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Role Of Phytochemicalsin Health Promotion

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Introduction:

Phytochemicals are natural compounds found in fruits and vegetables. They are substances that don't fall within any other categories- they are not vitamins, proteins, carbohydrates, fats or minerals. Although they are not nutrients- that is necessary for sustaining life- phytochemicals are beneficial to our health. Besides being a source of nutrients, foods, particularly plant foods, are a rich source of bioactive phytochemicals or bionutrients. Each type of fruit or vegetable may contain hundreds of phytochemicals. An orange alone may contain 170 or more different phytochemicals. Studies carried out during the past 2–3 decades have shown that these phytochemicals have an important role in preventing chronic diseases like cancer, diabetes, coronary heart disease and hyper-cholesterolaemia. The major classes of phytochemicals with disease-preventing functions are dietary fibre, antioxidants, detoxifying agents, immunity-potentiating agents and neuropharmacological agents. Each class of these functional agents consists of a wide range of nutrients, such as vitamin E, vitamin C and pro vitamin A. Other phytochemicals that have antioxidant properties are carotenoids, phenolic compounds, flavonoids and is othiocyanates. Some of these phytochemicals have more than one function. Foods rich in these chemicals and exhibiting disease-protecting potential are called functional foods. Indian habitual diets, which are based predominantly on plant foods like cereals, pulses, oils and spices, are all good sources of these classes of phytochemicals, particularly dietary fibre, vitamin E, carotenoids and phenolic compounds.

Phytochemicals are bioactive non-nutrient plant compounds in fruits, vegetables, whole grains, and other plant foods that have been hypothesized to reduce the risk of major chronic diseases. More than 5000 individual dietary phytochemicals have been identified in fruits, vegetables, whole grains, legumes, and nuts, but a large percentage of them still remain unknown. These phytochemicals need to be isolated and identified before we can fully understand the health benefits of bioactive compounds in whole foods. In addition, recent research suggests that the benefits of bioactive compounds in fruits, vegetables, and other plant foods may be even greater than is currently understood because in vitro and animal studies suggest that they have multiple mechanisms of action beyond antioxidant activity. Because bioactive compounds differ widely in composition and ratio from fruits to vegetable to grains and often have mechanisms complementary to one another, it is suggested that, to receive the greatest health benefits, one should consume a wide variety of plant-based foods daily.

The most important groups of dietary phytochemicals can be divided into general categories as phenolics, alkaloids, nitrogen-containing compounds, organosulfur compounds,

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phytosterols, and carotenoids. The most studied groups of dietary phytochemicals related to human health and well-being are phenolics and carotenoids. There were, however, no concerted efforts to coordinate the chemical and biological studies on these phytochemicals to identify their disease-preventing potential, if any.

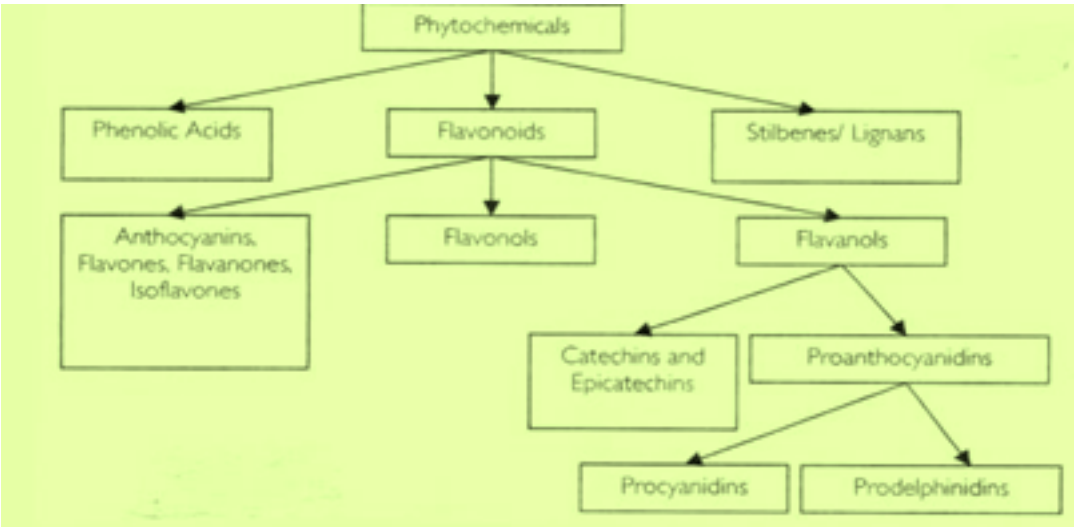

Fig. flow chart showing different types of phytochemicals.

Bioactive phytochemicals and Functional Foods:

For the last two to three decades, however, there has been a surge of interest in plant foods as a source of phytochemicals that may have a useful role in the prevention of chronic diseases such as cancer, diabetes, cardiovascular disease, cataract and gallstone. Such an association between consumption of certain foods and low prevalence of non-communicable disease was derived initially from epidemiological observations. Foods that have disease-preventing potential are designated 'functional foods'. **Functional foods are foods that provide health benefits beyond basic nutrition**. 'The appeal of functional foods lies in their potential to lower the incidence of diet related diseases and, with a rapidly ageing world population, the cost of national health bills'. Health claims for certain foods are permitted by the health, food and nutrition authorities of several countries, including USA, Europe, Australia and Japan. Japan has taken a leading role in this regard, where several functional foods, both natural and processed, are marketed. **In Japan, functional foods are called FOSHU (foods for specific health use)** and are defined as foods derived from naturally occurring substances (not a capsule or powder) that can regulate a particular body process when consumed as part of the daily diet.

The FOSHU are classified into five categories, namely:

(i) Enhancers of the body's immune system
(ii) Preventers of diabetes and heart diseases
(iii) Hypocholesterolaemic agents
(iv) Promoters of digestion and absorption and
(v) Retardants of ageing.

The phytochemicals present in functional foods that are responsible for preventing disease and promoting health have been studied extensively to establish their efficacy and to

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understand the underlying mechanism of their action. Such studies have included identification and isolation of the chemical.

Functional Foods from Plant Sources:

Overwhelming evidence from epidemiological, in vivo, in vitro, and clinical trial data indicates that a plant-based diet can reduce the risk of chronic disease, particularly cancer. In 1992, a review of 200 epidemiological studies (Block et al, 1992) showed that cancer risk in people consuming diets high in fruits and vegetables was only one-half that in those consuming few of these foods. It is now clear that there are components in a plant-based diet other than traditional nutrients that can reduce cancer risk. Steinmetz and Potter (1991a) identified more than a dozen classes of these biologically active plant chemicals, now known as "phytochemicals."

Oats: Oat products are a widely studied dietary source of the cholesterol-lowering soluble fiber b-glucan. There is now significant scientific agreement that consumption of this particular plant food can reduce total and low density lipoprotein (LDL) cholesterol, thereby reducing the risk of coronary heart disease (CHD). For this, the Food and Drug Administration (FDA) awarded the first food-specific health claim in January 1997 (DHHS/FDA, 1997) in response to a petition submitted by the Quaker Oats Company (Chicago, III).

Soy: Soy has been in the spotlight during the 1990s. Not only is soy a high quality protein, as assessed by the FDA's "Protein Digestibility Corrected Amino Acid Score" method, it is now thought to play preventive and therapeutic roles in cardiovascular disease (CVD), cancer, osteoporosis, and the alleviation of menopausal symptoms.

Flaxseed: Among the major seed oils, flaxseed oil contains the most (57%) of the omega-3 fatty acid, a-linolenic acid. Recent research, however, has focused more specifically on fiber-associated compounds known as lignans. The two primary mammalian lignans, enterodiol and its oxidation product, enterolactone, are formed in the intestinal tract by bacterial action on plant lignan precursors (Setchell et al, 1981). Flaxseed is the richest source of mammalian lignan precursors (Thompson et al, 1991). Fewer studies have evaluated the effects of flaxseed feeding on risk markers for cancer in humans. Phipps et al (1993) demonstrated that the ingestion of 10 gm of flaxseed per day elicited several hormonal changes associated with reduced breast cancer risk. In rodents, flaxseed has been shown to decrease tumors of the colon and mammary gland (Thompson, 1995) as well as of the lung (Yan et al, 1998).

Tomatoes: Selected by Eating Well magazine as the 1997 Vegetable of the Year, tomatoes have received significant attention within the last three years because of interest in lycopene, the primary carotenoid found in this fruit (Gerster, 1997), and its role in cancer risk reduction (Weisburger, 1998).

Garlic: Garlic (*Allium sativum*) is likely the herb most widely quoted in the literature for medicinal properties (Nagourney, 1998). Thus, it is not surprising that garlic has ranked as the second best selling herb in the United States for the past two years. The purported health benefits of garlic are numerous, including cancer chemopreventive, antibiotic, anti-hypertensive, and cholesterol-lowering properties (Srivastava et al, 1995).

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Broccoli and other Cruciferous Vegetables: Epidemiological evidence has associated the frequent consumption of cruciferous vegetables with decreased cancer risk. In a recent review of 87 case-control studies, Verhoeven et al (1996) demonstrated an inverse association between consumption of total *Brassica* vegetables and cancer risk. The percentages of case-control studies showing an inverse association between consumption of cabbage, broccoli, cauliflower, and Brussels sprouts and cancer risk were 70, 56, 67, and 29%, respectively. Verhoeven et al (1997) attributed the anticarcinogenic properties of cruciferous vegetables to their relatively high content of glucosinolates.

Citrus Fruits: Several epidemiological studies have shown that citrus fruits are protective against a variety of human cancers. Although oranges, lemons, limes, and grapefruits are a principal source of such important nutrients as vitamin C, folate, and fiber, Elegbede et al (1993) have suggested that another component is responsible for the anticancer activity. Citrus fruits are particularly high in a class of phytochemicals known as the limonoids (Hasegawa and Miyake, 1996).

Cranberry: Cranberry juice has been recognized as efficacious in the treatment of urinary tract infections since 1914, when Blatherwick (1914) reported that this benzoic acid-rich fruit caused acidification of the urine. Recent investigations have focused on the ability of cranberry juice to inhibit the adherence of *Escherichia coli* to uroepithelial cells (Schmidt and Sobota, 1988). This phenomenon has been attributed to two compounds: fructose and a nondialyzable polymeric compound. The latter compound, subsequently isolated from cranberry and blueberry juices (Ofek et al, 1991), was found to inhibit adhesins present on the pili of the surface of certain pathogenic *E. coli*.

Tea: Tea is second only to water as the most widely consumed beverage in the world. A great deal of attention has been directed to the polyphenolic constituents of tea, particularly green tea (Harbowy and Balentine, 1997). Polyphenols comprise up to 30% of the total dry weight of fresh tea leaves. Catechins are the predominant and most significant of all tea polyphenols (Graham, 1992). The four major green tea catechins are epigallocatechin-3-gallate, epigallocatechin, epicatechin-3-gallate, and epicatechin.

Wine and Grapes: There is growing evidence that wine, particularly red wine, can reduce the risk of CVD. The link between wine intake and CVD first became apparent in 1979 when St. Leger et al (1979) found a strong negative correlation between wine intake and death from ischemic heart disease in both men and women from 18 countries. France in particular has a relatively low rate of CVD despite diets high in dairy fat (Renaud and de Lorgeril, 1992). Although this "French Paradox" can be partly explained by the ability of alcohol to increase HDL cholesterol, more recent investigations have focused on the non-alcohol components of wine, in particular, the flavonoids.

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Table: Phytochemicals in Foods and Possible Health Benefits:

Foods	Phytochemicals	Possible Health Benefits
Soybeans, soy milk, tofu	Isoflavones (genistin, daidzein), types of flavonoids	Reduction in blood pressure and increased blood vessel dilation
Strawberries, red wine, blueberries	Anthocyanins, a type of flavonoid	Blood vessel dilation, induction of cancer cell death, improved insulin sensitivity, neuroprotective effects
Red wine, grape juice, grape extracts, cocoa, peanuts	Proanthocyanidins, a type of flavonoid; resveratrol	Inhibition of LDL oxidation and inflammation
Garlic, onions, leeks, olives, scallions	Sulfides, thiols	Decreased LDL cholesterol, anticancer effects
Carrots, tomatoes and tomato products, other orange, yellow, and red fruits and vegetables	Carotenoids, such as lycopene, and beta-carotene	Neutralization of free radicals that cause cell damage
Cruciferous vegetables such as broccoli and kale, horseradish	Isothiocyanates (sulforaphane)	Neutralization of free radicals that cause cell damage and protection against some types of cancer
Green and black tea, cocoa	Catechins, epicatechins, types of flavonoids	Vasodilation, improved blood flow to the brain, improved insulin sensitivity

Conclusion:

Mounting evidence supports the observations that functional foods containing physiologically active components, either from plant or animal sources, may enhance health. It should be stressed, however, that functional foods are not a magic bullet or universal panacea for poor health habits. There are no "good" or "bad" foods, but there are good or bad diets. Emphasis must be placed on over-all dietary pattern - one that follows the current U.S. Dietary Guidelines, and is plant-based, high in fiber, low in animal fat, and contains 5-9 servings of fruits and vegetables per day. Moreover, diet is only one component of an overall lifestyle that can have an impact on health; other components include smoking, physical activity, and stress.

Health-conscious consumers are increasingly seeking functional foods in an effort to control their own health and well-being. The field of functional foods, however, is in its infancy. Claims about health benefits of functional foods must be based on sound scientific criteria (Clydesdale, 1997). A number of factors complicate the establishment of a strong scientific foundation, however. These factors include the complexity of the food substance, effects on the food, compensatory metabolic changes that may occur with dietary changes, and, lack of surrogate markers of disease development. Additional research is necessary to substantiate the potential health benefits of those foods for which the diet-health relationships are not sufficiently scientifically validated.

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Research into functional foods will not advance public health unless the benefits of the foods are effectively communicated to the consumer. The Harvard School of Public Health (Boston, Mass) and the International Food Information Council Foundation (Washington, D.C.) recently released a set of communication guidelines, aimed at scientists, journal editors, journalists, interest groups, and others for improving public understanding of emerging science. The guidelines are intended to help ensure that research results about nutrition, food safety, and health are communicated in a clear, balanced, and no misleading manner (Fineberg and Rowe, 1998). Finally, those foods whose health benefits are supported by sufficient scientific substantiation have the potential to be an increasingly important component of a healthy lifestyle and to be beneficial to the public and the food industry. Phytochemicals not only improve our health but they also improve our enjoyment of food by painting the fruits and vegetables we eat in a rainbow of colors. There are almost 2000 different plant pigments in the food we eat. For instance, Anthocyanins give strawberries, cherries, cranberries and raspberries their rich red color. Carotenoids give carrots their characteristic orange hue.

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