

HERBS AND SPICES FOR HEALTH AND WELLNESS



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The tenet "Let food be thy medicine and medicine be thy food" was put forward by Hippocrates, the father of modern medicine. The "food as medicine" concept even though not new, the past decade witnessed a growing global interest on food and health and there was massive explosion of research on health products especially nutraceuticals and functional foods. The governmental agencies and food industries are also responding to the growing health concerns to promote health and wellness.

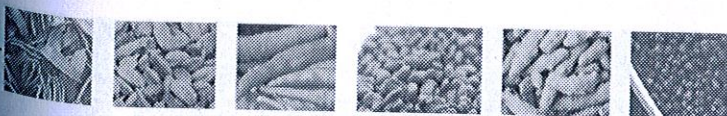
Herbs and spices, the predominant flavouring,

colouring and aromatic agents in foods and beverages could contribute a lot to health and wellness due to their multiple health beneficial effects and as sources of natural colour, flavour, anti-microbial properties and anti oxidants. Biologically active compounds in herbs and spices are the secondary metabolites and they include alkaloids, glycosides, flavones, saponines, gums and volatile oils.

The International Standard Organisation (ISO) defines spices and condiments as vegetable products or mixtures there of, free from extraneous matter, used for flavouring, seasoning and imparting aroma to foods. Herbs, in this context, are defined as plant materials (leaf, tender stem, flowering tops etc.) of aromatic plants used to impart flavour, aroma

and taste to food.

As per ISO, there are 109 spices and condiments, of which 52 spices, approved by the Spices Act of Government of India are grown in the country. India, is known world over as the "land of spices" and cultivation of spices started in India from time immemorial. It was the fame of Indian spices that attracted the explorers, invaders and traders of various lands to Indian shores. India, with the varied climatic and soil conditions is the natural home of many spices and produces spices with high intrinsic qualities. Spices play a vital role in the national economy of India. India is the largest producer, consumer and exporter of spices in the world, contributing 86 per cent of global spice production followed by China (four per





cent), Bangladesh (three per cent), Pakistan (two per cent), Turkey (two per cent) and Nepal (one per cent). The domestic market in India absorbs 90 per cent of the spices produced in the country and the rest is exported. India enjoys a formidable position in world spice trade with 47 per cent share in volume and 40 per cent share in value. India has the monopoly in the supply of spice oils and oleoresins and is a major supplier of curry powders, spice powders, spice mixes and spices in consumer packs. India exported 373,750 tonnes of spices in 2006-07, fetching a foreign exchange of Rs. 35760 million. Spices from India are mainly exported to America followed by European Union, East Europe, East and West Asia and Africa. The highest export earning was from mint products (Rs.11010 million), followed by chillies (Rs.8080), black pepper (Rs.3060 million), cumin (Rs. 2010 million) and turmeric (Rs.1650 million).

USES OF SPICES - CHANGING SCENARIO

Spices played a prominent role in all ancient civilizations that prevailed in China-India, Greece-Rome and Babylon-Egypt. The first authentic record on the uses of spices dates back to the pyramidal age in Egypt. During the period, onion and

garlic were fed to workers to preserve their health and cinnamon was used to embalm the dead. Spices were valued for their medicinal properties during early times and there were mentions about medicinal uses of spices in Charaka Samhita and Susrutha Samhitha. The first use of spices in food was as preservatives due to their antimicrobial properties, to preserve meat. With the advent of refrigeration, the demand for spices as a preservative in the western world decreased. In the passage of time, spices became indispensable in the culinary art of cooking to enhance flavour and taste of foods and beverages. With the development of extraction procedures for the extraction of spice extracts, spices were extensively used in perfumery, cosmetics and pharmaceutical industries. In the globalization era, due to consumer resistance to chemical additives, spices became all the more important as sources of natural colours, flavours, antimicrobials and antioxidants in food industry. The cosmetic industry also showed tremendous growth in the use of herbal and natural plant products and the importance of spices like turmeric, saffron, coriander, basil, fenugreek etc. increased in this sector. In the emerging nutraceutical and wellness

industry, herbs and spices could play a pivotal role with their proven therapeutic uses, scientific validation and safety evaluation of the reported therapeutic properties and health promoting and health beneficial attributes.

Bio prospecting of herbs and spices could isolate new and novel therapeutic molecules. This area of research has got high impetus around the world. Classical example of such a study is the Piperine alkaloid isolated from black pepper and marketed as Bioperine (98 per cent pure piperine). This alkaloid could increase bioavailability of certain drugs and nutrients like β carotene.

Bioinformatics play an essential role in the *in silico* analysis of active compounds from herbs and spices, screening of new drugs and studies on their biological activities. The bioinformatic approaches consequently provide a new insight for treatment of various diseases using traditional drugs from spices and herbs. Further, creation of a data base on the topic through bioinformatic tools will help strengthening the research and developmental activities in this field.

The medicinal uses of herbs and spices, uses of spices in

foods and beverage industries, in nutraceutical and health food industry and role of bioinformatics on biomolecule separation and drug designing are briefly dealt here under:

SPICES IN TRADITIONAL MEDICINE

The medicinal properties of spices were known to mankind from time immemorial. Spices were used extensively in the traditional systems of medicines like Ayurveda, Sidha and Unani. Some of the spices are inevitable ingredients in indigenous medicines. Long pepper, black pepper and ginger are the widely used spices in Ayurvedic system of medicine. Spices not only have their own therapeutic role, but also enhance the absorption and utilization of other therapeutic substances administered along with them. They are prepared in a number of ways to extract their active ingredients for internal and external uses. Extracts from herbs and spices are used as infusions, decoctions, macerations, tinctures, fluid extracts, teas, juices, syrups, poultices, oils, ointments and powders. Many spices used in Ayurveda have multiple bioactive principles. The most commonly used spices and their medicinal properties are given in Table 1.

The essential oils of many

herbs and spices are used now-a-days in aroma therapy for curing ailments like aches and pains and emotional problems like depression, stress and anxiety. The essential oil of coriander and pepper mint is analgesic, dill and anise oils are antipyretic, coriander, celery, parsley, cumin and ginger oils are anti-inflammatory. Recently anticarcinogenic property is reported for essential oils of cumin and basil. They can be used as protective agents against carcinogenesis. Also, methanol extracts of allspice, marjoram, tarragon and thyme strongly inhibited platelet aggregation induced by collagen in human beings.

SPICES IN FOODS AND BEVERAGES INDUSTRIES

In foods and beverages industries, spices find application as sources of natural colour, flavour, antimicrobials and antioxidants.

Spices as sources of natural colour

The food sector is now experiencing a trend back towards natural colours due to changes in legislation and consumer preference, as synthetic food colours pose health hazards like cancer, asthma, allergy, hyperacidity and thyroidism. But low tinctorial power, poor stability (to changes in pH, oxygen, heat

and light), low solubility, off flavour and high cost limit the use of natural colours. These problems can be overcome by improving the traditional extraction methods using enzymes, microorganisms, super critical CO_2 , membrane processing and encapsulation techniques.

Before synthetic colours came into existence, spices like chilli, saffron, turmeric etc. were used in Indian cuisines to add colour. Central Food Technological Research Institute of India (CFTRI) developed technologies for the manufacture of certain natural food colours such as kokum (red) and chillies (red). Kokum contains two-three per cent anthocyanin and is regarded as a natural colour source for acidic foods. Garcinol is the fat soluble yellow pigment isolated from rind of kokum fruit. Garcinol is added at 0.3 per cent level to impart an acceptable yellow colour to butter. Colour components present in spices and natural shades available with spices are presented in Table 2.

SPICES AS SOURCES OF NATURAL FLAVOURS

The increasing demand in developed countries for natural flavour offers tremendous potential for spices as sources of natural flavours. Spices are

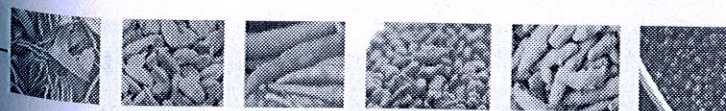
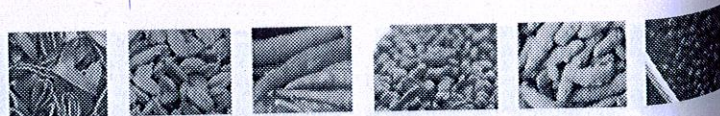




Table 1. MEDICINAL PROPERTIES OF SPICES

Spices	Medicinal properties
Black pepper	Carminative, antipyretic, diuretic, anthelmintic, anti-inflammatory and antiepileptic
Cardamom	Antidepressive, carminative, appetizer, diuretic
Ginger	Carminative, anti-nauseant, diuretic, antifatulence, antihistaminic, aphrodisiac and cholesterol lowering
Turmeric	Carminative, antibiotic, antifatulence, antiseptic and anti-inflammatory
Garlic	Antimicrobial, diuretic, diaphoretic, antifatulence, cholesterol lowering and anti-inflammatory
Clove	Antiflatulence, analgesic, stimulant, carminative and anti-nauseant
Nutmeg	Stimulant, carminative, astringent, aphrodisiac, anti-inflammatory
Cinnamon	Stimulant, Carminative, astringent, aphrodisiac, anti-inflammatory
Chilli	Carminative and antirheumatic
Saffron	Stimulant, stomachic and anticarcinogenic
Allspice	Stimulant, digestive and carminative
Basil, sweet	Stomachic, anthelmintic, diaphoretic, expectorant, antipyretic carminative, stimulant, diuretic, demulcent
Bayleaves (laurel)	Stimulant, narcotic
Caraway	Stomachic, carminative, anthelmintic, lactagogue
Celery	Stimulant, tonic, diuretic, carminative, emmenagogue, anti-inflammatory
Chive	Stimulant, diuretic, expectorant, aphrodisiac, emmenagogue, anti-inflammatory
Coirander	Carminative, diuretic, tonic, stimulant, stomachic, refrigerent, aphrodisiac, analgesic, anti-inflammatory
Cumin	Stimulant, carminative, stomachic, astringent and antiseptic
Dill	Carminative, stomachic, antipyretic
Fennel	Stimulant, carminative, stomachic, emmenagogue
Fenugreek	Carminative, tonic, aphrodisiac
Leek	Stimulant, expectorant
Marjoram	Carminative, expectorant, tonic, astringent
Mint (peppermint)	Stimulant, stomachic, carminative, antiseptic
Mint (spearmint)	Stimulant, carminative and antispasmodic
Oregano	Stimulant, carminative, stomachic, diuretic, diaphoretic and emmenagogue
Parsley	Stimulant, diuretic, carminative, emmenagogue, antipyretic, anti-inflammatory
Rosemary	Mild irritant, carminative, stimulant, diaphoretic
Sage	Mild tonic, astringent, carminative
Tarragon	Aperient, stomachic, stimulant, febrifuge
Thyme	Antispasmodic, carminative, emmenagogue, anthelmintic, spasmodic, laxative, stomachic, tonic, vermifuge



Table 2. COLOUR COMPONENTS IN SPICES

Colour component	Tint	Spice
Carotenoid		
β -carotene	Reddish orange	Red pepper, mustard, paprika, saffron
Cryptoxanthin	Red	Paprika, red pepper
Lutin	Dark red	Paprika, parsley
Zeaxanthin	Yellow	Paprika
Capsanthin	Dark red	Paprika, red pepper
Capsorubin	Purple red	Paprika, red pepper
Crocetin	Dark red	Saffron
Neoxanthin	Orange yellow	Parsley
Violaxanthin	Orange	Parsley, Sweet pepper
Crocin	Yellowish orange	Saffron
Flavonoids	Yellow	Ginger
Curcumin	Orange yellow	Turmeric
Chlorophylls	Green	Herbs

Source: Ravindran *et al.* (2002)

added to foods in several forms like whole spices, ground spices and spice extracts. As spice extracts are highly concentrated, they are either encapsulated or emulsified in edible bases like salt or dextrose for getting uniform dispersion of the extracts in food materials. The main flavour compounds present in herbs and spices are presented in Table 3.

Extraction of oils and oleoresins is accomplished using a range of methods, including steam distillation, hydrocarbon extraction, chlorinated solvent extraction, enzymatic treatment and fermentation, super critical carbon dioxide extraction. Carbon dioxide extraction from

solid botanicals is now adopted on a commercial scale. The resulting extract is with no solvent residue, less terpenes and enhanced black notes. Enzymatic treatment and fermentation of raw botanicals also result in higher yields and quality of essential oil. More recently, the use of genetic engineering and recombinant DNA technology have resulted in *in vitro* production of natural esters, ketones and other flavouring materials. Cloning and single cell culture techniques are also of benefit to the flavourists.

SPICES AS SOURCES OF NATURAL ANTIOXIDANTS

Antioxidants are added to

foods to preserve the lipid components from quality deterioration. Synthetic antioxidants like butylated hydroxy anisole (BHA) butylated hydroxy toluene (BHT), propyl gallate (PG) and tert-butyl hydroquinone (TBHQ) are the commonly used ones. Due to their suspected action as promoters of carcinogenesis, there is growing demand for natural antioxidants. Antioxidants also play a role in defence mechanism of the body against cardiovascular diseases, cancer, arthritis, asthma and diabetes. Many herbs and spices are known as excellent sources of natural antioxidants and consumption of fresh herbs in the diet may therefore contribute to the daily antioxidant intake. Phenolic compounds are the primary antioxidants present in spices and there existed a linear relationship between the total phenolic content and antioxidant properties of spices. Essential oils, oleoresins and even aqueous extracts of spices possess antioxidative properties.

The plants of the Lamiaceae family are universally considered as important sources of natural antioxidants. Rosemary is widely used as antioxidant in Europe and the US. Oregano, thyme, marjoram,

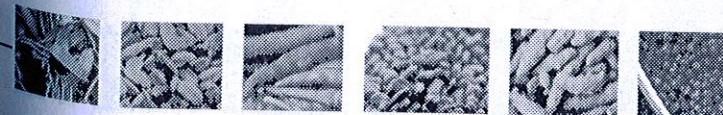




Table 3 IMPORTANT FLAVOUR COMPOUNDS IN SPICES

Spices	Important flavour compounds
Allspice	Eugenol, β -caryophyllene
Anise	(E)-anethole, methyl chavicol
Black pepper	Piperine, S-3 Carene, β -caryophyllene
Caraway	d-carvone, crone derivatives
Cardamom	α -terpinyl acetate, 1-80-cineole, linalool
Cinnamon, cassia	Cinnamaldehyde, eugenol
Chilli	Capsaicin, dihydro capsaicin
Clove	Eugenol, eugenyl acetate
Coriander	d-linalool, C10-C14-2-alkenals
Cumin	Cuminaldehyde, p-1,3-mentha-dienal
Dill	d-carvone
Fennel	(E)-anethole, fenchone
Ginger	Gingerol, Shogaol, neral, geranial
Mace	α -pinene, sabinene, 1-terpenin-4-ol.
Mustard	Ally isothiocyanate
Nutmeg	Sabinene, α -pinene, myristicin
Parsley	Apiol
Saffron	Safranool
Turmeric	Turmerone, Zingiberene, 1,8-cineole
Vanilla	Vanillin, p-OH-benzyl-methyl ether
Basil, Sweet	Methylchavicol, linalool, methyl eugenol
Bay laurel	1,8-cineole
Marjoram	e- and t-sabinene hydrates, terpinen-4-ol
Oregano	Carvacrol, thymol
Origanum	Thymol, carvacrol
Rosemary	Verbenone, 1-8-cineole, camphor, linanool
Sage, Clary	Salvial-4 (14)-en-1-one, linalool
Sage, Dalmation	Thujone, 1,8-cineole, camphor
Sage, Spanish	e-and t-sabinylacetate, 1,8-cineole, camphor
Savory	Carvacrol
Tarragon	Methyl chavicol, anethole
Thyme	Thymol, carvacrol
Peppermint	1-menthol, menthone, menthuran
Spear mint	1-carvone, carvone derivatives

sage, basil, fenugreek, fennel, coriander and pimento also possess antioxidant properties better than that of synthetic antioxidant butylated hydroxy

toluene. Important natural antioxidants and components responsible for the property are presented in Table 4.

SPICES AS SOURCES OF NATURAL ANTIMICROBIALS

Herbs and spices are important sources of antimicrobials and the use of spices, their essential oils or active ingredients for controlling microbial growth in food materials constitutes an alternate approach to chemical additives. Some of the spice essential oils (individual or combinations) are highly inhibitory to selected pathogenic and spoilage micro organisms. The fractionation of essential oils and further application help to improve the level of activity in some cases. The optical isomers of carvone from *Mentha spicata* and *Anethum sowa* (Indian dill) were highly active against a wide spectrum of human pathogenic fungi and bacteria than the essential oils as such. Mixing compounds like carvacrol and thymol at different properties may exert total inhibition of *Psuedomonas aeruginosa* and *Staphylococcus aureus*. The inhibition is due to damage in membrane integrity which further affects pH homeostasis and equilibrium of inorganic ions. Such a knowledge on the mode of action helps for the successful application of spice extracts/ingredients in foods. Also, application of active ingredients instead of essential



Table 4- ANTIOXIDANTS ISOLATED FROM HERBS AND SPICES

Spices	Antioxidants
Black pepper	Phenolic amides, flavonoids
Ginger	Gingerol
Turmeric	Curcumin
Red pepper	Capsaicin
Chilli pepper	Capsaicin, capsaicinol
Clove	Eugenol
Rosemary	Carnosic acid, carnosol, rosmarinic acid, rosmanol
Sage	Carnosol, carnosic acid, rosmanol, rosmarinic acid
Oregano	Derivatives of phenolic acid, flavonoids, tocopherols
Thyme	Carvacrol thymol, p-cymene, caryophyllene, carvone borneol
Summer savory	Rosmarinic acid, carnosol, carvacrol, thymol
Marjoram	Flavanoides
Allspice	Pimentol

oil will not cause much flavour change to the food stuff.

Of the various herbal spices, oregano and thyme are showing highest antimicrobial activities. Carvacrol present in essential oils of oregano and thyme is proved to be the most important fungitoxic compound. The activity of herbal spices against fungi and bacteria and the mode of application is given in Table 5.

SPICES IN COSMETICS AND PERFUMERY INDUSTRIES

The importance of spices in cosmetics, perfumery and body care are well known from ancient days. The cosmetics and

perfumery industries are employing oils of many spices for blending with other volatile and fixed oils to make high quality perfumes. The toiletries and allied industries also make use of spices and their fragrant oils for manufacture of soaps, tooth pastes, talcum powder, after shave lotions, freshness sachets, toilet waters, powders and hair oils. The uses of spices in cosmetic industry is furnished in Table 6.

SPICES IN NUTRACEUTICAL AND HEALTH FOOD INDUSTRY

In the nutraceutical and health food industry, the anti-

diabetic, anti-hypercholesterolemic, anti-carcinogenic, anti-inflammatory effects of spices have paramount importance, as the key health issues of mankind now-a-days are diabetes, cardio-vascular diseases, arthritis and cancer. Extensive investigations undertaken at Central Food Technological Research Institute, of India revealed the multiple health beneficial effects of spices. Safety evaluation studies conducted in animal models also indicate that spices could be consumed at higher dietary levels without any adverse effects on growth, organ weights, food efficiency ratio and blood constituents.

Spices or their active principles could thus be used as possible ameliorative or preventive agents for the various health disorders. Spices do not contribute significantly to the nutritional make up of our food per se because of the small quantities added to food stuffs. But due to promising health beneficial physiological effects, spices have immense potential in the nutraceutical industry. Spices like turmeric, ginger, fenugreek, garlic and red pepper are important in the nutraceutical industry with their promising biological effects.

Turmeric has anti-oxidant, anti-inflammatory, anti-carcinogenic, anti-diabetic and

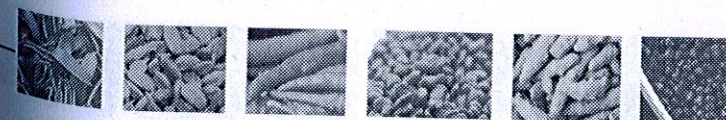




Table 5 ANTIMICROBIAL PROPERTIES OF HERBS AND SPICES

Spices	Mode of application	Activity against bacteria	Activity against fungus
Basil	Essential oil		<i>Ascophaera apis</i>
Basil	Methyl chavicol	<i>Aeromonas hydrophylla</i> , <i>Pseudomonas fluorescens</i>	
Coriander	Essential oil		<i>Ascophaera apis</i>
Fenugreek	Seed saponins		<i>Fusarium oxysporum f. sp. lycopersici.</i>
Fenugreek	Essential oil	<i>Bordetella bronchiseptica</i> , <i>Bacillus cereus</i> , <i>Bacillus pumilus</i> <i>Bacillus subtilis</i> <i>Micrococcus flavus</i> , <i>Staphylococcus aureus</i> , <i>Sarcinia lutea</i> , <i>Escherichia coli</i> , <i>Proteus vulgaris</i>	
Cumin	Essential oil		<i>Penicillium notatum</i> , <i>Aspergillus niger</i> , <i>Aspergillus fumigatus</i> , <i>Microsporium canis</i>
Fennel	Essential oil	<i>Staphylococcus aureus</i> , <i>Bacillus subtilis</i>	
Ajowan	Seed extracts		<i>Pythium aphanidematum</i> , <i>Macrophomina phaseolina</i> , <i>Rhizactonia solani</i>
Allspice	Plant extract		<i>Fusarium spp.</i> , <i>Alternaria spp.</i> and <i>Cladosporium spp.</i>
Oregano, coriander and basil	Essential oil	<i>Listeria monocytogenes</i> , <i>Staphylococcus aureus</i> , <i>Escherichia coli</i> , <i>Yersinia enterocolitica</i> , <i>Pseudomonas aeruginosa</i> , <i>Lactobacillus plantarum</i>	<i>Aspergillus niger</i>
<i>Anethum graveolens</i> , coriander	Seed diffusates		<i>Alternaria alternata</i> , <i>Fusarium solani</i> , <i>Macrophomina phaseolina</i>
Pepper mint, thyme, caraway	Essential oil	<i>Agrobacterium tumefaciens</i> ,	<i>Rhizactonia solanacearum</i> , <i>Erwinia carotovora</i>
Spearmint, basil, parsley	Essential oil	<i>Staphylococcus aureus</i> , <i>Escherichia coli</i>	<i>Candida albicans</i> , <i>Aspergillus niger</i>
Oregano and mint	Essential oil		<i>Aspergillus ochraceus</i>
Oregano	Essential oil or carvacrol		<i>Candida albicans</i>
Oregano, thyme	Essential oil or carvacrol	<i>Streptococcus pneumoniae</i> R36 A, <i>Bacillus cereus</i>	



Table 6 SPICES IN COSMETICS

Spices	Beauty care
Turmeric	Improves skin glow and complexion
Basil	Improves skin complexion
Fenugreek	Removes wrinkles on skin
Coriander	Skin tonic
Cinnamon	Removes skin blemishes
Saffron	Improves skin colour and complexion

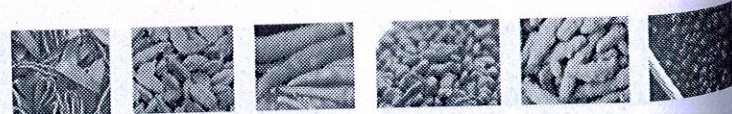
hypocholesterolemic properties. The anti-inflammatory, anti-carcinogenic and anti-oxidant activities are clinically exploited to control rheumatism, cancer and oxidative stress related pathogenesis. Curcumin, derivatives of curcumin, aqueous and organic solvent extracts of turmeric, turmeric powder, essential oil and Ar-turmerone were found biologically active. Of the various forms/compounds, the colouring pigment, curcumin is responsible for most of the medicinal properties. Safety evaluation studies indicate that both turmeric and curcumin are well tolerated at very high doses without any toxic effects.

Ginger was more valued for its medicinal properties and played an important role in primary health care in ancient India, China and Japan. In traditional medicine, ginger finds a wide range of applications. Because of the carminative, stimulant and digestive properties, ginger is commonly used in fever, cough,

vomiting, cardiac complaints, constipation, flatulence, colic, swelling, diarrhoea, cholera, diabetes, neurological disorders. Ginger powder, aqueous and ethanol extracts of ginger, oleoresin, and active principles of ginger like gingerol, shogaol, paradol, zingiberine, zingerone and zingerol were found biologically active. The efficacy of ginger extracts or active principles of ginger like gingerol and shogaol in lowering serum cholesterol level in relation to atherosclerosis and coronary heart diseases were investigated by several workers. Dietary intake of ginger reduced the risk of atherosclerosis by virtue of its hypolipidemic and antiatherogenic effects. Ginger is used as an anti-inflammatory drug in the treatment of arthritis. Patients receiving three to seven grams of powdered ginger daily for 56 days had significant reduction in pain and swelling associated with either rheumatoid or osteoarthritis.

Fenugreek seeds are carminative, galactagogue and tonic. Seeds are used to treat dysentery, diarrhoea, dyspepsia, cough and enlargement of liver and spleen, ricket and gout. Fenugreek seed, sprouted seed, seed powder, sprouted seed powder, decoction of seed, methanol extract of seed, diosgenin, fibre and 4-hydroxy isoleucine, an amino acid extracted from seeds, are found biologically active. The hypoglycemic activity of fenugreek seed is well documented by several workers. Fenugreek reduces fasting and post prandial blood glucose levels in diabetic patients. Supplementation of diet with fenugreek seeds is found to reduce total cholesterol, low density lipo protein cholesterol and triglycerides. Oxidative stress plays a key role in the complication of diabetes and fenugreek seed extract exhibits antioxidant properties also.

Garlic, the bulbous spice is known for its spicy flavour and medicinal properties. It acts as a stimulant, carminative, emmenagogue, antirheumatic, anti-helminthic and vermifuge. Garlic lowers cholesterol in the blood and is recommended for heart diseases and atherosclerosis. Daily use of garlic in the Mediterranean diet is thought to lower incidence of heart disease in these areas. The





active therapeutic compounds present in garlic are S-containing compounds like allicin, iso-allicin, diallyl/disulphide, S-allylcysteine and ajoene. Garlic, garlic powder, garlic oil, aqueous, garlic extract, alliin, allicin, diallyl disulphide, S-allyl cysteine, isoallicin and ajoene are found biologically active.

Aged garlic extract (AGE) has widespread use against cardiovascular diseases. Extracts of fresh garlic that are aged over a prolonged period will have unique water-soluble organosulphur compounds, lipid-soluble organosulphur components and favanoids. Aged garlic extract exerts antioxidant action by scavenging ROS, enhancing the activity of cellular antioxidant enzymes, superoxide dismutase, catalase and glutathione peroxidase and increasing glutathione in the cells. Aged garlic extract has cholesterol lowering and blood pressure reducing effects. AGE also inhibits platelet aggregation adhesion to collagen but only at higher intake levels. The reputation of garlic as an effective remedy for tumours extend back to Egyptian Codex Ebers of 1550 BC. Several garlic compounds including allicin and its corresponding sulphide inhibit proliferation and induce

apoptosis in several human non-leukaemia malignant cells including breast, bladder, colorectal, hepatic, prostate cancer, lymphoma and skin-tumour cell lines.

Capsaicin, the pungent principle of **chillies** is a potent anti-inflammatory and analgesic agent. Chillies are used for the treatment of headaches, toothaches and muscular sprains. It has cholesterol lowering effects and is used as an anti-obesity agent. It is effective against gaseous irritant induced pulmonary damages. It is digestive and has potent anti-microbial properties. Capsaicin treatment significantly reduces tissue damage, induces certain cells to undergo apoptosis and has putative role in cancer chemoprevention. Capsaicin can induce body heat and enhance blood flow and increase energy expenditure and prevent oxidative stress. Capsaicin is a potent antioxidant and can lower LDL even when consumed for a short period.

The phytochemicals present in spice crops hold promise for preventing or ameliorating various health disorders. India, the land of spices could exploit the fast growing nutraceutical sector with her high intrinsic quality

spices. Proven therapeutic uses of spices in traditional systems of medicine and safety of spices for consumption without side effects are the basic strengths in this field. Numerous *in vitro* evaluation studies, *in vivo* studies in animal models and clinical validation studies conducted on health beneficial effects of spices are the stepping stones to exploit spices in the nutraceutical and health food industry.

But most of the evaluation studies conducted on health beneficial effects of spices are short term and clinical studies are lacking in majority of spices except fenugreek. The mode of action of nutraceuticals, bioavailability of nutraceuticals and interaction of nutraceuticals with drugs need thorough investigations. The quality of raw materials for the nutraceutical industry should be ensured and quality and quantity of bioactive compounds in the raw material should be ascertained. The importance of Good Agricultural Practices and Good Manufacturing Practices could be emphasized in this context. "Clean spices production, not cleaned spices production" is the slogan. Quality clean spices could thus make a major break through in the nutraceutical and health food industry.

To be continued



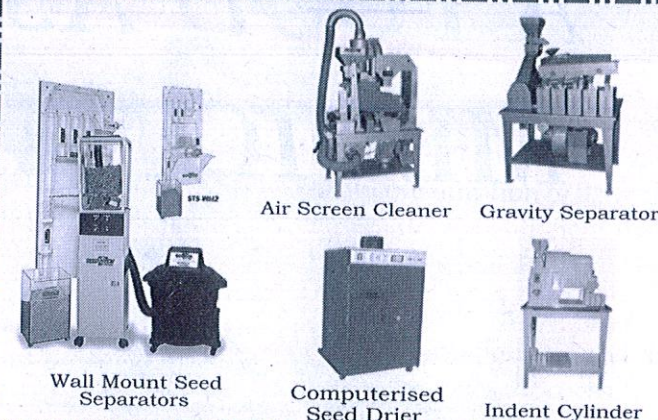
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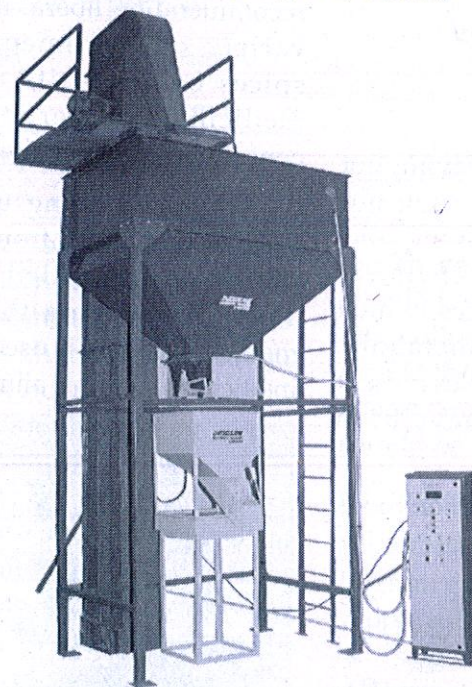
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