Program	B. Pharmacy
Semester	VI
Subject /Course	Herbal Drug Technology
Subject/Course ID	BP603T
Module No.	II
Module Title	Nutraceuticals
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Learning Outcome of Module-II

LO	Learning Outcome (LO)	Course Outcome Code
LO1	Understand the basic concept of nutraceuticals	BP603.2
LO2	Know the market growth of nutraceuticals	BP603.2
LO3	Understand about herbs used as a nutraceuticals	BP603.2
LO4	Know about the drugs used in various aliments	BP603.2
LO5	Know about the herbal-drug interactions	BP603.2

Content Table

Topic
• General aspects of Nutraceuticals • Market, growth, scope and types of products available in the market • Health benefits and role of nutraceuticals in various ailments • Study of various herbs as health food • Introduction of Herbal Drug and Herb –food interactions and their classification • Study of various herbs and their possible side effects

NUTRACEUTICALS

"Let food be your medicine"

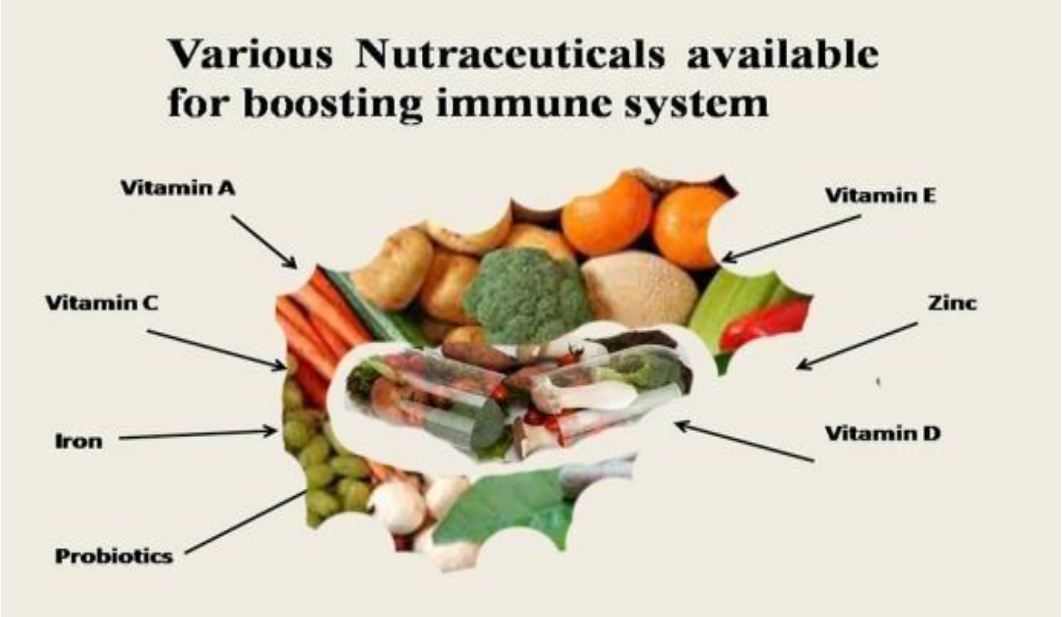
Introduction: Nutraceutical is a hybrid of nutrition and pharmaceutical. These are a group of products that are more than a food but less than pharmaceuticals. It is a substance which may be regarded as a food or part of a food which provides medical or health benefits, helps in prevention and treatment of a disease. These are foods which provide health benefits to reduce the risk of chronic diseases and basic nutrition. A nutraceutical may be a naturally nutrient- rich food such as spirulina, garlic, soy or a specific component of a food like omega-3 oil from salmon. They are also known as medical foods, nutritional supplements and dietary supplements. It ranges from isolated nutrients, dietary supplements, genetically engineered designer foods, herbal products, and processed products such as cereals and soups.

They have received considerable interest because of their presumed safety and potential nutritional and therapeutic effects. Foods and nutrients play a vital role in the normal functioning of the body. They help to maintain the health of the individual and to reduce the risk of various diseases. Worldwide acceptance of this fact formed a recognition link between "nutrition" and "health", and thus the concept of "nutraceuticals" evolve dietary active compounds in human nutrition is one of the most important areas of investigation. Examples of nutraceuticals are natural foods, antioxidants, dietary supplements, daisy products, citrus fruits, vitamins, minerals, milk and cereals. These products are generally consumed without medical prescription and supervision. They play vital role in human health and long life.

Nutraceuticals are products derived from food sources that provide both nutrition and medicinal benefits. Nutraceuticals are also known by the following terms:

- Functional foods
- Medical foods
- Designer foods
- Phyto-chemicals
- Nutritional supplements

These products include dietary supplements, diets, herbal products, genetically engineered foods,



and vitamins. They contain a high concentration of bioactive compounds, derived from a natural source and have physiological benefits and aid in the prevention and treatment of disease.

A healthy diet contributes to your health by providing the nutrients your body needs to repair itself, grow, and function well. When your diet does not supply enough of these essential nutrients and vitamins, nutraceuticals can act as a supplement. Nutraceuticals even include everyday foods like pre- and probiotics, fortified cereals, processed foods, and beverages.

Types:

Nutraceuticals are broadly classified based on their function, food source, and bioactive components. Most of them fall under two general categories: dietary supplements and functional food.

DIETARY SUPPLEMENTS

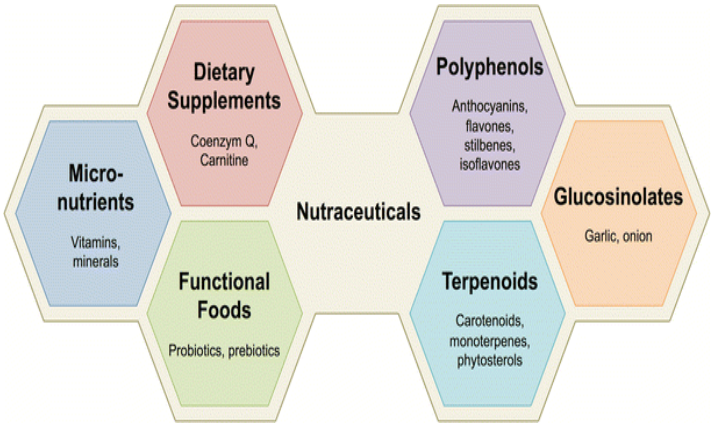
Dietary supplements are those products that contain concentrated bioactive nutrients from a food source processed into a suitable dosage form. These supplements can contain one or more of the following: amino acids, vitamins, herbs or other botanicals, minerals, important metabolites, and certain enzymes. Dietary supplements are available in tablets, capsules, powders, and liquids, gummies, energy bars, and any other suitable forms. Nutraceuticals that fall under the umbrella of dietary supplements not only supplement diet but also promote health and prevent disease.

FUNCTIONAL FOODS

Functional foods are any food or food ingredient that provides a health benefit other than basic nutrition. The foods under this category include whole foods and fortified, enriched, or enhanced foods that can improve health when consumed regularly as part of a varied diet. Functional food looks like food and is available as pasta, cereal, whole grains, yogurt, snacks, and more.

Functional foods can be:

Traditional Functional Food: These are nutrient-rich natural foods that deliver health benefits other than basic nutrition, such as omega-3 fatty acids in salmon and lycopene in tomatoes.



Classification Based On The Chemical Groups

s.no	Class	Examples
1	Inorganic mineral supplements	Minerals
2	Probiotics	Helpful bacteria
3	Prebiotics	Digestive enzymes
4	Dietary fibres	Fibres
5	Antioxidants	Natural antioxidants
6	Phytochemicals	
	Fatty acids	Omega 3 fatty acids
	Phenolics	Tea polyphenols
	Isoprenoids	carotenoids
	Lipids	Sphingolipids
	Proteins	soyaproteins
7	Herbs as functional food	--------

Non-Traditional Functional Food: These are artificial foods prepared by adding bioactive components to help enhance health and well-being. Examples include fortified nutraceuticals such as juice with added calcium, cereal fortified with iron, flour with added folic acid. Modified functional foods can also include recombinant nutraceuticals, which are energy-producing foods such as bread, yogurt, cheese, and vinegar produced via biotechnology techniques.

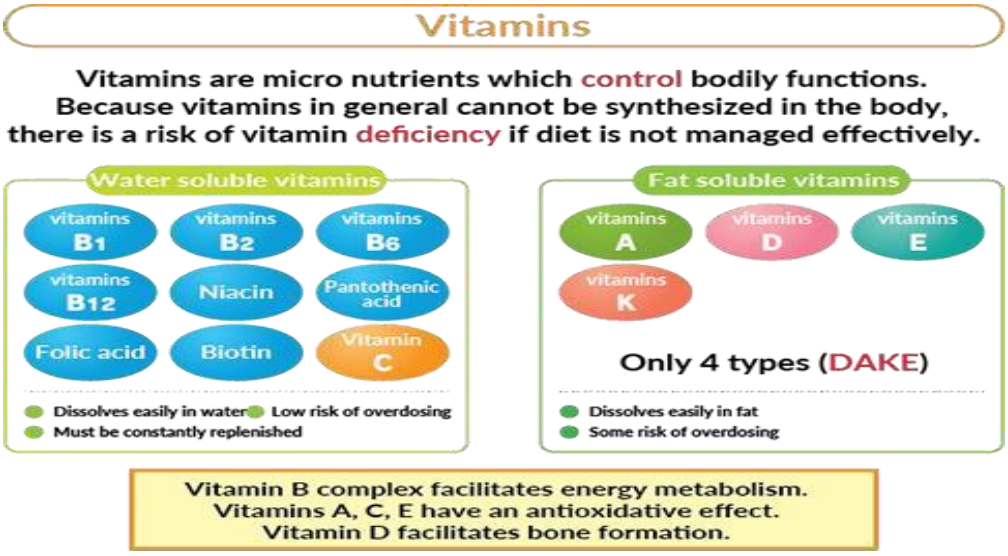
Essentially, a nutraceutical is a substance that has a physiological benefit or provides protection from chronic disease. Unfortunately, the definition of nutraceuticals varies from country to country depending on how they are categorized and regulated. At the moment there is no clear internationally accepted definition of a nutraceutical.

Nutraceuticals can improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure and functioning of the body. They are also used in the prevention and treatment of mental health issues and disorders.

Classification of Nutraceuticals: The food sources used as nutraceuticals are all natural and can be categorized as:

Classification Based On The Chemical Groups

s.no	Class	Examples
1	Inorganic mineral supplements	Minerals
2	Probiotics	Helpful bacteria
3	Prebiotics	Digestive enzymes
4	Dietary fibres	Fibres
5	Antioxidants	Natural antioxidants
6	Phytochemicals	
	Fatty acids	Omega 3 fatty acids
	Phenolics	Tea polyphenols
	Isoprenoids	carotenoids
	Lipids	Sphingolipids
	Proteins	soyaproteins
7	Herbs as functional food	--------



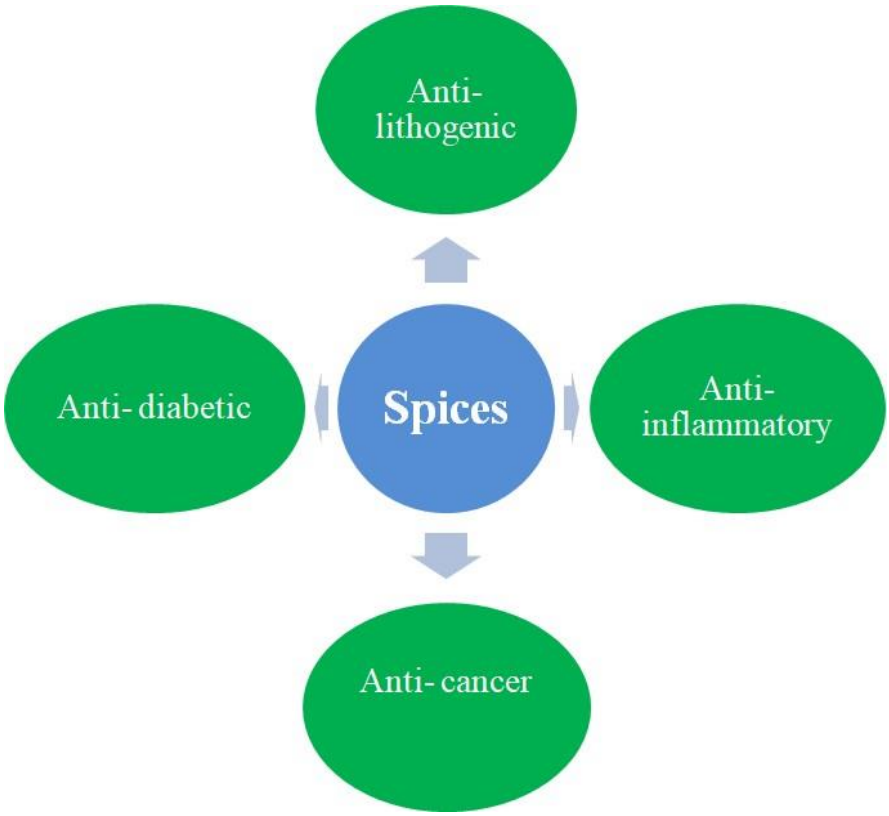
Nutrients	Health benefits
Vitamin A	Antioxidant, essential, for growth and development and in the treatment of certain skin disorders.
Vitamin E	Antioxidant, helps form blood cells, muscles, lung and nerve tissue, boosts the immune system.
Vitamin K	Essential for blood clotting
Vitamin C	Antioxidant, for healthy bones, gums, teeth and skin, in wound healing, prevent common cold and attenuate its symptoms.
Vitamin B1	Helps to convert food in to energy, essential in neurologic functions.
Vitamin B2	Helps in energy production and other chemical processes in the body, helps maintain healthy eyes,skin and nerve function.
Vitamin B3	Helps to convert food in to energy and maintain proper brain function.
Folic acid	Produce the genetic materials of cells, in pregnancy for preventing birth defects, RBCs formation,protects against heart disease.
Calcium	Bones and teeth and maintaining bone strength important in nerve, muscle and glandular functions.

Prebiotics vs Probiotics

Prebiotics	Probiotics
Prebiotics are defined as nonliving non-digestible special form of fiber or carbohydrates.	Probiotics are referred to as live active microorganisms that when administered in adequate amount will have beneficial effects to its host.
The powder form of prebiotics can survive heat, cold, acid.	• more fragile. • vulnerable to heat. • may be killed over time.
Prebiotics perform their role by nourishing the bacteria that live in the intestines.	Probiotics fight the harmful bacterial species present in the gut.

Benefits of Probiotics and Prebiotics

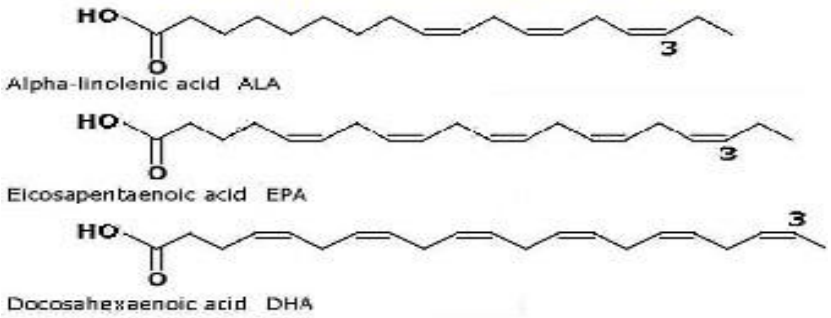
Role of Spices



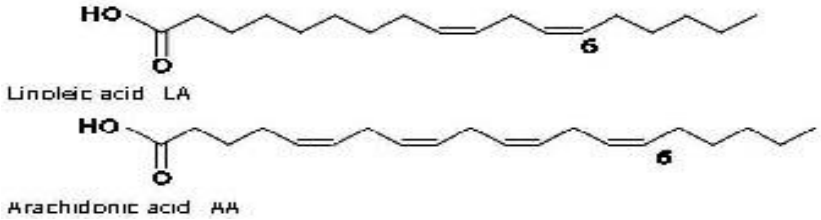
Poly unsaturated fatty acid (PUFA): The term "polyunsaturated" refers to their chemical structure, as "poly" means many and "unsaturated" refers to double bonds **.**The most important role and significant functions are attributed to PUFAs, which possess a unique subgroup referred to essential fatty acids (EFAs), cannot be synthesized de novo and like vitamins, and need to be delivered with food.

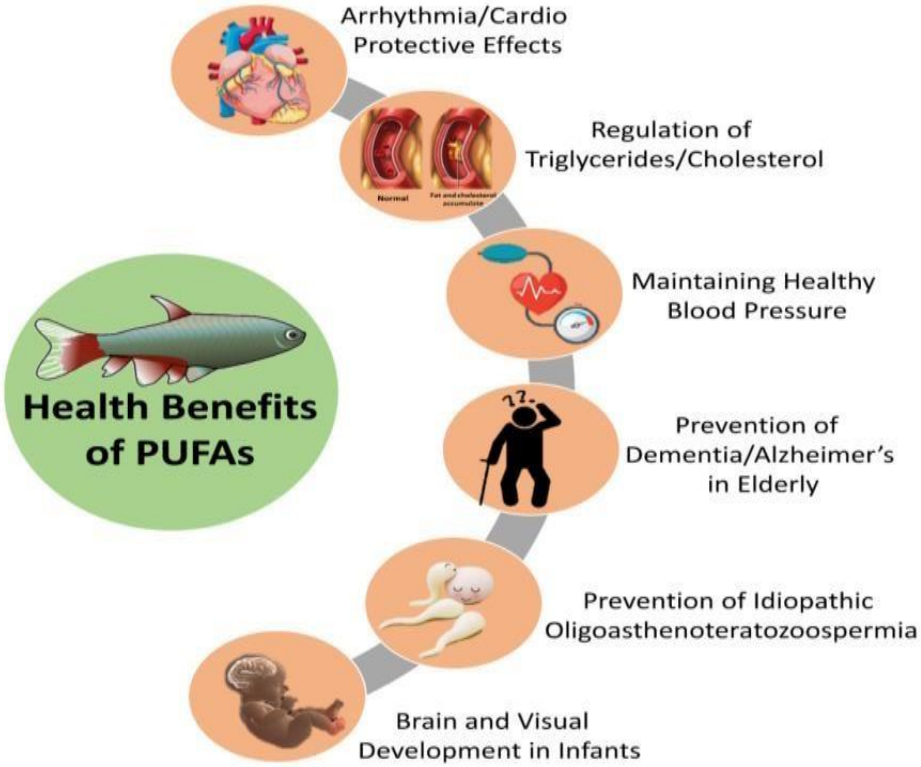
Among these fatty acids, omega-3 and omega-6 polyunsaturated fatty acids (PUFAs) seem to be the most important, due to their multiple biological roles, such as influencing the inflammatory cascade, reducing the oxidative stress, presenting neuro-protection and cardiovascular protection. Omega 3 fatty acids possess strong anti-inflammatory properties which lower risk of heart disease, Alzheimer's, promotes vision and boost brain health. MUFA and PUFA rich oils instead of saturated fats and other unhealthy fats as it can reduce the risk of heart disease.

Omega-3 fatty acids

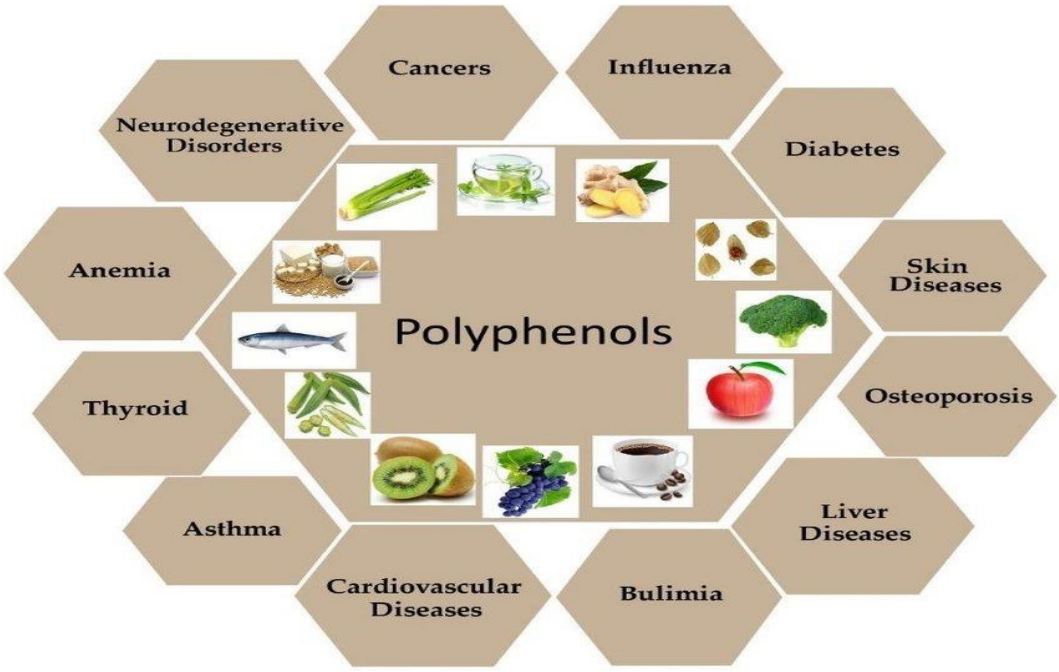


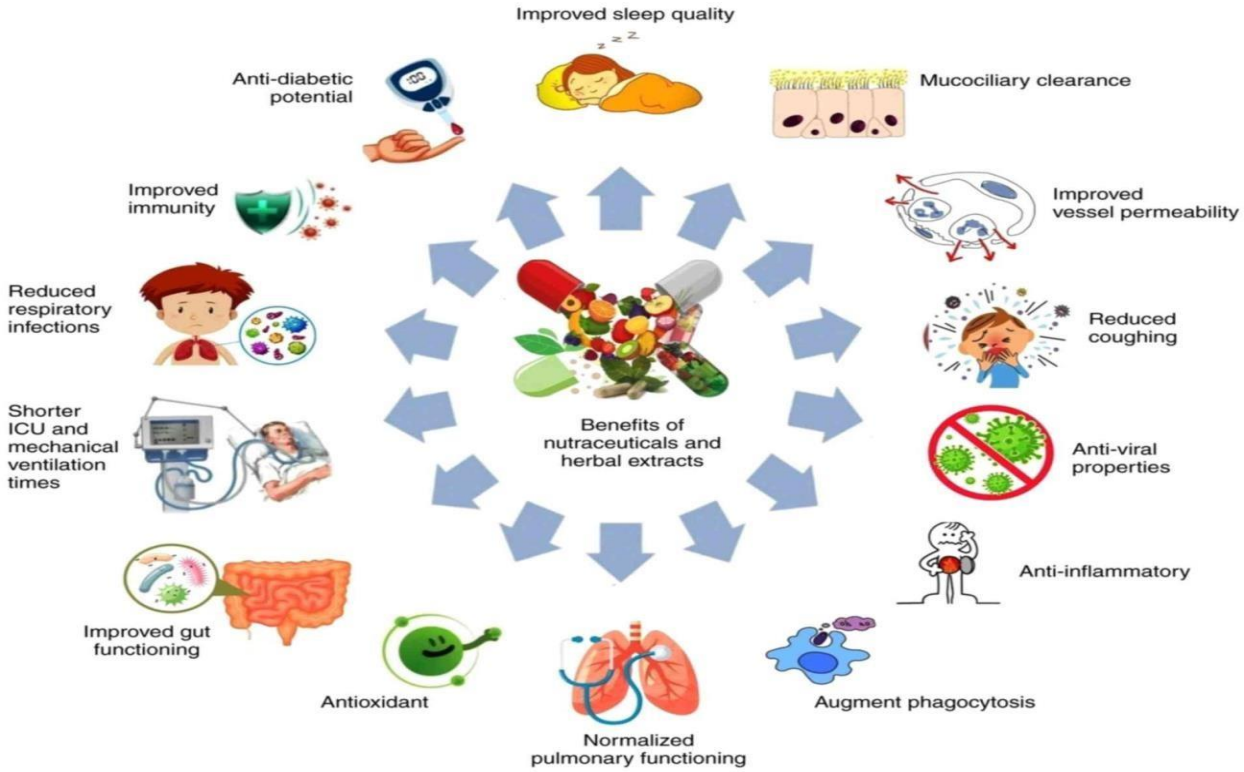
Omega-6 fatty acids





POLYPHENOLS

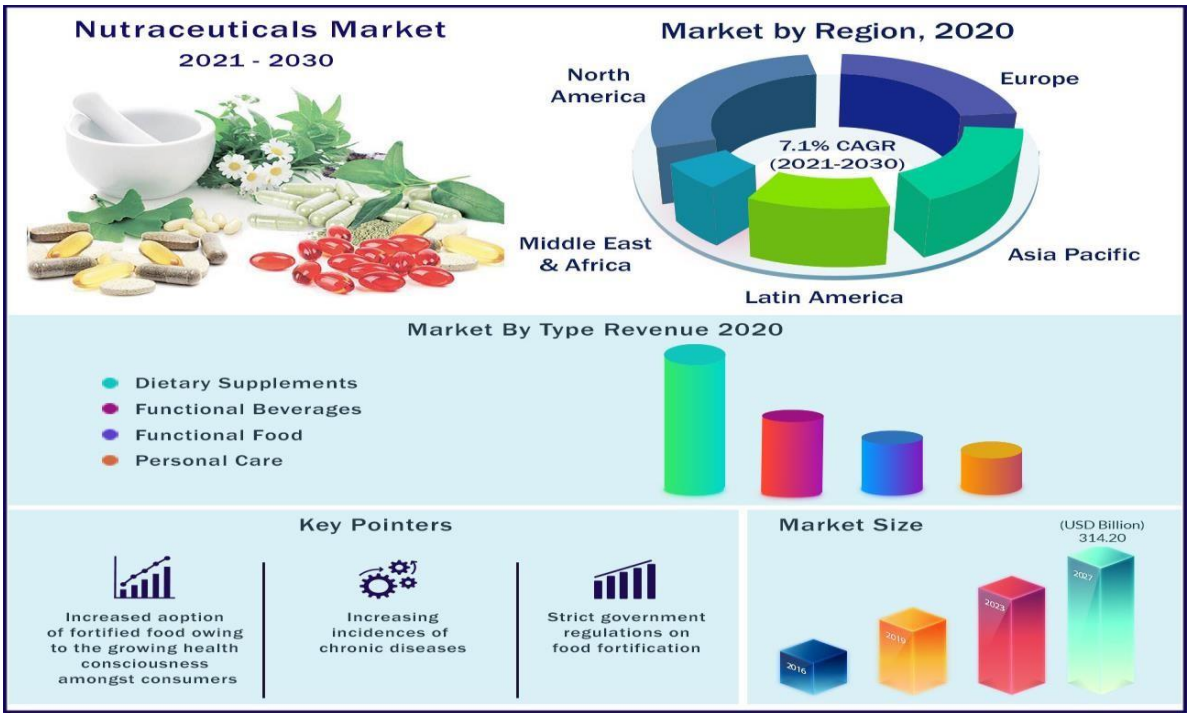




GLOBAL MARKET GROWTH & GENERAL DEMAND SCENARIO OF NUTRACEUTICALS

The nutraceutical industry lies under three main segments which include functional foods, dietary supplements, and herbal/natural products. Global nutraceutical market is estimated as USD 117 billion (INR 5148 billion). In 2007, nutraceuticals sale is projected to reach $74.7 billion at an AAGR of 9.9%. This assumes a world economic recovery in 2003 and an end to price competition.According to a recent report, the total market for nutraceuticals in India is growing at 21 percent per annum. It is currently valued at INR 44bn (€621 m), but could be worth more than INR 95bn in four years. As a concept, "Nutraceuticals" is still in its stage of infancy in India. But it has been growing much faster than global rates at CAGR of 18% for the last 3 years driven by functional food and beverages categories. The most rapidly growing segments of the industry were dietary supplements (19.5 percent per year) and natural/herbal products (11.6 percent per year). With the ever-changing lifestyle of humans, the antioxidant defense systems are often overloaded resulting in oxidative stress.

Moreover, the levels of antioxidant defense mechanism decrease appreciably with age. These may result in the development of a great many diseases. Hence research over the past several decades have primarily focussed on different nutraceuticals.Antioxidant products may either

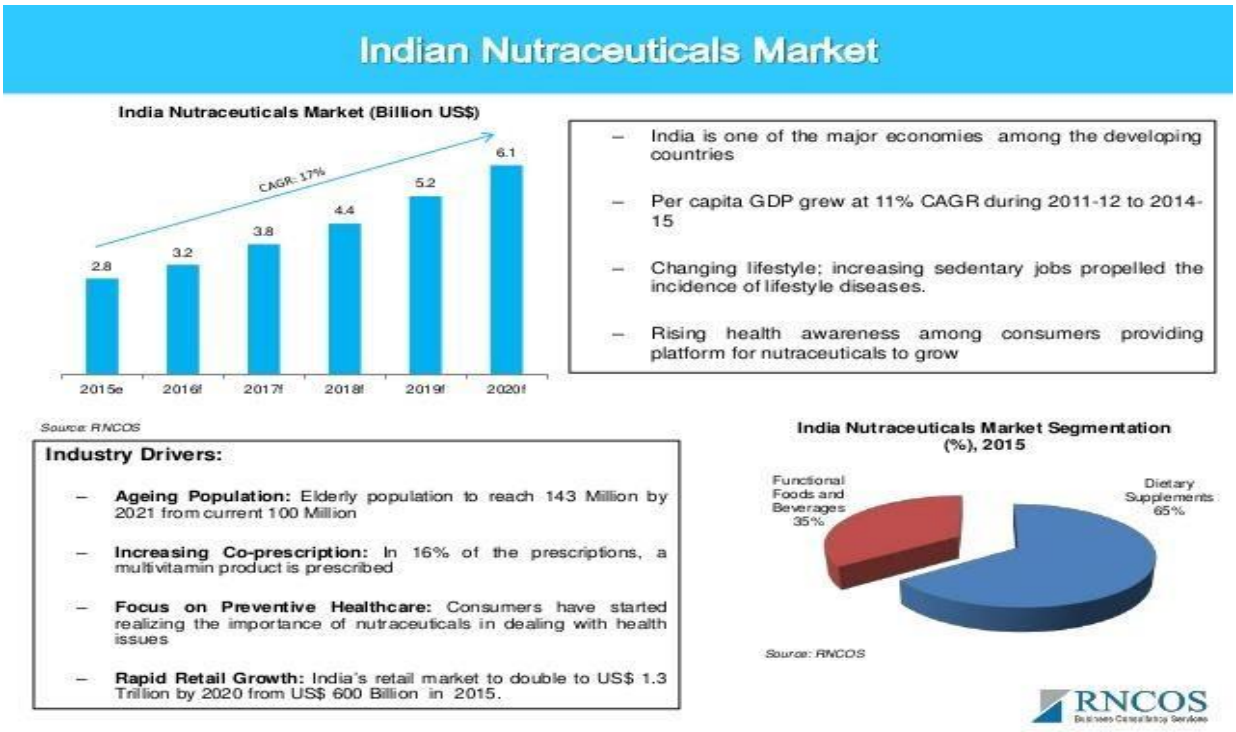


function intrinsically to scavenge free radicals (e.g. vitamins, PUFA) or specifically stimulate the body's defense system. This review reflects the potential merits and demerits of nutraceuticals among healthy individuals. However, an individual's susceptibility to any particular disease predominantly depends upon genetic predisposition and lifestyle disorders like smoking, high alcohol consumption. So the response of nutraceuticals can vary from person to person. Nutraceuticals have proven health benefits and their consumption (within their acceptable Recommended Dietary Intakes) will keep diseases at bay and allow humans to maintain an overall good health.

Market Overview

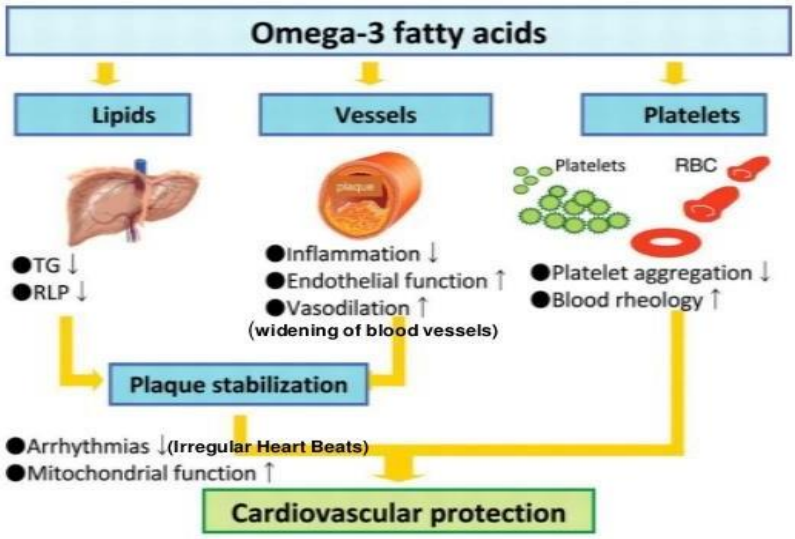
The global nutraceuticals market is projected to grow at a CAGR (Compound annual growth rate) of 7.5% during the forecast period (2020 - 2025).

- Globally, nutraceuticals are gaining importance and are becoming a part of the consumer's daily diet. The major reasons for this change have been the increasing prevalence of lifestyle diseases and people consciously taking preventive healthcare measures.
- Developed markets, like the United States and Europe, are discovering the untapped segment of customized products based on health claims. Functional food is the largest shareholding category of the studied market, followed by functional beverage and dietary supplement.



HEALTH BENEFITS OF NUTRACEUTICALS IN DISEASES

CARDIOVASCULAR DISEASES: Worldwide, the burdens of chronic diseases like cardiovascular diseases, cancers, diabetes and obesity is rapidly increasing. In 2001, chronic diseases contributed approximately 59% of the 56.5 million total reported deaths in the world and 46% of the global burden of disease. Cardiovascular diseases (CVD) 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*.



In 1999 CVD alone contributed to a third of global deaths and by 2010 it would be the leading cause of death in developing countries. Majority of the CVD are preventable and controllable. It was reported that low intake of fruits and vegetables is associated with a high mortality in cardiovascular disease.

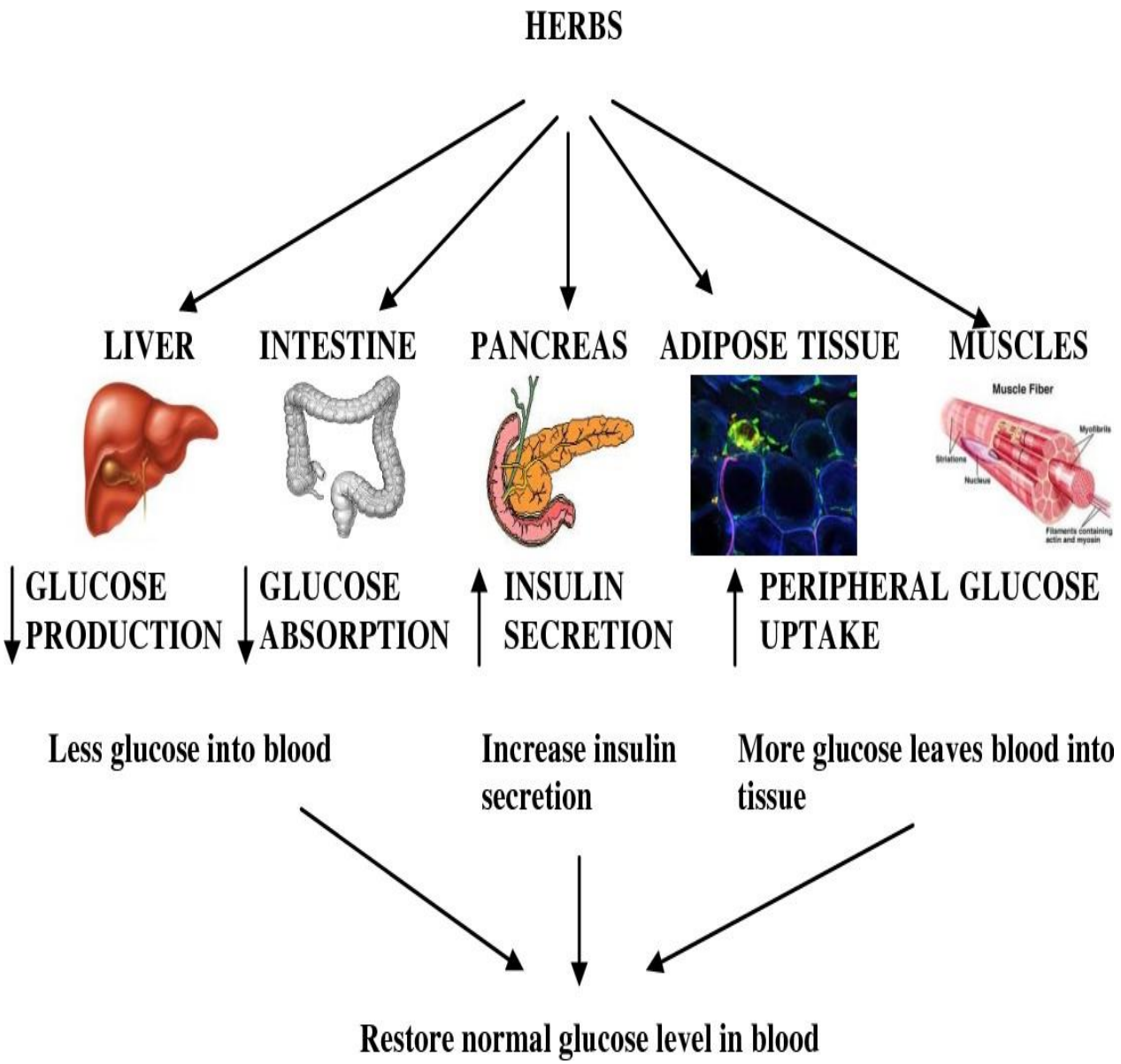
Many research studies have identified a protective role for a diet rich in fruits and vegetables against CVD. This apart, nutraceuticals in the form of antioxidants, dietary fibers, omega-3 polyunsaturated fatty acids (n-3 PUFAs), vitamins, and minerals are recommended together with physical exercise for prevention and treatment of CVD.

It has been demonstrated that themolecules like polyphenols present in grapes and in wine alter cellular metabolism and signalling, which is consistent with reducing arterial disease. Flavonoids are widely distributed in onion, endives, cruciferous vegetables, black grapes, red wine, grapefruits, apples, cherries and berries. Flavanoids in plants available as flavones (containing the flavonoid apigenin found in chamomile); flavanones (hesperidins - citrus fruits; silybin- milk thistle flavonols (tea:quercetin, kaempferol and rutin grapefruit; rutin buckwheat; ginkgo flavonglycosides -ginkgo) play a major role in curing the cardiovascular diseases. Flavonoids block the angiotensin-converting enzyme (ACE) that raises blood pressure; by blocking the "suicide" enzyme cyclo-oxygenase that breaks down prostaglandins, they prevent platelet stickiness and hence platelet aggregation. Flavonoids also protect the vascular system and strengthen the tiny capillaries that carry oxygen and essential nutrients to all cells.

DIABETES: Diabetes mellitus is characterized by abnormally high levels of blood glucose, either due to insufficient insulin production, or due to its ineffectiveness. The most common forms of diabetes are type 1diabetes (5%), an autoimmune disorder, and type 2 diabetes (95%), which is associated with obesity. Gestational diabetes occurs in pregnancy. Globally the total number of people with diabetes is projected to raise from 171 million in 2000 to 366 million in2003. Docosahexaenoic acid modulates insulin resistance and is also vital for neuro-visual development. This is especially important in women with gestational diabetes mellitus which foster the recommendation for essential fatty acids during pregnancy.

Lipoic acid is a universal antioxidant, now used in Germany for the treatment of diabetic neuropathy. It is possible that lipoic acid may be more effective as a long-term dietary supplement aimed at the prophylactic protection of diabetics from complications. Dietary fibers from *psyllium* have been used extensively both as pharmacological supplements, food ingredients, in processed food to aid weight reduction, for glucose control in diabetic patients and to reduce lipid levels in hyperlipidemia. Good magnesium status reduces diabetes risk and

improves insulin sensitivity; chromium picolinate, calcium and vitamin D appear to promote insulin sensitivity and improve glycemic control in some diabetics; extracts of bitter melon and of cinnamon have the potential to treat and possibly prevent diabetes.However it has been suggested that Nutraceuticals with meaningful doses of combinations may substantially prevent and presumably could be marketed legally.


HERBS
LIVER
INTESTINE
PANCREAS
ADIPOSE TISSUE
MUSCLES
Muscle Fiber
Myofibrils
Striations
Nucleus
Filaments containing actin and myosin
GLUCOSE PRODUCTION
GLUCOSE ABSORPTION
INSULIN SECRETION
PERIPHERAL GLUCOSE UPTAKE
Less glucose into blood
Increase insulin secretion
More glucose leaves blood into tissue
Restore normal glucose level in blood

CANCER: Cancer has emerged as a major public health problem in developing countries. According to the World Cancer Report the cancer rates are increasing and it would be 15 million new cases in the year 2020 that is, a rise in 50%. A healthy lifestyle and diet can help in prevention of cancer. Carotenoids are a group of phytochemicals responsible for different colors of the foods. They have antioxidant activities and effective on cancer prevention. Recent interest in carotenoids has focused on the role of lycopene in human health, especially in cancer disease. Plants rich in daidzein, biochanin, isoflavones and genistein, also inhibit prostate cancer cell growth. Because of the unsaturated nature of lycopene it is considered to be a potent antioxidant and a singlet oxygen quencher. Lycopene concentrates in the prostate, testes, skin and adrenal where it protects against cancer. The linkage between carotenoids and prevention of cancer and CAD, heightened the importance of vegetable and fruits in human diet.

Lycopene contained vegetables and fruits exert cancer-protective effect via a decrease in oxidative stress and damage to DNA. Lycopene is one of the major carotenoids and is found exclusively in tomatoes, guava, pink grapefruit, water melon and papaya.β-carotene has antioxidant activity and prevents cancer and other diseases. Among the carotenes, β-carotene has the most antioxidant activity. Alpha-carotene possesses 50–54% of the antioxidant activity of β-carotene, whereas epsilon carotene has 42–50% of the antioxidant activity. Chronicinflammation is associated with a high cancer risk. Chronic inflammation is also associated with immune-suppression, which is a risk factor for cancer. Ginseng is an example of an anti- inflammatory molecule that targets many of the key players in the inflammation-to-cancer sequence. Nowadays, phytochemicals with cancer-preventive properties have been on high attention. Chemopreventive components in fruits and vegetables, among other beneficial health effect, have potential anti-carcinogenic and anti-mutagenic activities. A broad range of phyto- pharmaceuticals with a claimed hormonal activity, called “phyto-estrogens,” is recommended forprevention of prostate and breast cancers.

Citrus fruit flavonoids are able to protect against cancer by acting as antioxidants. Soyfoods are a unique dietary source of isoflavones, the polyphenolic phytochemicals exemplified by epigallocatechin gallate from tea, curcumin from curry and soya isoflavones possess cancer chemopreventive properties. Soybean seems to offer protection against breast, uterine, lung,

colorectal, and prostate cancers. β-carotene found in yellow, orange, and green leafy vegetables and fruits such as tomatoes, lettuce, oranges, sweet potatoes, broccoli, cantaloupe, carrots, spinach, and winter squash has anticancer activity.

Saponins are reported to possessantimutagenic and antitumor activities and might lower the risk of human cancers, by preventing cancer cells from growing. Saponins are phytochemicals which can be found in peas, soybeans, and some herbs with names indicating foaming properties such as soapberry, soapwort and soapbark. They are also present in tomatoes, potatoes, alfalfa, spinach, and clover. Commercial saponins are extracted mainly from *Yucca schidigera* and *Quillaja saponaria.*Tannins also scavenge harmful free radicals and detoxify carcinogens.

Tannins present in grapes, lentils, tea, blackberries, blueberries and cranberries is a proven anti-carcinogen is used in alternative medicine and to prevent cancer. Ellagic acid, present in walnuts, pecans, strawberries, cranberries, pomegranates and red raspberry seeds, is an anticancer agent. Pectin is a soluble fiber found in apples has been shown to prevent prostate cancer metastasis by inhibiting the cancer cells from adhering to other cells in the body. Several studies have shown that pectin decreases serum cholesterol levels. Naturally occurring phenolic acid derivatives are reported to possess potential anticancer properties. Phenolic compounds such as curcumin, gallic acids, ferulic and caffeic acid are reported to possess anticancer activity.

Glucosinolates and their hydrolysis products, including indoles and isothiocyanates, and high intake of cruciferous vegetables has been associated with lower risk of colorectal and lung cancer. Bio-transformation products of glucosinolates include dithiol thiones, isothiocyanates, and sulforaphane. They block the enzymes that promote tumor growth, particularly in liver, colon, lung, breast, stomach and esophagus. The sulfur compounds, in garlic have been found to boost the immune system and reduce atherogenesis and platelet stickiness and cancer. Sulforaphane rich in broccoli is a potent phase 2 enzyme inducer. It produces D-glucarolactone, a significant inhibitor of breast cancer. Sulforaphane is an antioxidant and stimulator of natural detoxifying enzymes. Sulforaphane has been reported to reduce the risk of breast cancer and prostate cancer.

Curcumin is a polyphenol derived from the plant *Curcuma longa*, commonly called turmeric. Curcumin has been reported to possess anti-oxidative, anti-carcinogenic, and anti-inflammatory properties. Consumption of fruits and vegetables having cysteine, glutathione, selenium, Vitamin E, Vitamin C, lycopene, and various phytochemicals elevates the levels of anti-oxidative capacity. However, more investigations are needed to determine their beneficial effects in cancer prevention or treatment. Large scale clinical trials suggest that some agents such as green tea, Vitamins D and E, selenium, lycopene, soy, anti-inflammatory and inhibitors of 5a-reductase are effective in preventing prostate cancer. Cancer was not prevented by β-carotene, N-acetylcysteine, α-tocopherol, retinol, retinyl palmitate, or isotretinoin in smokers.

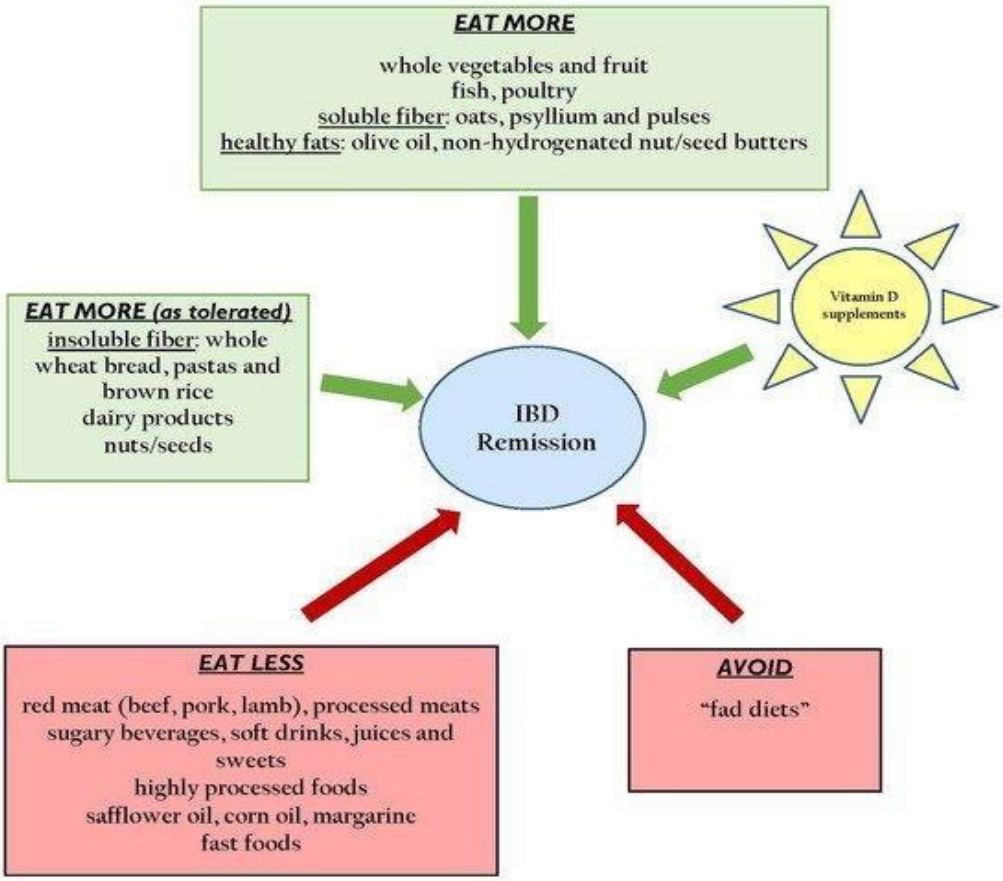
Ongoing trials may help define new avenues for chemoprevention. Several studies have shown the values of alternative and complementary medicine as adjuvant to chemotherapy or radiotherapy. Complimentary therapy may be reliable and useful supportive measure for prostate cancerpatients. Majority of the studies have shown a preventive role for nutraceuticals in cancer, however more elaborate studies are needed. Flavonoids which block the enzymes that produce estrogen reduce of estrogen induced cancers. Phytoestrogens is recommended to prevent prostate/breast cancer. Soy foods are source of Iso-flavones, curcumin from curry and soya isoflavones possess cancer chemo preventive properties.

Lycopene concentrates in the skin, testes, adrenal and prostate protects against cancer. Saponins contains antitumor and antimutagenic activities. Curcumin (diferuloylmethane) which is a polyphenol of turmeric possesses anti-carcinogenic, antioxidative and anti-inflammatory properties. Beet roots, cucumber fruits, spinach leaves, and turmeric rhizomes were reported to possess anti-tumor activity.

Inflammatory bowel syndrome (IBD) AND GIT disease : Inflammatory bowel diseases (IBD), including Crohn's disease (CD) and ulcerative colitis (UC), are a group of idiopathic, chronic and relapsing inflammatory disorders of the gastrointestinal tract, whose incidence and prevalence has been increasing in the last decades. it is assumed that many interacting components could affect IBD development, including genetic susceptibility, ethnicity, environmental factors, infectious diseases, and dietary habits. At present, the acknowledged pathogenetic mechanisms are featured by immune dysregulation, altered intestinal microflora,

oxidative stress, defects in the gastrointestinal mucosal barrier and increased permeability, whose interplay leads to the onset of a state of chronic mucosal inflammation. IBD patients often require lifelong medication, being the main goal of therapy both to induce a clinical remission and then maintain it for a long period of time.

Nutraceutical compounds, such as bioactive peptides, phytochemicals, and omega 3-polyunsaturated fatty acids, are currently under investigation for their helpful activities in inflammatory bowel syndrome. Dietary supplements, such as probiotics, fish oil, curcumin and aloe-vera are used for intestinal inflammation. Curcumin and green tea supplementation have been reported to be effective in reducing both inflammatory bowel diseases and inflammatory diseases. Dietary lipids are one of the most active nutritional substrates modulating the human immune response and in particular, the gut mucosal immune system. The behavior of polyunsaturated fatty acid has been widely investigated during inflammatory processes.



HERBS AS HEALTH FOOD

The COVID-19 pandemic has challenged healthcare systems across the globe, turning the world's attention to the immune system and the vital role it plays against disease-causing bacteria, viruses and other organisms that we touch, ingest and inhale every day. COVID-19 brings a shift in the complementary medicine industry. Two big Indian Ayurvedic medicine companies, The Dabur & Himalaya both witnessed huge sales spikes during this pandemic. These Ayurvedic herbs, could be the next blockbuster herbs, with substantial and convincing scientific and clinical support building around.

ALFALFA: Alfalfa (*Medicago sativa*) is a plant that has been grown as feed for livestock for hundreds of years. Alfalfa is a part of the legume family, but it's also considered to be an herb. People use the leaves, sprouts, and seeds to make medicine. Alfalfa is used for kidney conditions, bladder and prostate conditions, and to increase urine flow. It is also used for high cholesterol, asthma, osteoarthritis, rheumatoid arthritis, diabetes, upset stomach, and a bleeding disorder called thrombocytopenic purpura. People also take alfalfa as a source of vitamins A, C, E, and K4; and minerals calcium, potassium, phosphorous, and iron. It is used in High cholesterol. Taking alfalfa seeds seems to lower total cholesterol and "bad" low-density lipoprotein (LDL) cholesterol in people with high cholesterol levels. Kidney problems, Bladder problems, Prostate problems, Asthma, Arthritis and Diabetes. Due to its rich content in proteins, vitamins, minerals, isoflavones and other substances with estrogenic activity, anti-inflammatory properties and antioxidant activity (carotens, chlorophyll), alfalfa can be used as an efficient functional ingredient in the dietary prevention and treatment of several metabolic conditions, especially the metabolic syndrome.

CHICORY: Chicory (*Cichorium intybus*) is a perennial herbal plant of the dandelion family Asteraceae. In addition, chicory herb plays a key role as antioxidant, anti-inflammatory, sedative, immunological, productive and reproductive enhancer, cardiovascular, hypolipidemic, anticancer, anti-protozoal, gastro-protective, anti-diabetic, analgesic, anthelmintic, antimicrobial, wound healing and bitter tonic without inducing therapeutic adverse effect. Also, chicory plant is a good and very important protective source for hepatocytes and other liver cells as well as it is used as prebiotic against some species of pathogenic bacteria for both *in vitro* and *in vivo.* Chicory leaves contain inulin, A, B1, B2 and Cvitamins, Ca, K, Mg, Na, Fe, Cu, Mn, Zn, phenolic compounds, amongst others.

Flowers contain various sugars, coumarin derivatives *(e.g.*, umbelliferone, esculin, cicorin (esculetin 7-O-glucoside, scopoletin), silicic acid, taraxosterol, valeric acid, flavonoids (hyperoside), etheric oils and anthocyanins. The root contains 0.01–0.02% of the bitter intybin glycoside(whereby the herb contains between 0.1–2.0% of this chemical), 9–15% reducing sugars,and between 40–60% of inulin (as the plant energy store). The seeds contain abundant demulcent oils, a good source of both saturated and unsaturated fatty acids having the essential linoleic acid (18:2n-6) content of more than 76% of the total fatty acids profile which includes the monounsaturated oleic acid (18:1n-9), stearic acid (18:0), and palmitic acid (16:0). Relatively high levels of essential minerals such as potassium (K), calcium (Ca), magnesium (Mg), selenium (S), and zinc (Zn)

GINGER: It is the dried rhizomes of *Zingiber officinale,* belonging to family Zingiberaceae. It contains volatile oils, minerals, resins. Ginger oil contains zingiberine, bisaboline, curcumene. Resins contain phenolic keteones such as gingerols, shogoals, zingerone and other compounds. Ginger is commonly used for various types of "stomach problems," including motion sickness, morning sickness, colic, upset stomach, gas, diarrhea, irritable bowel syndrome (IBS), nausea, nausea caused by cancer treatment, nausea caused by HIV/AIDS treatment, nausea and vomiting after surgery, as well as loss of appetite. Other uses include pain relief from rheumatoid arthritis (RA), osteoarthritis, menstrual pain, and other conditions. However, there is not strong evidence to support the use of ginger for these conditions. Some people pour the fresh juice on their skin to treat burns. The oil made from ginger is sometimes applied to the skin to relieve pain. Ginger extract is also applied to the skin to prevent insect bites. In foods and beverages, ginger is used as a flavoring agent. In manufacturing, ginger is used as for fragrance in soaps and cosmetics. One of the chemicals in ginger is also used as an ingredient in laxative, anti-gas, and antacid medications.

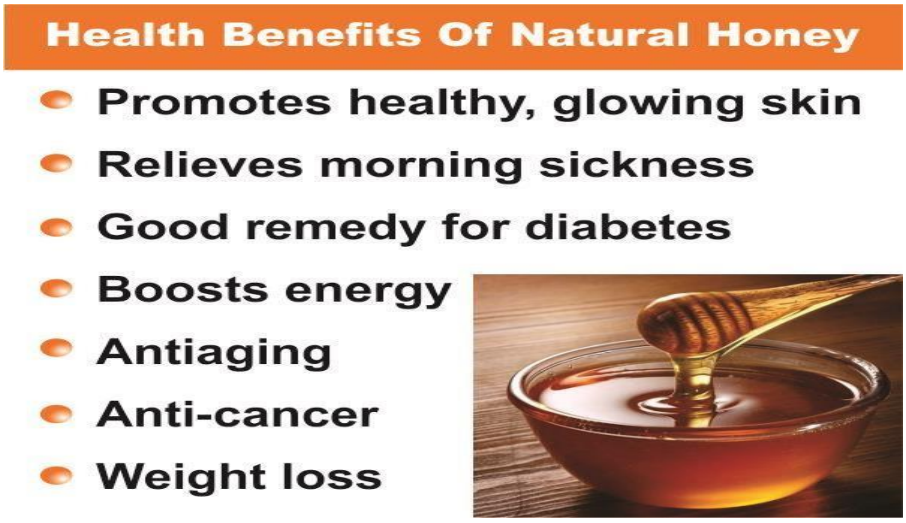
FENUGREEK: Fenugreek (*Trigonella foenum-graecum)* is a legume and it has been used as a spice throughout the world to enhance the sensory quality of foods. It is known for its medicinal qualities like antidiabetic, anticarcinogenic, hypocholesterolemic, antioxidant, immunological Activity etc. It contains alkaloids, flavonoids, coumarins, proteins, amino acids and steroidal saponins. Due to the presence of a substantial amount of fibre, phospholipids, glycolipids, oleic acid, linolenic acid, linoleic acid, choline, vitamin A, B1, B2, C, nicotinic acid, niacin, and many other functional elements, fenugreek seed is one of the hot ingredients in the health and wellness domain. The main ingredients of the seed contain steroidal saponins, alkaloids, mucilage, and fibres. The most important steroidal saponins are diosgenin and yamogenin. The seeds also contain a sapogenin peptide ester, named fenugreekine. Trigonelline is the alkaloid of this plant that has been extracted at up to 36% concentration.

The amount of protein in this plant is high (22-25%), and its protein is rich in lysine, arginine, tryptophan, and to some extent, histidine. It contains low levels of sulfur-containing amino acids, threonine, valine, methionine and high levels of lysine, arginine, and gelicin. 4-hydroxyisoleucine (4-HI) constitutes for about 80% of the total content of free amino acids in fenugreek seeds and are exclusively found in this plant. The amount of carbohydrates of this plant is about 8%. The seeds of fenugreek also contain proteinase inhibiting compounds. They are also reported to contain minerals such as iron, phosphate, calcium, and vitamins such as nicotinic acid, B1, C, A, and D. Fenugreek also contains galactomannan, a highly bioactive molecule.

GARLIC: It consists of dried bulbs of *Allium sativum*, belonging to the family Liliaceae. *Allium sativum* pulp contains vitamins especially B-1, vitamin C, vitamin A, flavonoids, ascorbic acid, phosphorous, potassium, sulphur, selenium, calcium, magnesium, germanium, sodium, iron,manganese and trace iodine. Garlic is being used from thousands of years for its medicinal properties. Numerous researches have proved its beneficial role in cardiovascular condition. Indeed, garlic does indeed have cardio-protective properties.

Researches also proved its active role as anticancer, natural immunity booster, antioxidant, antibiotic & anti-diabetic product. On other hand studies also report some side effects of garlic if it is used with blood-thinners, anti-HIV, or hypoglycemic drugs. It is found that garlic (pulp) contains more than 200 chemical compounds including volatile oil with sulphur-containing compounds like allicin, alliin, and ajoene. It also contains enzymes such as allinase, peroxidase and myrosinase. It is considered that Allicin is responsible for antibiotic properties and strong odor; it also shows fibrinolytic activity which reduces platelet aggregation by inhibiting prostaglandin.

HONEY: It is a sugar like secretion deposited in honey comb by the bees *Apis mellifera*, *Apis dorsata* and other species of Apis belonging to family- Apidae. The composition of honey is mainly sugars and water. In addition, it also contains several vitamins and minerals. The other constituents of honey are amino acids, antibiotic-rich inhibine, proteins, phenol antioxidants, and micronutrient. The sugars in honey are sweeter and give more energy than artificial sweeteners, and the most abundant sugar in honey is fructose. These substances are of nutritional and health importance. Some of the vitamins found in honey include ascorbic acid, pantothenic acid, niacin and riboflavin; along with minerals such as calcium, copper, iron, magnesium, manganese,phosphorus, potassium and zinc. Honey is an aquesous solution containing 35% glucose, 45% fructose and 2% sucrose. It is used as demulcent, sweetening agent, nutrient, antiseptic and expectorant.



AMLA: *Emblica officinalis* (*i.e., Phyllanthus emblica*/ Indian gooseberry/ Amla) has been used extensively as a nutraceutical in several diseases since it is known to boost immunity and offers numerous health benefits such as antioxidant, anti-inflammatory, and anti-aging effects. The antioxidants and vitamins found in amla berries offer several health benefits. High concentrations of vitamin C in amla helps the body recover from illness. Amla berries also include several flavonols, chemicals that have been linked to benefits like improved memory. Phytochemically, it is composed of several bioactive compounds such as flavonoids *(i.e,* Quercetin, Kaempferol), phenolic compounds (*i.e.,* gallic acid, methyl gallate, ellagic acid, trigallayl glucose), tannins *(i.e.,* Emblicanin A and B, phyllaemblicin B, punigluconin, pedunclagin, Chebulinic acid, Corilagin, Geraniin, Ellagotannin), amino acids (*i.e.,* glutamic

acid, aspartic acid, alanine, lysine, proline, cystine), fatty acids *(i.e.,* stearic acid, oleic acid, palmitic acid, myristic acid, linolenic acid, linoleic acid), alkaloids (*i.e.,* Phyllantine, Phyllembein, Phyllantidine), pectin, citric acid, ascorbic acid (Vitamin C), cellulose, gum, and albumin. It is used in the treatment of Anaemia, Diarrhoea, and Jaundice *etc*

GINGENG: It consists of roots of the plant *Panax gingeng* and other species of panax belonging to the family Araliaceae. Ginseng has tremendous role in boosting immunity against cancer, bacterial and viral infections and autoimmune diseases. Ginsenosides and polysaccharides are among the important constituent of ginseng that has immune boosting properties. It contains saponins, glycosides, volatile oils, sterols, polysaccharides, minerals vitamin-B, biotin etc. Ginseng has beneficial antioxidant and anti-inflammatory properties. Ginseng could help improve brain functions like memory, behavior and mood. Ginseng has been shown to benefit mental functions, feelings of calmness and mood in both healthy people and those with Alzheimer's disease. .

Ginseng has anti-carcinogenic (inhibits the development of cancer) properties. People who take it may be at lower risk for cancers in the stomach, ovaries, lungs, liver, colon, pancreas, and mouth. Ginseng is often used as an alternative therapy to help people with diabetes. Studies suggest that ginseng may help improve fasting blood glucose levels in people with and without diabetes.

ASHWANGANDHA: It consist of dried roots and stem bases of the plant *Withania somnifera* belonging to the family Solanaceae. The name "ashwagandha" is derived from two Sanskrit words: "ashwa" meaning "horse" and "gandha" meaning "smell," which roughly translates to "horse-like smell," or "horse essence," which could be a reference to the traditional belief that the root provides the strength, character, essence, or stamina of a stallion. Ashwagandha, has health benefits which are as follows such as it controls cholesterol levels, increases fertility in men, reduces anxiety, relieves stress, fights diabetes, controls hair fall, hinders, treat osteoporosis, rheumatic arthritis, treats cancer, increases blood production, prevents seizures, aids in muscle growth, stimulates the thyroid gland, reduces ocular diseases, anti-tumor, anti- inflammatory and antibacterial properties etc. Ashwagandha supplements can prove beneficialfor those suffering with infertility. From improving your libido to facilitating the production of testosterone. Diseases like Tuberculosis, Chronic upper respiratory diseases and HIV have been added to the list of Ashwangnadha due to its strong immune-stimulatory activity and it is recognized as blood tonic, especially in gynecological disorders including anemia and irregular menstruation.

SPIRULINA: Spirulina is a type of blue-green algae that contains a number of nutrients, including B vitamins, beta-carotene, and vitamin *E*. *Spirulina* also contains antioxidants, minerals, chlorophyll, and phycocyanobilin and is commonly used as a source of vegan protein.

Spirulina is a biomass of cyanobacteria (blue-green algae) that can be consumed by humans and animals. The two species are *Arthrospira platensis* and *A. maxima.* As an ecologically sound, nutrient-rich dietary supplement, spirulina is being investigated to address food security and malnutrition, and as dietary support in long-term space flight or Mars missions.

Its advantage for food security is that it needs less land and water than livestock to produce protein and energy. Dried spirulina contains 5% water, 24% carbohydrates, 8% fat, and about 60% (51–71%) protein (table). Provided in its typical supplement form as a dried powder, a 100-g amount of spirulina supplies 290 kilocalories (1,200 kJ) and is a rich source (20% or more of the Daily Value, DV) of numerous essential nutrients, particularly protein, B vitamins (thiamin, riboflavin, and niacin, providing 207%, 306%, and 85% DV, respectively), and dietary minerals, such as iron (219% DV) and manganese (90% DV).

The lipid content of spirulina is 8% by weight (table) providing the fatty acids, gamma-linolenic acid, alpha-linolenic acid, linoleic acid, stearidonic acid, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and arachidonic acid. Potential health benefits of Spirulina are mainly due to its chemical composition, which includes proteins, carbohydrates, essential amino acids, minerals (especially iron), essential fatty acids, vitamins, and pigments.

In this respect, three major bioactive components of Spirulina, the protein phycocyanin, sulfated polysaccharides, and γ-linolenic acid, seem to play significant roles in imparting improved human body functions. It boost the immunity and increases resistance to various infections. The antioxidant and anticancer properties has also been reported. It plays an important role in metabolic diseases like diabetes, hypertension and anemia.

HERBAL- DRUG AND HERB FOOD INTERACTIONS

Introduction: According to the World Health Organisation, herbal medicines are defined as 'finished, labelled medicinal products that contain as active ingredients aerial or underground parts of plants, or other plant material, or combinations thereof, whether in the crude state or as plant preparations. Plant material includes juices, gums, fatty oils, essential oils, and any other substances of this nature. Herbal medicines may contain excipients in addition to the active ingredients. Medicines containing plant material combined with chemically defined active substances, including chemically defined, isolated constituents of plants, are not considered to be herbal medicines. Thus, herbal medicines contain a combination of pharmacologically active plant constituents that are claimed to work synergistically to produce an effect greater than the sum of the effects of the single constituents.

There is a general belief by the public that herbal medicines are safe becausethey are natural. However, this is a hazardous oversimplification. Many different side effects to herbs have been reported and recently reviewed, including adverse events caused by herb- to-drug interactions. Since all herbal medicines are mixtures of more than one active ingredient, such combinations of many substances obviously increase the likelihood of interactions taking place. Hence, theoretically, the likelihood of herb-to-drug interactions is higher than drug-to-drug interactions, if only because synthetic drugs usually contain single chemical.

General introduction to interaction and classification: A drug interaction is a change in the action or side effects of a drug caused by concomitant administration with a food, beverage, supplement, or another drug. There are many causes of drug interactions. For example, one drug may alter the pharmacokinetics of another. Alternatively, drug interactions may result from competition for a single receptor or signaling pathway. The risk of a drug-drug interaction increases with the number of drugs used. Over a third (36%) of the elderly in the U.S. regularly uses five or more medications or supplements, and 15% are at potential risk of a significant drug-drug interaction. When two drugs are used together, their effects can be additive (the result is what you expect when you add together the effect of each drug taken

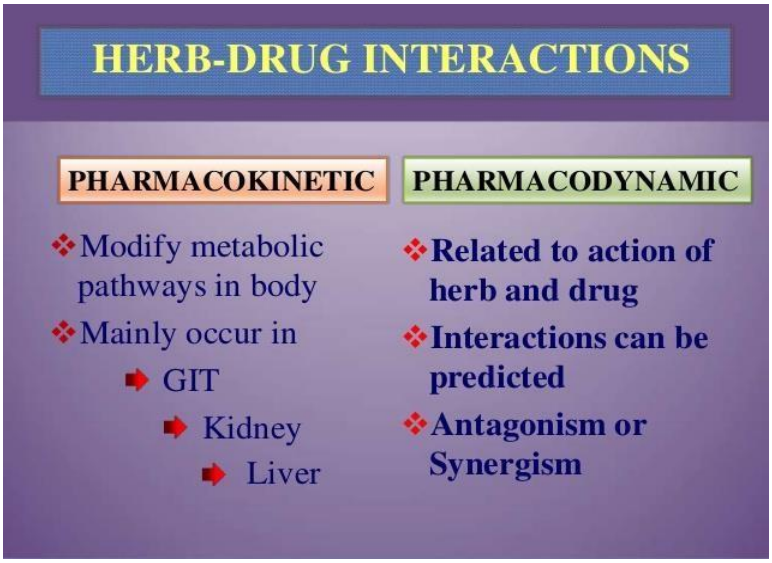
independently), synergistic (combining the drugs leads to a larger effect than expected), or antagonistic (combining the drugs leads to a smaller effect than expected). There is sometimes confusion on whether drugs are synergistic or additive, since the individual effects of each drug may vary from patient to patient. A synergistic interaction may be beneficial for patients, but may also increase the risk of overdose. Both synergy and antagonism can occur during different phases of the interaction between a drug, and an organism.

For example, when synergy occurs at a cellular receptor level this is termed agonism and the substances involved are termed agonists. On the other hand, in the case of antagonism, the substances involved are known as inverse agonists. The different responses of a receptor to the action of a drug has resulted in a number of classifications, such as "partial agonist", "competitive agonist" etc. These concepts have fundamental applications in the pharmacodynamics of these interactions. The proliferation of existing classifications at this level, along with the fact that the exact reaction mechanisms for many drugs are not well understood means that it is almost impossible to offer a clear classification for these concepts. It is even possible that many authors would misapply any given classification. Direct interactions between drugs are also possible and may occur when two drugs are mixed prior to intravenous injection.

For example, mixing thiopentone and suxamethonium in the same syringe can lead to the precipitation of thiopentone. The change in an organism's response upon administration of a drug is an important factor in pharmacodynamics interactions. These changes are extraordinarily difficult to classify given the wide variety of modes of action that exist, and the fact that many drugs can cause their effect through a number of different mechanisms. This wide diversity also means that, in all but the most obvious cases it is important to investigate, and understand these mechanisms. The well founded suspicion existsthat there are more unknown interactions than known ones.

A. MECHANISMS OF HERB-TO-DRUG INTERACTIONS:

Herb-to-drug interactions are based on the same pharmacokinetic (changes of plasma drug concentration) and pharmacodynamic (drugs interacting at receptors on target organs) principles as drug-to-drug interactions.



The pharmacokinetic interactions that have been identified so far all point towards the fact that a number of herbs, most notably St. John's wort, can affect the blood concentration of different conventional medicines that are metabolized by cytochrome P450 (CYP, the most important phase I drug-metabolizing enzyme system) and/or are transported by P-glycoprotein (a glycoprotein which influences drug absorption and elimination by limiting the cellular transport from the intestinal lumen into epithelial cells and by enhancing the excretion of drugs from hepatocytes and renal tubules into the adjacent luminal space). Polymorphisms in the genes for CYP enzymes and P-glycoprotein may influence the interactions mediated through these pathways [12]. Probe drugs used in pharmacokinetic trials include midazolam, alprazolam, nifedipine (CYP3A4), chlorzoxazone (CYP2E1), debrisoquine, dextromethorphan (CYP2D6), tolbutamide, diclofenac and flurbiprofen (CYP2C9), caffeine, tizanidine (CYP1A2) and omeprazole (CYP2C19). Fexofenadine, digoxin and talinolol have been extensively used in pharmacokinetic trials as P-glycoprotein substrates.

Pharmacodynamic interactions have been less studied but may be additive (or synergetic), i.e. the herbal medicines potentiate the pharmacological/toxicological action of synthetic drugs, or antagonistic, i.e. the herbal medicines reduce the efficacy of synthetic drugs. Warfarin interactions are a classical example of pharmacodynamic interactions. Theoretically, increased anticoagulant effects could be expected when warfarin is combined with coumarin-containing herbs (some plant coumarins exert anticoagulant effects) or with antiplatelet herbs. Conversely, vitamin K-containing herbs can antagonize the effect of warfarin (the action of warfarin is due to its ability to antagonize the cofactor function of vitamin K) entities.

A. MECHANISM OF FOOD – DRUG INTERACTIONS

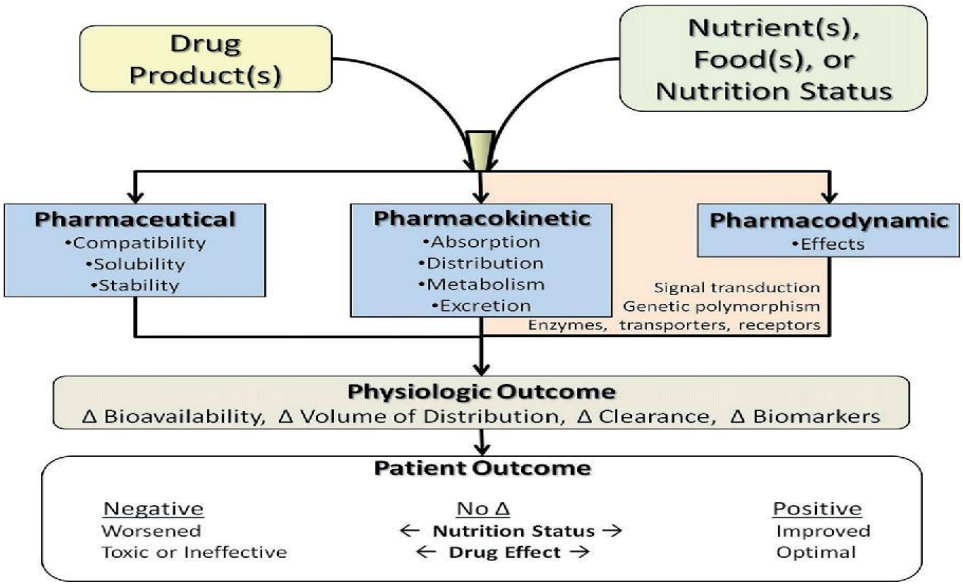
The effect of drug on a person may be different than expected because that drug interacts with another drug the person is taking (drug-drug interaction), food, beverages, dietary supplements the person is consuming (drug-nutrient/food interaction) or another disease the person has (drug-disease interaction). A drug interaction is a situation in which a substance affects the activity of a drug, *i.e.* the effects are increased or decreased, or they produce a new effect that neither produces on its own. These interactions may occur out of accidental misuse or due to lack of knowledge about the active ingredients involved in the relevant substances. Regarding food-drug interactions physicians and pharmacists recognize that some foods and drugs, when taken simultaneously, can alter the body's ability to utilize a particular food or drug, or cause serious side effects. Clinically significant drug interactions, which pose potential harm to the patient, may result from changes in pharmaceutical, pharmacokinetic, or pharmacodynamic properties. Some may be taken advantage of, to the benefit of patients, but more commonly drug interactions result in adverse drug events. Therefore it is advisable for patients to follow the physician and doctors instructions to obtain maximum benefits with least food-drug interactions.

Major side-effects of some diet (food) on drugs include alteration in absorption by fatty, high protein and fiber diets. Bioavailability is an important pharmacokinetic parameter which is correlated with the clinical effect of most drugs. However, in order to evaluate the clinical relevance of a food-drug interaction the impact of food intake on the clinical effect of the drug has to be quantified as well.

The most important interactions are those associated with a high riskof treatment failure arising

from a significantly reduced bioavailability in the fed state. Such interactions are frequently caused by chelation with components in food. In addition, the physiological response to food intake, in particular, gastric acid secretion, may reduce or increase the bioavailability of certain drugs.

Drug interactions can alter the pharmacokinetics and/or pharmacodynamics of a drug. The pharmacodynamic interaction may be additive, synergistic, or antagonistic effects of a drug. Drug interactions (DIs) represent an important and widely under recognized source of medication errors. The gastrointestinal absorption of drugs may be affected by the concurrent use



of other agents that have a large surface area upon which the drug can be absorbed, bind or chelate, alter gastric pH, alter gastrointestinal motility, or affect transport proteins such as P-glycoprotein.

- When a food affects medications in the body, this is called food-drug interaction. Food can prevent medicine from working the way it should and can cause medicinal side effects to becomebetter or worse and/or cause new side effects to occur. Drugs can also change the way the body uses food. There are a variety of food and drug interactions that can occur, but here is a small listof common drugs and how food affects the way they are used in the body. Green, leafy vegetables, which are high in vitamin K, can decrease how well aspirin thinsthe blood. Consuming the same amount of green-leafy vegetables each day will decrease this interaction.
- Grapefruit juice alters the way the body absorbs statins (cholesterol-lowering drugs) like Lipitor in the blood. It can cause these drugs to be absorbed in higher than normal amounts resulting in a greater risk of side effects.
- Calcium channel blockers are prescribed for high blood pressure and are also affected by grapefruit juice. Grapefruit juice changes the way this drug breaks down in the body and may cause overly high levels of the drug in the blood, raising the risk of side effects.
- Dairy products such as milk, yogurt and cheese decrease the absorption of antibiotics. Try to eat meals one to two hours before taking these to avoid this interaction.
- Alcohol affects insulin or oral diabetic pills. Alcohol prolongs the effects of these drugs, which leads to low blood sugar

- Moderate pain reliever drugs with acetaminophen should not be taken with alcohol because it has a higher chance of causing severe liver damage. Antihistamines, like Benadryl, should not be taken with alcohol because it will cause increased drowsiness.
- Vitamin K is vital for the production of clotting factors that help prevent bleeding, but anticoagulants like warfarin exert their effect by inhibiting vitamin K. Therefore, an increased intake of the nutrient can antagonize the anticoagulant effect and prevent the drug from working.
- Antithyroid drugs work by preventing iodine absorption in the stomach. A high-iodine diet requires higher doses of antithyroid drugs. The higher the dose of anti-thyroid drugs, the greater the incidence of side effects that include rashes, hives, and liver disease.
- Digoxin (Digitalis, Digitek, Lanoxin) is used to strengthen the contraction of the heart muscle, slow the heart rate, and promote the elimination of fluid from body tissues. Dietary fiber, specifically insoluble fiber such as wheat bran, can slow down the absorption of digoxin and lessen its effectiveness. To prevent this, elders should take digoxin at least one hour before or two hours after eating a meal. Herb use can also affect digoxin. For example, ginseng can elevate blood levels of digoxin by as much as 75%, while St. John's Wort decreases blood levels of this drug by 25%.

STUDY OF DRUGS AND THEIR SIDE EFFECTS AND INTERACTIONS

HYPERCIUM: St. John's Wort (*Hypericum perforatum*) extracts are widely used as a safe alternative to conventional antidepressant drugs for mild to moderate forms of depressive disorders. The herb contains numerous compounds with documented biological activity, including the naphthodianthrone hypericin, a broad range of flavonoids, and the phloroglucinol

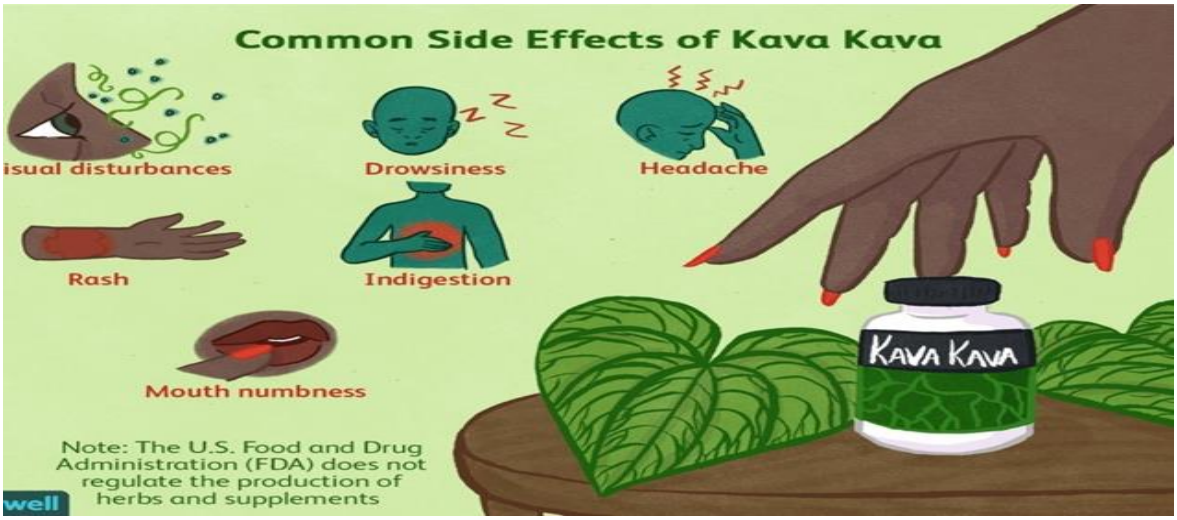
hyperforin, which inhibits the re-uptake of several brain neurotransmitters, including 5-hydroxytryptamine (5-HT, serotonin). Pharmacodynamic interactions may occur when St. John's wort is given together with drugs that enhance 5-HT signaling in the brain (e.g. 5-HT re-uptake inhibitors, 5-HT ligands).

St. John's wort has been shown to clinically interact with a number of conventional drugs mostly via these pharmacokinetic and/or pharmacodynamic mechanisms; such interactions take place with immunosuppressants (cyclosporine, tacrolimus, prednisone), hormones (oral pill, tibolone), cardiovascular drugs (the anticoagulants warfarin and phenprocoumon, the cardiac inotropic drug digoxin, the antilipidaemic drugs simvastatin, rosuvastatin and atorvastatin, the calcium blockers nifedipine and verapamil.

St. John's wart with warfarin (cause bleeding), serotonin uptake inhibitors (cause mild sserotonin syndrome), indinavir (decresed bioavalibilty) digitoxin, theophylline, cyclosporine, phenprocoumon and oral contraceptives reduces bioavailabilty. Concurrent uses of digioxin and St. John's wart may result in reduced digoxin efficacy.

KAVA- KAVA:(*Piper methysticum***):** Preparation from the rhizome and roots of Piper methysticum (Fam. Piperaceae) are used for the treatment of anxiety, and the available evidence suggests that kava extracts are superior to placebo for treating patients with anxiety disorders. Unfortunately, in the UK and various other European countries, the sale of kava is currently prohibited due to reports of potential hepatotoxicity. There are some BIG safety concerns about kava. Many cases of liver damage and even some deaths have been traced to kava use. As a result, kava has been banned from the market in Europe and Canada. This ban has hurt the economies of Pacific Island countries that export kava. Despite health concerns, kava has not been taken off the U.S. market. Some people take kava by mouth to calm anxiety, stress, and restlessness, and to treat sleeping problems (insomnia). It is also used for attention deficit-hyperactivity disorder (ADHD), withdrawal from benzodiazepine drugs, epilepsy, psychosis, depression, migraines and other headaches, chronic fatigue syndrome (CFS, common cold and other respiratory tract infections, tuberculosis, muscle pain, and cancer prevention.

Some people also take kava by mouth for urinary tract infections (UTIs), pain and swelling of the uterus, venereal disease, menstrual discomfort, and to increase sexual desire. Kava is applied to the skin for skin diseases including leprosy, to promote wound healing, and as a painkiller. It is also used as a mouthwash for canker sores and toothaches. Kava is also consumed as a beverage in ceremonies to promote relaxation. Kava affects the brain and other parts of the central nervous system. The kava-lactones in kava are believed to be responsible for its effects.

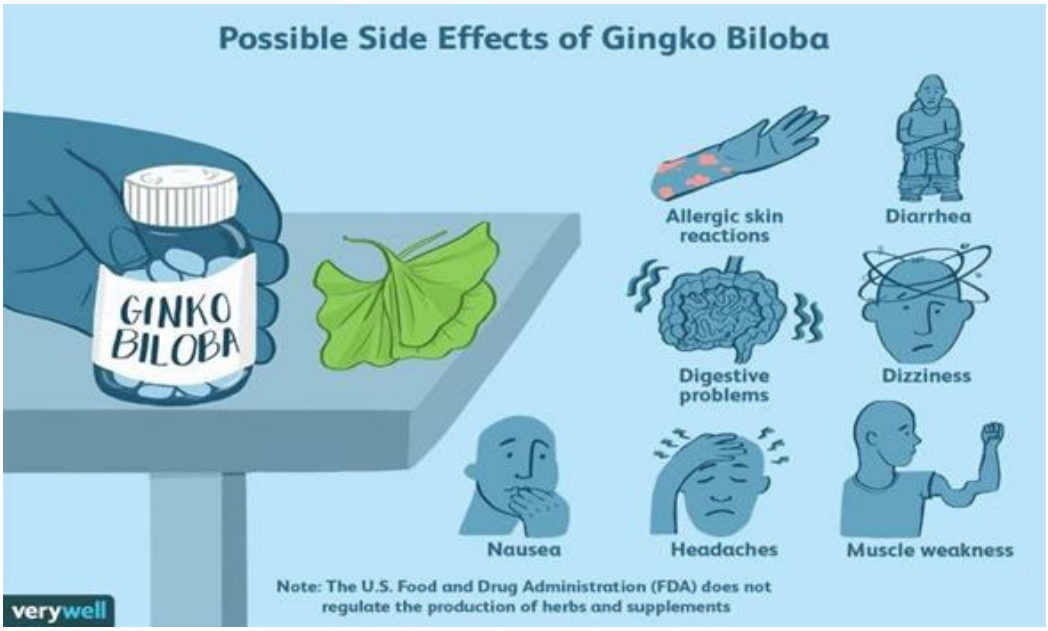


In vitro, kava-lactones, the active ingredients of kava, have been shown to be potent inhibitors of several enzymes of the CYP450 system. However, clinical trials have shown that, at therapeutic doses, kava inhibits CYP2E1 but not other CYP isoforms, such as CYP3A4, CYP2D6 or CYP1A2. Some possible pharmacodynamic interactions, highlighted by single case reports have been postulated to occur when combining kava with benzodiazepines, anti-Parkinson or antidepressant drugs. Kava has also been found to increase the likelihood of liver and kidney damage when used with acetaminophen, though the mechanism remains unknown.

GINKO-BILOBA: Ginkgo is a large tree with fan-shaped leaves. Although Ginkgo is a native plant to China, Japan, and Korea, it has been grown in Europe since around 1730 and in the United States since around 1784. The ginkgo tree is thought to be one of the oldest living trees, dating back to more .Ginkgo leaf is often taken by mouth for memory disorders including Alzheimer's disease. It is also used for conditions that seem to be due to reduced blood flow in the brain, especially in older people. These conditions include memory loss, dizziness, difficulty concentrating, and mood disturbances. Some people use it for leg pain when walking related to poor blood flow .The list of other uses of ginkgo is very long. This may be because this herb has been around for so *Ginkgo biloba* is one of the longest living tree species in the world. Ginkgo trees can live as long as a thousand years. Using ginkgo for asthma and bronchitis was described in 2600 BCE.

In manufacturing, ginkgo leaf extract is used in cosmetics. In foods, roasted ginkgo seed, which has the pulp removed, is an edible delicacy in Japan and China. Ginkgo seems to improve blood circulation, which might help the brain, eyes, ears, and legs function better. It may act as an antioxidant to slow down Alzheimer's disease and interfere with changes in the brain that might cause problems with thinking. Ginkgo seeds contain substances that might kill the bacteria and fungi that cause infections in the body. The seeds also contain a toxin that can cause serious side effects like seizures and loss of consciousness. Extracts from the leaves of the ginkgo tree (*Ginkgo biloba*, Family. Ginkgoaceae) are used for the treatment of cognitive impairments, dementia, intermittent claudication and tinnitus. The effect of ginkgo on various CYP isoforms as well as on P-glycoprotein has been investigated in a number of clinical trials by using different probe drugs, such as alprazolam, midazolam, diazepam, nifedipine (CYP3A4), caffeine (CYP1A2), chlorzoxazone (CYP2E1), debrisoquine (CYP2D6), tolbutamide, diclofenac,

flurbiprofen (CYP2C), omeprazole, voriconazole (CYP2C19), fexofenadine, digoxin and talinolol (P-glycoprotein substrates). It is often mentioned that ginkgo can interact with anticoagulant drugs. Clinical trials have also shown that ginkgo has no additive effect with aspirin on platelet aggregation, does not change the anti-platelet activity of clopidogrel and cilostazol.



GINSENG: *Panax quinquefolius* (Fam. Araliaceae), commonly known as 'American ginseng', is a herbaceous perennial herb native to North America. A clinical study showed that American ginseng reduced the anticoagulant effect of warfarin in healthy volunteers. On the other hand, two clinical trials have recently shown that American ginseng did not affect the pharmacokinetics of the antiretroviral drugs indinavir and zidovudine. *Panax ginseng* is a plant that grows in Korea, northeastern China, and far eastern Siberia.

People use the root to make medicine. Do not confuse *Panax ginseng* with American ginseng, Siberian ginseng, or Panaxpseudoginseng. See the separate listings for American Ginseng, Ashwaganda, Blue Cohosh, Canaigre, Codonopsis, Panax Pseudoginseng, and Siberian Ginseng. Panax ginseng is taken by mouth to improve thinking, concentration, memory, Alzheimer's disease work efficiency, physical stamina, preventing muscle damage from exercise, and athletic endurance. Some people use Panax ginseng to help them cope with stress and as a general tonic for improving well-being. They sometimes call Panax ginseng an "adaptogen"

when it's used in this way. *Panax ginseng* is also used for depression anxiety, general fatigue and chronic fatigue syndrome (CFS), multiple sclerosis for boosting the immune system, and for fighting particular infections in a lung disease called cystic fibrosis. These infections are caused by a bacterium named Pseudomonas. Some people use Panax ginseng to treat breast cancer and prevent ovarian cancer, liver cancer, lung cancer and skin cancer.

Other uses include treatment of anemia, chronic bronchitis, swine flu, prediabetes and diabetes, inflammation of the stomach lining (gastritis), fever, hangover, chronic obstructive pulmonary disease (COPD), HIV/AIDS, fertility problems and sexual dysfunction in men, to increase sexual arousal in women, and asthma.

Panax ginseng is also used for bleeding disorders, loss of appetite, vomiting, intestinal problems, gallstones, bad breath, fibromyalgia, sleeping problems (insomnia), nerve pain, joint pain, dizziness, headache, hearing loss, convulsions, disorders of pregnancy and childbirth, hot flashes due to menopause, common cold and flu, heart failure, high blood pressure, quality of life, wrinkled skin, and to slow the aging process.

Some men apply Panax ginseng to the skin of the penis as part of a multi-ingredient product for treating early orgasm (premature ejaculation).In manufacturing, Panax ginseng is used to makesoaps, cosmetics, and as a flavoring in beverages. Panax ginseng contains many active substances. The substances thought to be most important arecalled ginsenosides or panaxosides. Ginsenosides is the term coined by Asian researchers, andthe term panaxosides was chosen by early Russian researchers. Panax ginseng is often referred toas a general well-being medication, because it affects many different systems of the body.

GARLIC: (*Allium sativum* L., Fam. Alliaceae) is used in modern phytotherapy to treat hypercholesterolaemia and prevent arteriosclerosis although the clinical evidence is far from compelling. Garlic is an herb that is grown around the world. It is related to onion, leeks, and chives. It is thought that garlic is native to Siberia, but spread to other parts of the world over 5000 years ago. Garlic is used for many conditions related to the heart and blood system. These conditions include high blood pressure, low blood pressure, high cholesterol, inherited high cholesterol, coronary heart disease, heart attack, reduced blood flow due to narrowed arteries, and "hardening of the arteries" (atherosclerosis). Some people use garlic to prevent colon cancer,

rectal cancer, stomach cancer, breast cancer, prostate cancer, multiple myeloma, and lung cancer. It is also used to treat prostate cancer and bladder cancer.

Garlic has been tried for treating an enlarged prostate (benign prostatic hyperplasia; BPH), cystic fibrosis, diabetes, osteoarthritis, hay fever (allergic rhinitis), and traveler's diarrhea, high blood pressure late in pregnancy (pre-eclampsia), yeast infection, flu, and swine flu. It is also used to prevent tick bites, as a mosquito repellant, and for preventing the common cold, and treating and preventing bacterial and fungal infections. Garlic is also used for earaches, chronic fatigue syndrome, menstrual disorders, abnormal cholesterol levels caused by HIV drugs, hepatitis, shortness of breath related to liver disease, stomach ulcers caused by *H. pylori* infection, exercise performance, exercise-induced muscle soreness, a condition that causes lumps in the breast tissue called fibrocystic breast disease, a skin condition called scleroderma, and lead toxicity.

Other uses include treatment of fever, coughs, headache, stomach ache, sinus congestion, gout, joint pain, hemorrhoids, asthma, bronchitis, shortness of breath, low blood sugar, snakebites, diarrhea and bloody diarrhea, tuberculosis, bloody urine, a serious nose and throat infection called diphtheria, whooping cough, tooth sensitivity, stomach inflammation (gastritis), scalp ringworm, and a sexually transmitted disease called vaginal *trichomoniasis*. It is also used for fighting stress and fatigue. Some people apply garlic oil to their skin or nails to treat fungal infections, warts, and corns. It is also applied to the skin for hair loss and thrush. Garlic is used in the vagina for yeast infections. Garlic is injected into the body for chest pain. In foods and beverages, fresh garlic, garlic powder. Garlic produces a chemical called allicin. This is what seems to make garlic work for certain conditions.

Allicin also makes garlic smell. Some products are made "odorless" by aging the garlic, but this process can also make the garlic less effective. It's a good idea to look for supplements that are coated (enteric coating) so they will dissolve in the intestine and not in the stomach. Garlic preparations include garlic powder standardized to contain 1.3% alliin and 0.6% allicin, garlic aged extract, which does not contain allicin but is high in water soluble phytochemicals, such as diallyl sulphides and garlic oil (i.e. essential oil obtained from the distillation of the cloves). Two garlic preparations, namely garlic oil and garlic powder, have been evaluated for their potential to affect CYP enzymes in clinical trials. The results suggest that garlic oil may selectively inhibit CYP2E1, but not other CYP isoforms (such as CYP1A2, CYP3A4 or CYP2D6) and that garlic

powder has no effect on CYP3A4. Recently, it has been shown that a 21-day garlic treatment (aged garlic extract) induces intestinal expression of P-glycoprotein without affecting intestinal or hepatic CYP34A in humans

PEPPER: The black pepper (*Piper nigrum* Linn.) vine and its extracts have been used as a folk medicine in a variety of cultures and are the source of the most commonly used spice worldwide. Black pepper and white pepper are made from the *Piper nigrum* plant. Black pepper is ground from dried, whole unripe fruit. White pepper is ground from dried, ripe fruit that has had the outer layer removed. The black pepper and white pepper powder are used to make medicine. People take black pepper for stomach upset, bronchitis, and cancer. They take white pepper for stomach upset, malaria, cholera, and cancer. Black pepper is sometimes applied directly to the skin for treating nerve pain (neuralgia) and a skin disease called scabies. Black pepper and white pepper are also used topically as a counterirritant for pain.

In foods and beverages, black pepper, white pepper, and pepper oil (a product distilled from black pepper) are used as flavoring agents. Black and white pepper might help fight germs (microbes) and cause the stomach to increase the flow of digestive juices. There is conflicting evidence about their role in cancer. Some evidence suggests pepper might protect against colon cancer, but other evidence suggests it might promote liver cancer. The chemical piperine is a major bioactive component present in black pepper (and white pepper as well) that has numerous

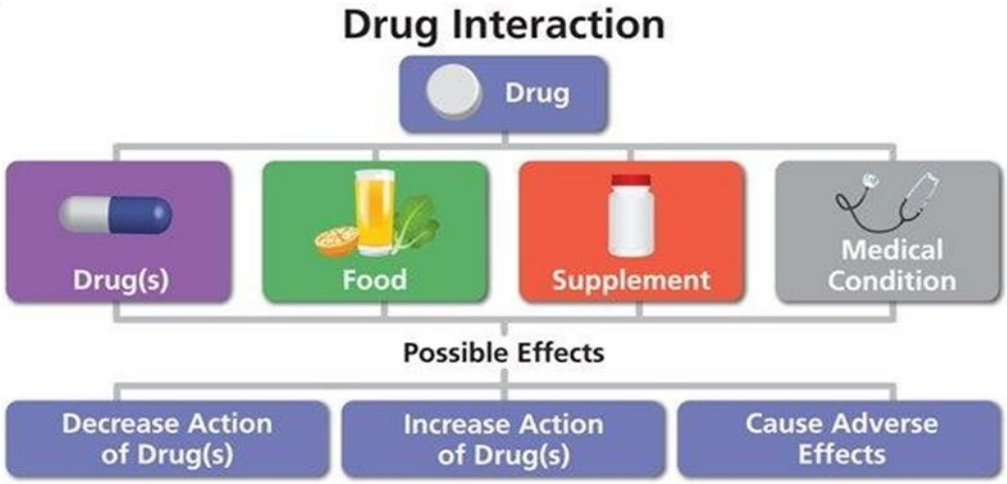
reported physiological and drug-like actions. The various evidences show that black pepper may have health benefits, particularly in enhancing digestive tract function. There is suggestive evidence that black pepper piperine may have nervous system benefits and may influence body energy usage in rats. Preliminary evidence in cell culture studies suggests that black pepper contains antioxidant constituents and possesses anti-inflammatory and antimicrobial properties.

EPHEDRA: Ephedra is an herb. Usually, the branches and tops are used to make medicine, but the root or whole plant can also be used. Ephedra is banned in the U.S. due to safety concerns Ephedra is used for weight loss and obesity and to enhance athletic performance. It is also used for allergies and hay fever; nasal congestion; and respiratory tract conditions such as bronchospasm, asthma, and bronchitis. It is also used for colds, flu, swine flu, fever, chills, headache, inability to sweat, joint and bone pain, and as a “water pill” to increase urine flow in people who retain fluids**.** Ephedra contains a chemical called ephedrine. Ephedrine stimulates the heart, the lungs, and the nervous system**.** The risks of using ephedrine-containing supplements appear to outweigh the benefits.

Consequently, patients should be advised not to use these products if they are sensitive to the effects of sympathomimetic agents. Such patients include those with hypertension, hyperthyroidism, diabetes mellitus, psychiatric conditions, glaucoma, prostate enlargement, seizure disorders and cardiovascular disease. Concomitant use of ephedrine-containing products and caffeine or other stimulants should also be discouraged.

Side Effects of Select Herbal Products

Herbl product	**Side effects**
Ginkgo biloba	Bleeding
St. John's wort	Gastrointestinal disturbances, allergic reactions, fatigue, dizziness, confusion, drymouth, photosensitivity
Ephedra (ma huang)	Hypertension, insomnia, arrhythmia, nervousness, tremor, headache, seizure,cerebrovascular event, myocardial infarction, kidney stones
Kava	Sedation, oral and lingual dyskinesia, torticollis, oculogyric crisis, exacerbation of Parkinson's disease, painful twisting movements of the trunk, rash



Herbal product	Interacting drugs
Ginkgo biloba	Aspirin, warfarin (Coumadin), ticlopidine (Ticlid), clopidogrel (Plavix), dipyridamole(Persantine)
St. John' s wort	Antidepressants
Ephedra	Caffeine, decongestants, stimulants
Ginseng	Warfarin
Kava	Sedatives, sleeping pills, antipsychotics, alcohol

Long Answer type Questions (10)

1. Write in detail about the current status and scope of nutraceuticals in a global market.

2. Discuss in detail about the various nutraceuticals products available in the market and their role in prevention of various ailments.

3. What do you mean by drug interactions and discuss the side effects of following herbs:

a. Hypercium

b. Ginseng

c. Ginko biloba

d. Pepper

4. Write a brief note on Herbs as heath food with an appropriate examples.

Short Answer type Questions (5)

1. Discuss the health benefits of nutraceuticals in the treatment of Cancer.

2. Write down the different types of herbal interactions?

3. Give health benefits of Spirulina and Alfa-alfa.

4. Write a short note on Ginseng and Honey as a health food.

5. Discuss about the interactions of Garlic with other drugs.

6. Write short note on Dietary supplements.

7. Discuss the health benefits of nutraceuticals in the treatment of Diabetes and Irritable bowel syndrome.

8. Discuss the drug interaction of St. John's wort with other drugs.

7. Discuss the health benefits of Nutraceuticals in the management of GIT and IBD.

Very short Answer type Questions (2)

1. What is health food?
2. Define Nutraceuticals.
3. Give uses of Spirulina.
4. What do you mean by PUFA.
5. Difference between Prebiotics and Probiotics.
6. What are Antioxidants.
7. Mention the role of Vitamins as a health food.
8. Give uses of Chicory.
9. Give classification of Nutraceuticals
10. What do you mean by Pharmacokinetic and Pharmacodynamic interactions?
11. What are functional foods?
12. How probiotics are helpful in maintain the gut health?
13. Give uses of Fenugreek.
14. What are fortified nutraceuticals?
15. Mention side effects of Hypercium.