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Nutraceutical Values of Fruits and Vegetables - Prospect of Utilization and Commercial Status

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Abstract: Plants are one of the most important resources of human foods and medicines. Rapidly increasing knowledge on nutrition, medicine, and plant biotechnology has dramatically changed the concepts about food, health and agriculture, and brought in a revolution on them. Nutraceuticals are products isolated from foods and sold in medicinal forms. Fruits and vegetables in general represent the best examples of edible plant harvest having nutraceutical food properties with a potential of nutritional ingredients or supplements. Majority of the nutraceuticals are claimed to possess multiple therapeutic benefits. Phytochemicals and antioxidants are two specific types of nutraceuticals. Research has proved that foods with phytochemicals may help to provide protection from diseases such as cancer, diabetes, heart disease, and hypertension. There are many components like carotenoids, lycopene, betaine, sulforaphane, capsaicin, pectin, lutein etc which behave like nutraceuticals. Several bioactive compounds of different class like phenolicacids, Indoles, phytosterol etc, reported to be present in different fruits and vegetables possess either antioxidant properties or beneficial effect against many diseases. Nutraceuticals have been claimed to have a physiological benefit or provide protection against the diseases eg., cardiovascular diseases , obesity, diabetes , cancer, immune boosters, inflammatory disorders, degenerative diseases etc. The paper discusses the nutraceutical potential of different fruits and vegetables and the prospect of utilization for different purposes.

Key words: neutraceuticals, phytochemicals, antioxidants, functional foods, health

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1. Introduction

Epidemiological and clinical studies have demonstrated the relationship between diet and health status. It is well known that populations consuming a large proportion of plant-based foods, including fruits, vegetables, whole grains and cereals or those with a high intake of seafood's, have a lower incidence of cardiovascular diseases and certain types of cancer (Eskin, 2006). Nutraceuticals are food product that provides health as well as medical benefits; including the prevention and treatment of disease (Brower, 1991). Phytochemicals and antioxidants are two specific types of Nutraceuticals. Nutraceuticals can also be defined as a product isolated or purified from foods and sold in medicinal forms having physiological benefit. Nutraceutical is a combination of 2 words viz. Nutrition and Pharmaceutical.

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1.1 Nutraceuticals in fruits and vegetables

Vegetables and fruits represent the best examples of edible plant harvest having functional and medicinal food properties (Table 1) with a potential to develop nutritional ingredients or supplements. (Khanuja, 2011) .The perception of utilizing these crops only as food, pulps and juices in various forms is now changing with developments in nutrition research. The chemistry of crops including edible and non-edible plant biomass is gaining importance for their metabolite capabilities to compete with conventional medicinal plants constituents for preventive health care (Khanuja, 2011). Among fruits, berries are the most common. True types represent the fleshy fruit produced from a single ovary called bacciferous berries. Many other fruits are classified as epigynous berries. These include diverse examples including bananas, cranberries and blueberries, and the cucurbitaceous species like cucumbers, melons and squash. Therefore, the berries whether bacciferous (true berry) or epigynous ((false berry), represent a huge diversity and metabolic potential to be used in or as functional foods. Important case examples are grape (*Vitis vinifera*), watermelon (*Citrullus lanatus*), banana (*Musa* spp.) and tomato (*Solanum lycopersicum*). (Tikunov *et al.,* 2010).

1.2 Components behaving as nutraceuticals

Carotenoids: They are the compounds having ability to quench and inactivate reactive oxygen species especially singlet oxygen. They can react with free radicals and can become radicals themselves.

Betacarotene: An important pigment under the group of carotene which possess many medicinal properties. Major sources are carrot cabbage etc. (Thane and Reddy, 1997)

Lycopene: Red colour of tomatoes, watermelon, pink grapefruit, guava & papaya. It binds tightly to fibres, freed by high heat. It is a Powerful antioxidant which reduces damage to DNA and proteins. It Helps in giving better skin protection against UV light than beta-carotene.

Capsaicin: It is the compound which makes chili peppers "hot". The compound stimulates neurons for burning and abrasion sensation. Also Promotes apoptosis in pancreatic cancer cells. (Kasbia, 2005).

Betaine: Betaine is a trimethylglycine which is found in spinach and beets. It is capable of curing eye problems and makes the bones stronger. (Selhub, 1999).

Pectin: It is the soluble fiber in apples gives feeling of fullness when eaten. It binds to sugars, releasing them slowly and keeping blood sugar levels steady. Helps in lowering cholesterol.

Anthraquinones Senna: Sennosides are the dianthrones which are from dried leaves of leguminous herbs or shrubs of the pulse family. It Iincreases peristaltic movements in the colon. It has a Nauseating taste. It is ccontraindicated for hemorrhoids or inflammation.

Thiosulfonates: It is the organosulfur phytochemicals in garlic and onions. The group also includes mercaptocysteines and allylic sulfides. Allicin is toxic to insects and microorganisms. It protects against ulcers by inhibiting Helicobacter pylori. (Gibson and Fuller, 2000).

Lutein: Lutein and zeaxanthin constitute about half of all carotenoids in the retina. They are also the only carotenoids in the macula of the eye. It absorbs damaging blue light. Also helps in protecting the eye from macular degeneration and cataracts. It may protect against colon cancer. The highest concentrations are present in kale, spinach, watercress and parsley (in that order).

Inulin-type Fructans: These group covers all linear fructans including native inulin and oligofructose. Act as prebiotics-increase and reduce the numbers of potentially health-promoting bacteria and potentially harmful species, respectively. Enhance calcium and magnesium absorption.

Dietary fibers: They are the plant polysaccharides and lignin which are resistant to hydrolysis by the digestive enzymes of man. They plays important role in intestinal health, obesity, diabetes and cancer. The recommended daily intake of DF is 25-30 g/person. It helps in slowing in gastric emptying & affects nutrient assimilation in the small intestine. (Steffen, 2003).

Apart from the mentione neutraceuticals, the fruits and vegetables are also rich in various phytochemicals (Table 2) which futher increases their beneficial aspects

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Table. 1 Medicinal values of some fruits and vegetables (Beceanu, 2003).

Crops	Main dietetic, medicinal and alimentary features
Carrots	Digestive, hepatic, diuretic, vitaminizing, anti-anaemic, depurative, detoxifying and emollient effect
Radishes	Vitaminizing, re-mineralizing effect. It must be consumed all the year round
Beet	Re-mineralizing, general tonic, antibacterial, depurative, diuretic effect
Root of celery	Stimulating, general tonic, diuretic, glycaemia reducer effect; winter consumption
Root of parsley	Diuretic, tonic-stomachic, stimulating, anti-anaemic, vitaminizing, revitalizing, detoxifying effect
strawberry	Regulating blood pressure, prevents cancer and osteoporosis
kiwi	Prevents asthma, antioxidant, produces collagen
avacacado	Immune system booster, prevents obesity, maintains blood sugar
Brusels sprouts	Reduces cholesterol, prevents constipation, supports immune health, prevents cancer of bladder and colon
Broccoli	Powerful antioxidant, maintains bone health, prevents cancer
Cherry	Vitaminizing, re-mineralizing effect, antioxidant
Lemon	Abolishes acne, boosts immune system, reduces obesity
Kale	Anti-inflammatory, rich source of iron
Papaya	Boosts immune system, anti-inflamatory, prevents cataract, supports cardiovascular system
Pomegranate	Powerful antioxidant, reduces cellular damage, prevents prostate cancer

Table 2. Phytochemicals present in fruits and vegetables

Class	Bioactive component	Source	Beneficial aspects
Phenolic acids	Caffeic acid, Ferulic acid, Chlorogenic acid	Apple pears, citrus fruits, some vegetables	Antioxidant , analgesic
Indoles	Indole-3-carbinol	Cruciferous vegetables	Against Cancer
Chlorophyll	Chlorophyllin	Green vegetables	Against Burns, Cancer
Phytosterol	Sitosterol, stigmasterol, Campsterol	Nuts	Against Obesity, Cardiovascular diseases
Monoterpenes	D-limonene	Citrus fruits	Antioxidant effect

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1.3 Nutraceuticals against diseases

Majority of the Nutraceuticals do possess multiple therapeutic benefits, however in the present review much effort has been devoted to decentralize them based on their disease specific major indication. Nutraceuticals have been claimed to have a physiological benefit or provide protection against the following diseases. (Nelson, 1999).

Cardiovascular diseases: It is the name for the group of disorders of the heart and blood vessels and include hypertension (high blood pressure), coronary heart disease (heart attack), cerebrovascular disease (stroke), heart failure, peripheral vascular disease, etc. It has been demonstrated that the molecules like polyphenols present in grapes and in wine alter cellular metabolism and signalling, which is consistent with reducing arterial disease. (Hollman *et al.,* 1996).

Obesity: Defined as an unhealthy amount of body fat, is a well-established risk factor for many disorders like angina pectoris, congestive heart failure, hypertension, hyperlipidemia, respiratory disorders Etc. (Caterson and Gill, 2002). A tolerable and effective Nutraceutical that can increase energy expenditure and/or decrease caloric intake is desirable for body weight reduction. Herbal stimulants, such as ephedrine, caffeine, ma huang-guarana, chitosan and green tea have proved effective in facilitating body weight loss. Blueberries, pears, grapefruit, broccoli etc are good against obesity.

Diabetes: Characterized by abnormally high levels of blood glucose, either due to insufficient insulin production, or due to its ineffectiveness. (Sirtori and Galli, 2002) Dietary fibres from psyllium have been used extensively both as pharmacological supplements. Broccoli, sweet potato and bitter melon are effective.

Cancer: A healthy lifestyle and diet can help in preventing cancer. Recently, attention has been on phytochemicals that possess cancer-preventive properties (Willis and Wians, 2003). Flavonoids found in citrus fruit appear to protect against cancer by acting as antioxidants Lycopene prevents cancer, cardiovascular disease, and gastrointestinal tract.

Degenerative diseases: A degenerative disease is a disease in which the function or structure of the affected tissues or organs will progressively deteriorate over time, whether due to normal bodily wear or lifestyle choices such as exercise or eating habits. Macular Degeneration, Vision Problems, Alzheimer's Disease and Parkinson's Disease are characterized under this.

1.4 Commercial status of nutraceuticals

The Indian Nutraceutical industry has great prospects. Over the last decade a wide range of products have been available, giving an insight into the tremendous growth. On one hand a booming economy has resulted in overall increase in disposable income of population. Added to this unhealthy, eating habits coupled with sedentary lifestyle have led to increase incidence of diet and its related health issues. On the other hand, there is a growing awareness on the importance of nutrition and diet for long term good health. These have contributed to a favourable market conditions for Nutraceutical industry in India.

1.5 Indian scenario

India has a lot of advantages like qualified human resources, world class R & D facilities and varied raw material-aspects that give our country a leading edge. The Indian Nutritional market is estimated to be USD 1 Billion. While the global market is growing at a CAGR (Compound Annual Growth Rate) of 7%, the Indian market has been growing much faster at a CAGR of 18% for the last three years, driven by Functional food and beverages categories. However the latent market in India is two to four times the current market size and is between USD 2 to USD 4 billion with almost 148 million potential customers. In USD 1 billion market size functional food having 54% market share followed by 32% market share of Dietary supplement and 14% share of Functional beverages. The Indian nutraceutical market is dominated primarily by pharmaceuticals and FMCG companies.

1.6 Some commercial nutraceuticals in market

Acute Phase is designed to provide highly targeted nutritional support for patients who may benefit from muscle tissue support and minor pain relief. Mainly contain vegetable and fruit extract.
Andrographis Plus is a concentrated blend of Ayurvedic and Chinese herbs designed to enhance immune health and support healthy respiratory function. Prepared from mainly amla and apricot seed.

ArginCor is a medical food formulated to provide specialized nutritional support for patients with peripheral artery disease. Beet powder is used.

Celapro is a combination of herbal extracts and phytochemicals that provide targeted cellular protection against free radicals. Lycpene is mainly used.

Gluategenics comprehensively support the integrity and healthy function of the gastrointestinal lining. Vegetables like cabbage and parsley are used for glutamine.

Meta-Sitosterol 2.0 is a naturally derived vegetable preparation featuring plant sterols. Helps to maintain healthy cholesterol levels already within a normal range.

Juicy Fruit-C supplies 500 mg of vitamin C plus complementary citrus bioflavonoids.

1.7 Conclusion

Nutraceuticals are currently receiving recognition as being beneficial in coronary heart disease, obesity, diabetes, cancer, osteoporosis and other chronic and degenerative diseases such as Parkinson's and Alzheimer's diseases. Evidences indicate that the mechanistic actions of natural compounds involve a wide array of biological processes, including activation of antioxidant defences, signal transduction pathways, cell survival-associated gene expression, cell proliferation and differentiation and preservation of mitochondrial integrity. It appears that these properties play a crucial role in the protection against the pathologies of numerous age-related or chronic diseases. It is very imperative that the nutrients found in many fruits and vegetables are responsible for the well documented health benefits. For example, lutein and zeaxanthin prevent cataracts and macular degeneration; beta-carotene and lycopene protect the skin from ultraviolet radiation damage; lutein and lycopene may benefit cardiovascular health, and lycopene may help prevent prostate cancer. Because of these and other remarkable health benefits like reducing the risk factors due to high cholesterol, high blood pressure and diabetes etc., the importance of nutraceuticals is gradually increasing. However many industries manufacture and market the nutraceuticals, where the side effects (especially consumed in large quantities) are not reported or often unproven.

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