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FOOD AS VECTOR FOR NUTRACEUTICAL INGREDIENTS

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ABSTRACT

Now-a-days people consumption habits are changing they are inclined to buy healthy food that fulfills the need of essential nutrients in the body. With increasing educational level, people are becoming ready to accept different types of food & beverages that have added nutritional ingredient. Hence with this change, nutraceutical ingredient is gaining importance. Nutraceutical are those that combine technological and health properties. Nutraceutical Ingredients are substances with clinically confirmed health benefits and have broad applications in foods, beverages, dietary supplements and nutritional preparations. There are huge numbers of ingredients which are still unexplored. They have still not gained popularity in food industry. In this review paper a brief introduction of nutraceutical ingredient, its market and detailed knowledge of- Ginseng, Pine Bark Extract, Seabuckthorn, Buckwheat is mentioned.

INTRODUCTION

Today people are becoming health conscious. They want to be in charge of their health hence the need and importance of nutraceutical ingredient is gaining importance. The aging population and an increasing number of chronic diseases generate health concerns in the consumers' mind, which are major factors that push the nutraceutical product and nutraceutical ingredients market[1]. Consumers are shifting their eating habits from hunger-satisfaction to the intake of healthy food in order to either fulfill the nutrient deficiency in the body or to prevent the deficiency of major nutrients. The concept of nutraceuticals is a modernized one and still seeks opportunities in several parts of the world. However, the growth prospects of this industry are extremely high in future due to the involvement of various herbal ingredients that tend to gain the consumers' trust in developing nations. Manufacturers are also taking in consideration the convenience factor for consumer and providing them with healthy nutrients in the form of food & beverages instead of supplements. The major players include DuPont (U.S.A), Royal DSM (Netherlands), Cargill (U.S.A), ADM (U.S.A) and BASF (Germany).

Nutraceutical Ingredients are substances with clinically confirmed health benefits and have broad applications in foods, beverages, dietary supplements and nutritional preparations. Nutraceutical ingredients are found as components of foods or in other ingestible forms that have been determined to be beneficial to the human body in preventing or treating one or more diseases or improving physiological performance. Nutraceutical ingredients are components of plants, animals or microoragnisms and also include synthetic variants of natural nutraceuticals sold in form of pills, capsules or powders or in other medicinal forms not usually associated with food[2]. Only natural nutraceutical ingredients are associated with food products. Nutraceutical ingredient provides physiological benefit or protects against chronic disease. Essential nutrients can be considered nutraceutical if they provide benefits beyond their essential role in normal growth or maintenance of the human body. These substances will provide the best growth opportunities in market. World demand for nutraceutical ingredients is projected to increase 7.2% annually to $23.7 billion in 2015.Global trends in nutraceutical ingredients will result in developing regions achieving much faster growth in both consumption and production than developed regions. Based on projected investment levels in these industries and rising consumer incomes, China will evolve into the largest global producer and consumer of nutraceutical ingredient by 2020, surpassing the U.S. And Western Europe.

Naturally derived ingredients to lead profits:

Nutrients, Including proteins, fibers and various specialized functional additives, will remain the top-selling group of nutraceutical ingredient. World demand for these substances will increase 6.7 percent annually through 2015. Fastest growing nutraceutical ingredient segment will be naturally derived substances, consisting of herbal and

botanical extracts and animal- and marine-based derivatives. World demand for these substances will increase 8.9 percent annually through 2015. Especially Omega fatty acids derived from fish oils and other marine sources will bring profits because it has been clinically proven cardiovascular benefits and expanding use in dietary supplement and nutritional therapies[3]. The rising popularity of homeopathic remedies, coupled with widespread trends promoting preventive medicine and self-treatment, will impact favorably on global demand for numerous other natural nutraceutical ingredients, including cranberry, garlic, ginkgo biloba and ginseng extracts; and glucosamine and chondroitin.

World demand for minerals and vitamin ingredients consumed in nutraceutical applications is forecast to rise 6.2 percent annually through 2015. Well established applications in food and beverage fortification; infant, adult and pediatric nutritional; and dietary supplements will underlie growth. Continuing widespread acceptance of health and wellness benefits will keep minerals and vitamins among the most widely used nutraceutical ingredients worldwide in spite of recent studies questioning their effectiveness.

Table 1: List of Nutraceutical Ingredients

Nutraceutical Ingredients	
DHA	Horny Goat Weed
EPA	Methyl Cobalamin
Omega3	Mucuna Pruriens
Seabuckthorn Oil	Nettle Root Extract
Berry Oil	Pine Bark Extract
Evening Primrose Oil	Red Wine Extract
Vitamin B12	Selenium
Iron	Turmeric Root
Folic Acid	Ubiquinol
Niacin	Garcinia
Glucosamine	Cod Liver Oil
Chondrotin	Fish Oil
Astaxanthin	Tangerine
Coenzyme Q10	Whey Protein
L-Arginine	Soy Protein
Probio Immune	Lycopene
Saw Palmetto	Tribulus
Ginseng	Acai
Magnesium	Ashwagandha
Vit D2/D3	Boswellia
Colostrum	Chaste Berry
Vitamin E	Cranberry
Fenugreek Seed	Garlic
Lutein	Lecithin
Circumin	Gymneman Sylvestre
Resveratrol	Hawthorn Extract
Green Tea Extract	Guarana
Grape Seed Extract	L-Carnitine
Spirulina	Coffee Bean Extract
Gingko Biloba	Milk Thistle

Source: http://www.garudaint.com/productguide.php
http://www.freedoniagroup.com/brochure/25xx/2565smwe.pdf

In this review paper we had focused on ingredients which are unexplored. Many studies have proven that these ingredients have abundant pharmacological importance. So these ingredients have potential to bring health benefit when added to food products. Food products would be an easy and friendly carrier of these nutraceutical ingredients.

NUTRACEUTICAL INGREDIENTS:

GINSENG: From the roots of several plants herbal remedies referred to as “Ginseng“are derived. Ginseng, Panax ginseng C.A. Meyer is one of the most researched ginseng[4]. It is one of the precious plant known among herbs. Figure 1 shows the appearance of ginseng root. Cultivated ginseng can be classified into three types, classification is done on the basis how it is processed: fresh ginseng(less than 4 years old), white ginseng (4-6 years old and dried after peeling) and red ginseng (harvested at 6 years old, Steamed and dried). The main bioactive constituents are ginsenosides[5,6] ;which are triterpene saponins. There are number of gisenosides that are isolated from ginseng. Asian ginseng and American ginseng are two variants which is known all over the world[7]. American ginseng is different from asian ginseng in terms of total ginsenosides[8]. Even steaming and heating process changes the ginsenoside profile in ginseng containing products.

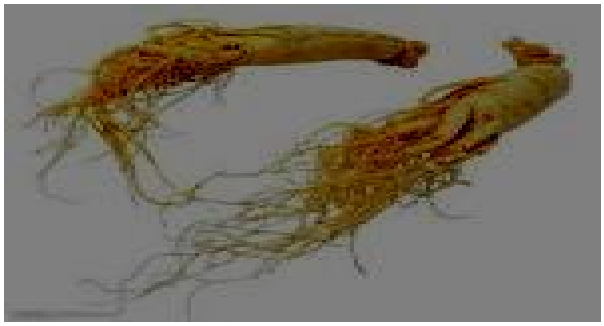

Figure 1. Ginseng Root

Ginseng and Ginsenosides show numerous pharmacological activities. Red ginseng is more effective as an herbal medicine than white ginseng because steaming process brings changes in the chemical constituents and enhances the biological activities of ginseng[9]. Ginseng has many therapeutic application it acts on central nervous system , cardiovascular system and endocrine secretion, promotes immune function and metabolism[10]; treats neurodegenerative diseases, possesses biomodulation action ,anti-stress and anti-ageing properties. Ginseng helps in neuroprotection either in vivo or in vitro; by enhancing nerve growth factor. Ginseng have anti-oxidative and anti-apoptotic mechanisms and reduces lipid peroxidation. It also increases cognitive performance-learning and memory by modulating neurotransmission. Ginseng also helps to fight against cardiovascular diseases it relaxes vascular smooth muscle cells through NO and Ca+2 mediated mechanisms and inhibit the production of endothelin which plays a role in blood vessel constriction[11].

Ginseng fortified food products are available in market[12,13]. Ginseng has a bitter and earthy taste. It is added in tea. Ginseng was first approved as an ingredient for food products back in 2009 at the 32nd meeting of the Codex Alimentarius Commission, when the commission also approved the international standard of food products derived from ginseng.

SEABUCKTHORN: Seabuckthorn (*Hippophae rhamnoides)* a traditional herbal medicine known since 1977.It is being used as a drug since ancient times[14]. Seabuckthorn fruits which includes flesh as well as peel, seeds and leaves are of value[15]. Figure 2 shows seabuckthorn fruits. Fruit/Fresh berries are rich source of vitamin C; Vitamin E; Folic acid, Carotenoids- including Beta-carotene, lycopene, Zea Xanthine (which contribute the yellow-orange-red colors of the fruit),Fatty acids(oils)- the main unsaturated fatty acids are oleic acid(omega-9), Palmitoleic acid(omega-7), Palmitic acid and linoleic acid(omega-6) and linolenic acid(omega-3;there are also saturated oils and sterols (mainly beta-sitosterol), Flavonoids(mainly isorhamnetin, Quercetin glycosides and Kaempferol)[16].100gms of fresh berries is having around 600mg of Vitamin C. Oil can also be extracted from seed, pulp and fruit residue. The extracted oil have less of the flavonoids and almost zero amount of Vitamin C of the fruit but are rich in fat soluble vitamin and plant sterols.

Fig 2: Seabuckthorn Fruits

Seeds has the highest level of the unsaturated fatty acids and sterols and the fruit residue which includes the outer peel is rich in the colorful carotenoids and Vitamin E. Studies have shown that there is high variation in biochemical and mineral concentration among different varieties of seabuckthorn hence there is need to select a particular variety for a defined purpose.

Numerous research on pharmacological effects of seabuckthorn have been carried out[17].

Seabuckthorn is a rich source of flavonols and these flavonoids can scavenge free radicals, lowers blood viscosity and increase cardiac function thus preventing the risk of cardiovascular disease[18] in humans. SBT leaf extract has significant anti-inflammatory activity[19] and can be used to treat arthritis disease. Seed extract of SBT has antioxidant and antimicrobial property which shows its potential to be used as natural preservative. Observation of various research papers suggest that the leaf extract of SBT has significant immunomodulatory[20] activity which increase human resistance against diseases and postpone senescence. It specially activates the cell-mediated immune response. Apart from these pharmacological uses SBT can also be used to treat gastrointestinal disease[21], skin disease[22], liver disease[23], wound healing [24,25]and cancer.

Development of health food products from Seabuckthorn is an interesting topic. Raw Seabuckthorn such as unstrained juice, clear juice, concentrated juice, seabuckthorn fruit oil and seabuckthorn seed oil, seabuckthorn fruit residual oil, raw powder, seabuckthorn pigment. Beverage with SBT such as soft drink(including syrup),alcoholic drink(sweet wine, semi-fluid drink, wine, beer),fruit juice(clear or unstrained) aerated fruit juice, powder, nutrient solution, jam. Even dairy products can be fortified with SBT. Study should be conducted to analyze the physical, physicochemical, rheological and sensory parameters of the fortified product. There are products in international market which are containing seabuckthorn, still it has not been explored completely.

BUCKWHEAT: Buckwheat belongs to genus *Fagopyrum.* Classification of genus is difficult as many number of species are present. Differentiation is done on basis of morphology, cotyledon shape and pollination type. Amongst all, common buckwheat is *Fagopyrum esculentum* & *Fagopyrum tataricum*, it is not a cereal grain as it may suggest; it is rather a fruit or nut. It is Pesudocereal.

There are many varities of buckwheat like unhulled groats, hulled groats and buckwheat flour[26].Figure 3 shows Buckwheat seeds.

Fig 3:Buckwheat Seeds

Buckwheat major composition is starch-59 to 70%, lipid is 1.5-3.7%, minerals, vitamins B1, B2, B6(FABJAN et al.2003) & major elements Potassium(K), Magnesium(Mg), Calcium(Ca), Sodium(Na) and minor elements like Iron(Fe), Manganese(Mn), Zinc(Zn)(WEI et al.1995) is also present[27]. Buckwheat contains flavonoids like: Rutin, quercitin, orientin, viterin, isovitexin and isoorientin. Rutin is most important, it is a medicinal agent used for the treatment of vascular disorders as it reduces capillary

fragility. Occurs in concentration of 3%-6% of the dry weight. *F.tataricum* sp. is having the highest concentration. Germinated buckwheat increases the bioavailability of vitamins and bio-elements and other biologically active compounds thus elevating the nutritional value.

Buckwheat has pharmacological importance: Buckwheat protein lowers blood glucose level. A study was conducted in which diabetic mice were injected with different dose of buckwheat protein. Result showed that blood glucose level of diabetic mice lowered[28]. Germinated buckwheat extract[29,30]decreases blood pressure[31].

Table 2. Nutrition Chart (100gm of buckwheat):

Nutrition	Amount
Food energy	355 cal
Moisture	11.00%
Protein	12gm
Fat	7.4gm
Total Carbohydrates	72.9gm
Calcium	114mg
Iron	13.2mg
Phosphorus	282mg

Source: USDA Composition of Food Agricultural Handbook No.8

Bioflavonoid rutin, is having blood-pressure lowering property. Rutin from germinated buckwheat lowers systolic blood pressure more than rutin from raw buckwheat. Buckwheat diet helps to increase microflora in gut and acts as a healthy food[32]. A study showed that there was an increase of aerobic mesophilic and lactic acid bacteria in rat's intestine. *Lactobacillus Plantarum*, *Bifidobacterium spp*., and *Bifidobacterium lactis* were found in buckwheat diet when compared with control diet. Apart from these studies also have proved eating buckwheat products produces lower GI response. Buckwheat is a valuable ingredients it finds wide application: it can be used as a meat extender, it can be added to cereals, soups, tea, energy bars for athletes. It is gluten free to can be consumed by people who are allergic to gluten. In Japan, it is added to make soba noddles, a famous dish. It is added to chocolate bar too. Sensory quality of food product containing buckwheat is superior.

PINE BARK EXTARCT:

Pycnogenol is the US registered trademark name for a product derived from the pine bark of a tree known as *Pinus Pinaster*. It is a mixture of 40 or more plant chemicals. Figure 4 shows pine bark extarct. It is a mixture of flavonoids; including the bioflavonoids- catechin and taxifolin as well as rich in phenol-carbonic acids. Phenol compound like- polyphenols monomers, Procyanidins and phenolic acids-derivatives of benzoic and cinnamic acids are present which are having anti-inflammatory, anti-mutagenic, antimetastatic, anticarcinogenic and high antioxidant activities. Researchers termed the group of antioxidants found in PBE as "Oligomeric proantocyanidins" or OPCs/PCOs for short. OPCs are some of the most powerful antioxidant available [33]. Red wine, grape seed extract, cranberries, blueberries, apples and tea are also having these OPCs. Grape seed extract is the cheapest alternative of Pine bark extract.

Figure 4.Pine Bark Extract

Pine bark extract clinical importance: A novel alpha-glucosidase inhibitor from pine bark[34]. Inhibitors of carbohydrates hydrolyzing enzymes play an important role for the treatment of diabetes. Highest inhibition activity against several carbohydrates hydrolyzing enzymes. Studies have also proved that supplementation of pycnogenol to conventional diabetes treatment lowers glucose levels[35]and improves endothelial function. They are rich in OPCs so is used to treat cardiovascular disease. Recent research is also proving that it can also used to lower blood pressure. The blood pressure[36] lowering effect of PBE have physiological plausibility because of its ability to antagonize the vasoconstriction caused by epinephrine & norepinephrine through increased activity of endothetilial nitric oxide synthase. PBE also fight against allergy and asthma, menstrual disorders, pregnancy associated pain and endometriosis. It also has anti-microbial and anti-viral property[37,38]. Pine bark extract is GRAS (Generally regarded as safe) ingredient so can be added to food products. It is added in food products in which astringent flavor properties of OPCs are desired. Pine bark extract is taken as dietary supplement and present in market in form of capsules and tablets. As of now no food product is fortified with pine bark extract. So there is gap, pine bark extract can be added to variety of food products as an ingredient. PBE stability and interaction with food product has to be checked. A study has showed that effectiveness of PBE is increased in presence of other antioxidants, including Vitamin C, Vitamin E, Vitamin A and selenium mineral. Diets rich in antioxidant and bioflavonoids like fruits and vegetables can increase PBE effectiveness.

CONCLUSION

It could be said that the larger the distance between natural and processed food, the bigger the consumer's suspicion for the processed food. Thus conventional foods are the best vector for nutraceutical ingredient. Nutraceutical Ingredient affect health and concern directly the final consumer. Involvement of various herbal ingredients as nutraceutical ingredient has extremely increased the consumer acceptability of the product as consumer tend to trust herbs. Many of the ingredients has still not be studied completely, there is a knowledge gap. There is a chance to study these ingredients, their pharmacological importance and their interaction with food components. This approach to enhance human health would be friendly and effective.

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