Considerable research on biopharmacognosy, chemistry, pharmacology, and clinical therapeutics has been carried out on Ayurvedic medicinal plants. Many medicines have been derived from the Ayurvedic experimental base. Examples include Rauwolfia alkaloids

for hypertension, guggulsterons as hypolipidaemic agents, Mucunapruriens for Parkinson's disease, baccosides in aiding mental retention, curcumin in reducing inflammation, withanolides and many other steroidal lactones and glycosides as immunomodulators [10].

Table 1.Ayurveda based functional food brands[6]

Ayurvedic Food Brands	Ingredients	Health Claims
Happydent	Neem, Pudina extract, pudina oil (M.Spiceta), Eucalyptus oil and Baking soda	Helps promote oral hygiene (Halitosis)/gum & teeth diseases
Hajmola	Black Pepper, Black Salt, Cummin Seeds and Ginger	Ayurvedic digestive medicine
Chaywanprash	Age-old formulation of a number of herbs like Amla, known to be one of the best antioxidants, Giloy (Guduchi) known to have immuno modulatory properties, and has more than 40 other natural ingredients.	Strengthens body's internal defense mechanism
Shilajit Gold	Shilajit, Gold, Saffron, Alkushi, Ashwagandha, SafedMushali	A powerful rejuvenator that helps increase stamina, vigour and vitality.
Diges Tea	Black Pepper, Mint, Cardamom, Fennel and Ginger	Aids digestion and relieves flatulence

Table 2. Indian Medicinal Plants Based on their Therapeutic Effects [8]

Therapeutic Properties	Plant (Common Name)
Cardioprotective properties	*Curcuma longa* (Turmeric), *Emblicaofficinalis* (Amla), *Ginkgo biloba, Panax ginseng, Panaxpseudoginseng, Vitisvinifera* (Grapes).
Hepatoprotective activities	*Allium cepa* (Onion), *Andrographispaniculata* (Kalmegh, Bhunimba), *Artemisia campestris, C. longa* (Turmeric), *E. officinalis* (Amla), *Hibiscus sabdariffa, Picrorhizakurroa* (Kutki), *Premnatomentosa, Trianthemaportulacastrum.*
Chemopreventive/anticarcinogenic and antimutagenic properties	*Aeglemarmelos, Allium sativum* (Garlic), *A. cepa* (Onion), *Aloe vera* (Ghritakumari), *A. paniculata* (Kalmegh, Bhunimba), *Azadirachtaindica* (Neem), *Brassica juncea* (Mustard), *Camellia sinensis* (Tea), *C. longa* (Turmeric), *Cymbopogan citrates* (Lemon grass), *E. officinalis* (Amla), *Garciniaatroviridis, Glycyrrhizaglabra, Ocimum sanctum* (Tulsi), *P. kurroa* (Kutki), *T. portulacastrum, V. vinifera* (Grapes), *Withaniasomnifera* (Ashwagandha)
Anti-inflammatory activity	*Aglaiaroxburghiana, A. indica* (Neem), *C. longa* (Turmeric), *E. officinalis*(Amla), *Emilia sonchifolia, Hemidesmusindicus* (Anantamul), *Nigella sativa, W. somnifera* (Ashwagandha)
Antimicrobial/antifungal and antiviral properties	*A. indica* (Neem), *E. officinalis* (Amla), *G. atroviridis, G. glabra, O. sanctum* (Tulsi)
Antidiabetic properties	*Capparisdesidua, C. longa* (Turmeric), *P. kurroa* (Kutki), *Salaciaoblonga, Syzigiumcumini* (Jamun), *Trigonellafoenum—graecum* (Fenugreek)
Immunomodulatory properties	*Asparagus racemosus* (Shatavari), *W. somnifera* (Ashwagandha)
Anti-ulcerogenic activities	*A. roxburghiana, C. sinensis* (Black tea), *P. kurroa* (Kutki)
Neuroprotective activity	*G. biloba*
Thyroid stimulatory properties	*Achyranthesaspara, Bauhaniapurpurea, O. sanctum* (Tulsi), *W. somnifera* (Ashwagandha).
Wound healing property	*Cantellaasiatica* (Chandan).
Antidermatophytic activity	*C. tamala* (Tejpat, Dalchini).
Hypolipidaemic activity	*Commiphoramukul, P. kurroa* (Kutki), *Tinosporacordifolia.*
Radioprotective activity	*C. longa* (Turmeric), *O. sanctum* (Tulsi).
Antipyretic activity	*A. paniculata* (Kalmegh, Bhunimba), *H. indicus* (Anantamul).
Anti-venom activity	*H. indicus* (Anantamul).
Antidepressant activity	*Hypericumperforatum.*
Anti-allergic activity	*P. kurroa* (Kutki). *Tinosporacordifolia.*
Anti stress activity	*A. racemosus* (Shatavari), *W. somnifera* (Ashwagandha).
Cholinergic activity	*G. biloba, Mellissa officinalis.*
Memory improving capacity	*Bacopamonniera* (Brahmi), *M. officinalis.*
Antiageing effects	*W. somnifera* (Ashwagandha).

2.1. *Grains*

Rice, wheat, jowar, bajra, ragi, and maize are the major grains consumed in India. There are also many types of minor grains consumed, especially by the rural poor. Paspalumscorbiculatam, a minor grain consumed in India, has been characterized by its various constituents [11]. Although soy is not of Indian origin, its consumption in this part of the world has been on the increase due to its health benefits. Being a storehouse of several phytochemicals, its nutraceutical value has assumed unprecedented importance. The isoflavones, genistein, and daidzein do function as estradiol agonists, but can have antiesterogenic qualities as well. The antiesterogenic potential is due to its ability to bind estrogen receptors and by stimulating sex hormone- binding globulin production, to decrease the free and active hormone in the blood. Genistein is also effective in the inhibition of both androgen-dependent and androgenindependent prostate cancer cells in vitro and in vivo [12].

2.2. *Legumes*

Legumes and pulses have long been a part of traditional diets in Asia, Africa, and South America, which include most of the world's developing countries. More than 1,000 species of legumes are known to be grown [13]. In India, from time immemorial, many legumes and pulses have been consumed as part of a primarily cereal-based diet. They are consumed as whole gram or as split pulses (dhals). Pulses are the main source of protein in the primarily vegetarian Indian diet. Besides proteins, pulses are also good sources of vitamins, minerals ω-3 fatty acids and dietary fiber or non-starch polysaccharides (NSP) [14]. Legumes play a major role in different food preparations of the vegetarian diet. They also constitute important sources of protein for a major part of the population. A diet rich in heated chickpea (Cicerarietinum) has been recommended for humans with altered lipid profiles, such as type IIahyperlipoproteinemia. It has also been demonstrated to have a positive effect in diabetic therapy [15]. Germinated legumes are an integral part of the Indian diet. Interestingly, germination increases the levels of melatonin, the hormonal product of the pineal gland, reported to be an antioxidant. Melatonin production in the pineal gland declines progressively with age such that its levels in the elderly are a fraction of those found in young individuals [16].

2.3. *Spices*

India is the home of many herbs and spices, being both the largest producer and consumer in the world. Many herbs have been shown to contain dimethylfuran fatty acids, a group of minor components of lipid fractions that are reported to have antioxidant properties (by hydroxyl radical scavenging and peroxidase inhibitor activity) [17]. The spices having antioxidant properties are *Allium cepa* (onion), *Allium sativum* (garlic), *Brassica juncea* (mustard), *Capsicum annum* (red chilli), *Curcuma longa* (turmeric), *Cinnamomumtamala* (dalchini), *Cinnamomumverum* (cinnamon), *Crocus sativus* (saffron), *Murayyakoenigii* (curry leaf), *Trigonellafoenumgraecum* (fenugreek), and *Zingiberofficinalis* (ginger). Curcumin, eugenol, capsacicin are some of the active ingredients in spices such as turmeric, black pepper, asafoetida, pippali, coriander, and garlic [8]. The salt–spice herbal mixture "amrita bindu" prevented carinogen-induced depletion of antioxidant enzymes, glutathione, and vitamins A, C, and E [18]. While the seeds of Bixaorellana L. are well known as a source of food color, the other parts of its plant are reported to possess antipoeriodic, antipyretic, diuretic, antidysenteric, hypotensive, hypoglycaemic, antitumor, and antihepatitis properties, one or all the effects being attributed to the presence of carotenoids, flavonoids, tannins, amino acids, and trace amounts of alkaloids. This has been recently reviewed [19].

2.4. *Turmeric*

Turmeric has been consumed as a spice in Indian cuisine since ancient times. Curcumin, one of its major components, has been used for centuries as a naturally occurring medicine and as an anti-inflammatory agent. This effect is also attributed to inhibition of prostaglandin synthesis [12].Antibacterial activity of the Turmeric oleoresin after extraction of the yellow color, curcumin, has also been shown effective against organisms such as Bacillus cereus, Bacillus coagulans, Bacillus subtilis, Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa [20]. Xanthorrhizol, another compound present in a different species of turmeric, Curcuma xanthorrhizaRoxb., has also been shown to have antibacterial activity against the cariogenic bacterium, Streptococcus mutans [21].

2.5. *Fenugreek Seed*

Among the various herbs and spices, none has attracted greater attention than fenugreek seed. It is one of the most important and time-tested folk medicinal plants in India. Dietary administration at 1%–2% has been shown to increase the levels of glutathione as well as the glutathione S-transferase activity in the liver [22]. Oral administration of fenugreek powder before eating at 25–50 g twice a day has been shown to have a hypolipidemic effect in hypercholesterolemic patients [23].The inclusion of fenugreek in the diet significantly decreased lipid peroxidation with simultaneous enhancement of circulating antioxidants and thus exerts chemopreventive effects [24].Isolated fenugreek fractions have been shown to act as hypoglycemic and hypocholesterolemic agents in both animal and human studies. The unique dietary fiber composition and high saponin content in fenugreek appear to be responsible for these therapeutic properties [25].A hypoglycemic effect of fenugreek when incorporated with millets and legumes in the form of traditionally processed products, has been confirmed by measurements of glycemic index [26].

2.6. *Saffron*

Saffron, the dehydrated red stigmas of the flower of the plant Crocus sativus L., comprises the most expensive spice in the world. It is mainly used as a spice highly valued for its coloring power, bitter taste and unique aroma attributed primarily to crocins, picrocrocin, and safranal, respectively [27]. Saffron (C. *sativus*), a highly valued spice in India, has been shown to exert modulatory effects on the in vivo genotoxicity of test compounds such as cisplatin, cyclophosphamide, mitomycin C and urethane. The efficacy was also confirmed by the increased levels of hepatic glutathione S- transferase as compared to its levels in the absence of saffron extract [28].

2.7.*Garlic*

Garlic is one of the edible plants which has generated a lot of interest throughout human history as a medicinal cure/remedy for many diseases. Ancient medical texts from Egypt, Greece, Rome, China, and India each describe medical applications of garlic. Garlic is one of the earliest documented examples of a plant employed for treatment of disease and maintenance of health [29]. Garlic (A. *sativum*) is used in various Indian food preparations. In low doses, it has been shown to enhance the endogenous antioxidant status. Care must be taken, however, in using this spice, since higher doses can reverse the effect and also cause morphological changes in the liver and kidney [30]. It is probable that garlic and its associated allyl sulfur

compounds influence several key molecular targets in disease prevention [31].

2.8. *Ginger*

Ginger is another important ingredient in various Indian curry preparations. The active components in ginger stimulate digestion and absorption and also relieve constipation and flatulence by increasing the muscular activity in the digestive tract. One of the features of rheumatic disease is polyarthritis inflammation. The biochemical manifestation of inflammation is increased oxygenation of arachidonic acid, which results in theproduction of prostaglandin and leukotrienes. Ginger is reported to be useful in treating inflammation and rheumatism, possibly through inhibition of prostaglandin and leukotriene biosynthesis [32]. Its antimicrobial activity against E. coli, Proteus sp., Staphylococci, Streptococci, Salmonella and the aflatoxin producingAspergillus has been reported. Its potential to provide relief from a migraine and to protect against the toxic effects of xenobitics has also been suggested [8].

2.9.*Fruits*

Among the Indian fruits, *Aeglemarmelos* (bilva), *Mangiferaindica* (mango), *Punicagranatum* (pomegranate), *Syzigiumcumini* (jamun), and *Vitisvinifera* (grapes) have functional properties such as antioxidant activity. Other dietary components, used as vegetables or for seasoning, with possible antioxidant effects are *Cicerarientium* (Bengal gram), *Emblicaofficinalis* (amla), *Momordicacharantia* (bitter gourd), *Sesamumindicum* (til), *Psophocarpustetragonolobus* (winged bean), *Cyamopoistetragonolobus* (guar), *Spirulinaplatensis* (blue green algae), *Helianthus annus* (sunflower), *Vignasinensis* (cowpea), *Linus usitatissimum* (linseed), *Arachis hypogea* (ground nut), *Hibiscus cannabinus* (kenaf), *Carthamustinctorus* (safflower), *Brassica campestris* (Rape seed), *Doichosbiflorus* (horse gram), rice bran, pearl millet, wheat grass, sorghum, soybean etc., *Amaranthushypochondriacus*, *Cocciniaindica* (ivy guard), *Brassica dorada* (cabbage), cassava, sweet potato, and yams [9].

2.10. *Root Tuber Crops*

Root tuber crops, including cassava, sweet potato, yams, and aroids enjoy considerable importance as vegetables, staple foods or sources of raw materials for small-scale industries. They are also sources of “lectins” [9]. Some wild tubers from Jammu and Kashmir like *Pueraria* tubers can be consumed without cooking, while *Droscoreusbellophyla* tubers need some preparation prior to consumption. Wild tubers also are rich sources of vitamin C, Ca, iron, and carbohydrates [33].

2.11. *Fermented Foods*

Many types of fermented foods are used in India. Idli, made from rice and legumes, is one such favorite South Indian dish. Studies indicate that dietary changes in lunches in the workplace and at home could bring about a behavioral change and improvement in iron-deficiency anemia, which is prevalent in poorer sections. Increasing consumption of idli enhanced haemogobin status in women significantly [34].

III. Functional Food Ingredients

Functional Food ingredients available in the Indian market include: vitamin antioxidant & mineral premixes; tomato powder, garlic powder, onion powder, spice mixes; amino acids, chitosan; Omega-3-fatty acids (fish and flax seed); whey protein powder; Guarana extract, G. biloba extract, ginseng extract, rosemary probiotics; natural antioxidants (from tea); “shield” liquid antioxidants; vegetable peptones; essential fatty acids concentrates; performance proteins; natural fruit based flowering compounds; natural colours; total extracts of medicinal plants “antioxidants”; soy ingredient, soy proteins, soy protein hydrolysate; soya protein isolate & concentrate; super critical extracts of spices; and herbs; glutamine peptides; lactoferrin, milk calcium; lycopene, garcinia, raw herbs; whey protein concentrate; wheat fiber, b-carotene; A. vera gel powder, etc. [8].

IV. Conclusion

Diet in India is unique; it contains many of the medicinal plants. On the other hand, many of the traditional Indian foods are considered as a functional food, because of its rich in substances that installation of afunctional impact as Grains, Legumes, Spices, Turmeric, Fenugreek Seed, Saffron, Garlic, Ginger, Fruits, Root Tuber Crops, and Fermented Foods. Here we have been a review some medicinal plants and foods with properties function and some of the ingredients used in the manufacture of functional foods in India.

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