Chapter 9
Food-Based Therapeutics: A Converging Paradigm of Traditional and Modern Food Science

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9.1 Introduction

Hippocrates stated around 2,000 years ago, "Let food be your medicine and medicine be your food." Herbs and spices have a long history of both culinary and medicinal uses. They are an integral part of the daily diet. Herbs and spices can add variety, flavor, color, and aroma to everyday food while contributing a wide range of both nutrients and bioactives that may contribute to improved health. They can act synergistically to enhance the health-promoting properties of other food. Many of the pharmacological properties of traditional herbs have been well documented [1, 2].

Since prehistoric times, herbs have been the basis of nearly all medicinal therapy until synthetic drugs were developed in the nineteenth century. Today, herbs are grown and used for their ability to enhance and complement the flavors of a wide variety of foods. The majority of herbs and spices constitute important bioactive secondary metabolites that possess versatile pharmacological and medicinal properties. The health-promoting effects of vegetables and fruits is thought to relate not only to their general nutritional profile – high in dietary fibers, low in fat and salts, low energy density, and high in vitamins A, C, and foliate – but also to a wide range of nonnutrient bioactives and phytochemicals such as flavonoids and phenols. It has been proposed that the additive and synergistic effects of the complex mixture of phytochemicals in fruits and vegetables, herbs, and spices are largely responsible for their health benefits. Wild vegetables have been reported to contain comparatively high amounts of vitamins A and C and other antioxidant micronutrients and promote good health by assisting in the prevention of cancer and high blood pressure, stimulating the immune system, and improving drug metabolism and tissue regeneration. Food-based therapeutics utilize traditional knowledge based on

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Table 9.1 Common food plants and their medicinal properties

Plants	Scientific name	Medicinal properties/indication
Ajowain	*Trachyspermum roxburghianum*	Expectorant, antiflatulent
Asafoetida	*Aerula asfoetida*	Antihelminthic, antitussive
Capsicum pepper	*Capsicum frutescens*	Analgesic, counterirritant
Cinnamon cassia	*Cinnamomum zeylanicum*	Antiseptic, antidiarrheal
Clove	*Syzygium aromaticum*	Topical anesthetic, antidyspeptic
Coriander	*Grewia tilaefolia*	Antispasmodic, diuretic, anti-inflammatory
Cumin	*Cuminum cyminum*	Antimicrobial, vermifuge, diuretic
Black pepper	*Piper nigrum*	Carminative, anti-inflammatory
Curry leaves	*Murraya koenigii*	Antiemetic
Ginger	*Zingiber officinale*	Cold, antiemetic, antirheumatic
Nutmeg	*Myristica fragans*	Astringent, hallucinogenic
Peppercorns	*Piper nigrum*	Expectorant, antimicrobial
Saffron	*Crocus sativa*	Antirheumatic, for neuralgia
Turmeric	*Curcuma longa*	Antiarthritic, antioxidant, anticancer
Garlic	*Allium ativum*	Antimicrobial, antihypercholesterolemic, anticancer, antihypertensive
Mustard	*Brassica compestris*	Eczema, intestinal catarrh, colic pain, flatulence
Onion	*Allium cepa*	For cold, expectorant, anticancer, antiasthma
Aniseed	*Brassica oleracea*	Counterirritant, emetic, purgative antispasmodic, expectorant
Cardamom	*Elettaria cardamomum*	Antiseptic
Fennel	*Foeniculum valgae*	Antispasmodic, diuretic
Lemon grass	*Cymbopogon citrates*	Fever, insect bites
Sesame seed	*Sesamum indicum*	Diuretic, galactogogue, demulcent
Dalchini	*Cinnamomun zelanicum*	Menstrual pain, indigestion
Mint	*Menthe arvensis*	Expectorant, for cold, local anesthesia, antispasmodic
Oregano	*Origanum vulgare*	Antitussive, antirheumatic, vermifuge
Poppy seed	*Papaver somniferum*	Sedative, antispasmodic
Coffee	*Coffea robusta*	Stimulant, diuretic, bronchodilator
Tea	*Thea sinensis*	Antioxidant, source of theophylline
Tamarind	*Tamarindus indica*	Antiseptic, cholagogue, laxative, antipyretic
Tejpatra	*Cinnamomum tamala*	Migrane, peptic ulcer
Bail	*Aegel marmelos*	Constipation, diarrhea, peptic ulcer, diabetes
Mulethi	*Glycyrrhiza glabra*	Muscular pain, mouth ulcers, sore throat
Soyabean	*Glycine max*	Malnutrition, allergies, diabetes, dandruff
Tulsi	*Ocimum sanctum*	Anti-inflammatory, expectorant, analgesic, antitumor, antibacterial
Banana	*Musa paradisiaca*	Mild laxative, diarrhea/dysentery

Chinese and indigenous herbal food recipes from ancient times [3–5]. Some of the common plants used since ancient times in food preparation and also traditionally used in "grandma's recipes" are given in Table 9.1.

It has been observed that food herbs works better when administered as a whole compared to the isolated compounds. In Ayurveda it is mentioned that polyherbal

formulations have better therapeutic potential compared to single herbs or their isolated active compounds due to the synergistic pharmacological effects of each herb. These food-based herbs have significant potential in preventing rather than curing diseases [6].

9.2 Food as Antioxidants

One of the benefits of culinary herbs and spices is due primarily to their antioxidant properties. Free radicals and related species are generated in the body as a result of metabolic reactions. The accumulation of free radicals causes damage in living systems, resulting in oxidative stress. Free radical scavengers (antioxidants) have the potential to prevent, delay, or ameliorate many human chronic and aging diseases such as cancer, diabetes, heart disease, stroke, and rheumatoid arthritis. Free radical scavenging is an important mechanism for the inhibition of lipid peroxidation and can be a good marker for antioxidant activity. Results of studies indicate that the addition of some spices and herbs to food products can prevent the oxidative deterioration of foods. The multiple roles of traditional vegetables as food and medicinal sources have been widely documented [7].

The newly developed branches of food science are briefly discussed in what follows.

9.2.1 Nutraceuticals

Any substance that is a food or part of a food and provides medical or health benefits, including the prevention and treatment of diseases, is called a nutraceutical. Such products may range from isolated nutrients, dietary supplements, and specific diets to genetically engineered designer foods and herbal products [7].

There is a slight difference between functional foods and nutraceuticals. When food is being cooked or prepared using "scientific intelligence" with or without knowledge of how or why it is being used, the food is called a functional food. Thus, functional food provides the body with its daily requirements of vitamins, fats, proteins, carbohydrates, and other nutrients needed for healthy survival. When functional food aids in the prevention or treatment of diseases or disorders other than anemia, it is called a nutraceutical. Examples of nutraceuticals include fortified dairy products (e.g., milk) and citrus fruits (e.g., orange juice).

9.2.2 Probiotics

Probiotics are live microorganisms (in most cases bacteria) that are similar to beneficial microorganisms found in the human gut. They are also called friendly

bacteria or good bacteria. Probiotics are available for consumers mainly in the form of dietary supplements and foods. They are also used as complementary and alternative medicine (CAM). Most often, the bacteria come from two groups, *lactobacillus* or *bifidobacterium*. Probiotics can be used to alleviate lactose intolerance, treat diarrhea, and enhance immune functions. In reference to using probiotics to treat diarrhea, but the evidence supporting the prevention of travelers's diarrhea by probiotics is weak. There exists an overall protective effect in the prevention and treatment of antibiotic-associated diarrhea, with strong evidence for the efficiency of *lactobacillus* in treating diarrhea-induced by rotavirus infection. As probiotics play a role in immunomodulation, naw a days, has received most attention. Several in vitro and in vivo studies on probiotics have reported an immune-boosting role. The specific mechanisms of the probiotics-induced observed changes remain unclear. Generally, enhanced sIgA production and splenocyte proliferation were observed during probiotics treatment. Moreover, regarding cytokine production, several studies have shown that cytokine production by the cells of the immune system can be altered by probiotic use, which may lead to immunomodulation. Hence, probiotics may play a significant role in defense against various infectious microorganisms [8, 9].

9.3 Food-Based Therapeutics

The basic qualities of food products, such as, for example, aroma, flavor, pungency, and color, must be conserved for value-added products and this must start at the farm level. The first spice, oil, and oleoresin industry was launched in 1930 in India at Calicut. An extract of ginger was manufactured for therapeutics during World War II. The major oils extracted for therapeutic purposes were from black pepper, chili seed, capsicum, clove, nutmeg, mace, cassia, juniper, and peppermint. Pepper, ginger, and peppermint oils are the major oils exported from India. The food spices exported from India are black pepper, chilies, capsicum, ginger, turmeric, white pepper, coriander, cumin, fennel, mustard seed, garlic, clove, nutmeg, and curry powder, which are food ingredients and have therapeutic potentials. The role of these food plant products has been known since ancient times for the prevention of many diseases and for the treatment of diseases [10–14]. Green tea extract (*Camellia sinensis*) was given qualified approval by the U.S. Food and Drug Administration for cancer prevention due to the presence of (−)-epigallocatechin gallate.

Some of the common herbs used as food ingredients since antiquity, with their scientific validity as pharmaceuticals, are described in what follows.

9.3.1 Garlic (Allium sativum)

Garlic has been the most important food ingredient since ancient times, and its uses are widely described in Ayurveda. The scientific therapeutic effects of

garlic as a hypolipidemic, antithrombotic, antihypertensive, antihyperglycemic, antihypercholesterolemia, and immunomodulatory substance have been reported [15, 16]. The bioactive components responsible for the health benefits of garlic are assumed to be allylic sulfur compounds. The use of herbs to displace fats and salts in the diet may reduce cardiovascular risk. The most convincing studies on the specific herbs or spices shows beneficial effects in cardiovascular diseases similar to garlic which is commonly used to reduce cholesterol and cardiovascular risk [15].

The consumption of garlic or garlic oil has been associated with a reduction in total cholesterol, low density lipoprotein (LDL) cholesterol, and triglyceride levels. An intake of the one half and one garlic per day may reduce total cholesterol by 9 %. Garlic extracts have been shown to have anticlotting properties and to cause a modest reduction in blood pressure, an approximately 5.5 % decrease in systolic blood pressure. Its effectiveness is associated with the active substances in garlic such as allicin and other breakdown products. Allicin has also been isolated and identified as the component responsible for remarkable antibacterial activities. It has been observed that these therapeutic effects are more pronounced compared to the isolated components alone [17].

The therapeutic application of allicin as an antifungal, antiparasitic, and anti viral agent having other antibiotic effects as well has been shown. Inhibition of certain thiol-containing enzymes in microorganisms by the allicin assumed to be the main mechanism involved in its antibiotic effect. Allicin and ajoene, the major sulfur containing compounds of garlic, were shown to inhibit inducible nitric oxide synthetase (iNOS), by reducing the protein and mRNA, and thus to promote vasodilatation. Rodent cancer model have shown that diallyl sulfite, a compound of garlic, is effective in the detoxification of carcinogens through its effect on Phase I and Phase II enzymes [18–20]. Modern medicine has also adopted garlic as a medicine, especially for cardiovascular diseases, and pharmaceutical preparations of it are now available.

9.3.2 Ginger (Zingiber officinale)

Ginger is used in food recipes and in herbal tea preparation worldwide and is widely used to treat the common cold. It has many therapeutic attributes such as antimicrobial, antithrombotic, antiinflammatory, and anticancer activities [21, 22]. It has also been demonstrated to possess antimutagenic properties, induce detoxification, prevent DNA damage in vitro, and reduce nausea and vomiting in pregnancy [23]. Ginger has a mixture of several of 100 known constituents, including gingerols, shagaols, β-carotene, caffeic acid, curcumine, salisylates, and capsaicin.

The aroma of ginger is due to the constituents of its steam-volatile oils, which are mainly sesquiterpene hydrocarbon, monoterpine hydrocarbon, and oxygenated hydrocarbons, while its pungency is due to the nonsteam volatile components also known as gingerols. The major sesquiterpene hydrocarbon constituent of ginger oils is a-zingiberene. Certain ginger oils have a reputation for possessing a particular

lemony aroma due to their high contents of the isomers neral and geranial, often collectively referred to as citral.

Ginger is a major tranquillizer and carminative agent due to its gingerols. It is used as a spice and as an important medicinal product. It has been recommended for use in treating peptic ulceration due to its action as a thromboxane synthatase inhibitor. Several controlled clinical trials suggest that ginger root can relieve symptoms of motion sickness by a mechanism of action that differs from that of antihistamines. The responsible constituents are believed to be gingerols and shagaols. Ginger root is a putative agent for preventing aging-dependent vascular changes and impotence. A recent reverse pharmacological study on ginger aqueous extracts of whole rhizome showed an antihypertensive activity of the extracts in experimental animals [22–24]. Clinical studies must be designed to scientifically validate the potential of this plant.

9.3.3 Nutmeg (Myristica fragans)

Nutmeg is a spice that has been used in culinary arts and food preparation since ancient times. It is claimed that nutmeg can be used to treat ailments of the digestive tract such as stomach cramps and diarrhea as well as catarrh of the respiratory tract. Extracts of nutmeg were found to stimulate mounting behavior in mice and to significantly increase their mating performance, with no conspicuous general short-term toxicity. Nutmeg oil possesses strong antibacterial, antifungal, anti-inflammatory, and insecticidal properties due to the presence of sarbinen, β- and α-pinenes, eugenols, isoeugenols, methyl engenol, safrol, neolignan, myristicin, ellemicin, and linalool. Myristicin isolated from the nut has hallucinogenic properties, and lignin types of the constituents are anticarcinogenic [25]. There is a need to scientifically validate the therapeutic potential of nutmeg using a reverse pharmacology approach.

9.3.4 Onion (Allium cepa)

Onions are commonly used worldwide as food component and whole green plant & their dried bulbs are used in food preparations. Onion juice has been claimed to treat appetite loss, the prevention of age-related changes in blood vessels (arteriosclerosis), minor digestive disturbances, and other ailments such as cold, cough, asthma, and diabetes. Onions undergo enzymatic breakdown of sulfur-containing substances due to damage to tissues, and this gives off pungent volatile compounds that cause weeping. The pharmacological activity and the pungent smell are due to sulfur-containing compounds, mainly sulfoxides and cepanenes. The therapeutic properties of onion require more clinical emphasis to scientifically validate the potential of this plant.

9.3.5 *Black Pepper* (Piper nigrum)

Black pepper is the core spice in the preparation of curry, which has been used since ancient times. It contains β- and α-pinenes, δ-limonene, and β-caryophyllene as major components. Major compounds in fresh pepper include trans-linanalool oxide and α-terpineol. Pepper has long been recognized as a carminative due to its beneficial effects of stimulating gastric acid secretion by piperine. It has impressive antioxidant and anti-inflammatory effects. Chili causes dyspepsia in patients with or without ulcers, and patients with ulcers are often advised to avoid its use. The protective effect of capsicum could involve vanilloid receptors because resiniferatoxin, an ultrapotent analog of capsaicin, also displays antiulcer activity. Piperine has synergistic effects and increases bioavailability of some modern drugs [26]. Recent reverse pharmacological studies also suggest that piperine has good antioxidant potential and shows protective effects against heavy metal toxicity. A reverse pharmacological approach is needed to scientifically validate the therapeutic use of black pepper. Some pharmaceutical preparations of piperine are available in combination with some antibiotics to increase its bioavailability and reduce toxicity.

9.3.6 *Chili* (Capcicum frutescens)

Chili pepper is a hot spice and an essential component of culinary preparation. Scientifically, it may interact with epithelial cells of the gastrointestinal tract to modulate their transport properties. It contains piperine and capsaicin as the main components. Several pharmacological effects of capsaicin transiently reduced resistance and piperine increased resistance, making them similarly effective as seen with crude spice extract. Both red and black pepper may induce epigastric pain by removing the stomach's hydrophobic lining and activating intramucosal pain receptors. Chili, being rich in phenolic compounds, would be expected to bind iron in the intestine and inhibit its absorption. Capsaicin in commercially available therapeutic skin creams is effective in the treatment of various kinds of pain [27, 28].

9.3.7 *Red Pepper* (Capsicum annuum)

Red pepper contains capsain and capsaicin and is used as a spice and as medicine. Capsaicin, the pungent active principal component of red chili, has been shown to cause gastric mucosal edema and hyperemia and decrease gastric acid output. Capsaicin helps in the metabolism of epoxide aromatic hydrocarbons, which interferes with their ability to bind to DNA (causing mutations). Capsaicin interacts with

the cough receptor and sensitizes it and produces coughing [28, 29]. The reverse pharmacological approach is further needed to validate Ayurvedic claims and to understand this spice's molecular mechanisms of action.

9.3.8 Tamarind (Tamarindus indica)

The fruit of tamarind has a sour taste and is commonly used in food preparations to increase taste. It has numerous traditional therapeutic uses, including in the treatment of liver and bile disorders. The fruit pulp is used as a drink and is rich in pectin, monosaccharides, and organic acids. Further research is needed to scientifically validate the use of tamarind as a therapeutic preparation.

9.3.9 Turmeric (Curcuma longa)

Turmeric is a yellow powder obtained from the dried rhizome of the *Curcuma longa* plant. Apart from its culinary appeal and common use as a spice, it has been well known in India for its medicinal properties for more than 6,000 years. The powder form is used in various dishes. It is a widely and extensively studied spice of Indian origin. It is used in the treatment of peptic ulcer and for its carminative effects. Curcumin [1,7-bis (4-hudroxy-3-methoxy phenyl)-1-6-heptadine-3-5-dione], demethoxycurcumin, and bis-dimethoxycurcumin are the main yellow compounds isolated from turmeric. Its immunomodulatory, antioxidant, anti-inflammatory, and antitumor properties are well documented. The molecular structure of turmeric is widely understood. The pharmacological actions of turmeric are wast, and some of them are discussed in what follows.

Curcumin reduces nitric oxide (NO) and exerts beneficial effects in experimental colitis, which is why inflammatory bowel disease (IBD) due to oxidative and nitrosative stresses is treated using this yellow pigment. The three types of curcuminoids, I, II, and III, differ with regard to their hydroxyl and methyl groups. Whole turmeric or extracted curcuminoids appear to be active in many disease processes, with specific reference to chronic ailments such as cardiovascular, degenerative, infective, and inflammatory disorders as well as cancers [30].

The chemopreventive and bioprotectant properties of curcumin in turmeric increases cancer cells' sensitivity to certain drugs commonly used to combat cancer, rendering chemotherapy more effective. Curcumin also possesses strong antimicrobial activity and inhibits the HIV-1 integrase enzyme. Curcumin and capsaicin alter bile salt secretion to make it less lithogenic and lower cholesterol levels, with no significant effect on fat absorption. Capsaicin with curcumin acts as a lipotrope, preventing triglyceride accumulation and increasing preferential utilization of fats [31]. It also stimulates lipid mobilization and lowers adipose tissue weight and serum triglycerides in fat-fed rats. The therapeutic uses of curcumin are limited

because of its unstable nature in isolated form. According to researchers studying turmeric, the bioavailablity of curcumin is very low. When curcumin is combined with piperine, its unstable nature and bioavailability increased. It is a wonder spice and has strong therapeutic potential in preventing many diseases including cancer [32]. But no single drug comes out from this golden spice for medical practice till date. There is a need for further research using pharmaceutical techniques to increase curcumin's stability and to enhance its bioavailability. Drug targeted delivery systems like nanotechnology are needed to take advantage of the therapeutic potential of curcumin to treat and prevent noncurable diseases like cancer [30, 33]. Reverse pharmacological approaches and use of molecular biology techniques are needed to understand its molecular mechanisms of action at signal transduction level.

9.3.10 Star Anise (Illicium verum)

In star anise, the presence of prenyl moiety in the phenylpropanoid plays an important role in antitumor-promoting activity. Hence, prenylated phenylpropanoids might be valuable as a potential cancer chemoprotective agent. Star anise is the industrial source of shikimic acid, a primary ingredient used to create the antiflu drug Tamiflu, which is regarded as the most promising drug to mitigate the severity of the bird flu H_5N_1 strain of virus. Tamiflu is the only therapeutic drug available for clinical use in modern medicine that may reduce the severity of bird flu [34].

9.3.11 Tulsi (Ocimum sanctum)

Preliminary studies on Tulsi have shown that its leaves and seeds may help people with type 2 diabetes to control their blood sugar level. Its protective effects in stress and anxiety disorders have also been proven. Its leaves are used in medicated diets and in herbal teas, which have some potential protective effects against sore throat and respiratory infections. It is commercially available in powder form for therapeutic purposes [35].

9.3.12 Curry Leaf (Murraya koenigii)

The curry leaf plant is highly valued for its characteristic aroma and medicinal value. A number of leaf essential oil constituents and carbazole, murrayacine, and koenigine alkaloids have been extracted from the plant. There are a large number of oxygenated mono- and sesquiterpenes present, for example, cis-ocimene (34.1 %), β-caryophyllene (9.5 %), α-pinene (19.1 %), δ-terpine (6.7 %), and β-phellandrene,

which appear to be responsible for intense odor associated with stalk and flowery parts of curry leaves. Both *Murraya koenigii* and *Brassica juncea* showed significant hypoglycemic action in experimental rats [36].

9.3.13 Bitter Gourd (Momordica charantia)

Commonly known as bitter melon, bitter lemon, and karela in Hindi, the gourd is an economically important medicinal food plant. The immature fruit is eaten as a vegetable and is a good source of vitamins C and A, phosphorus, and iron. The vitamin content of Chinese bitter gourd varies from 440 to 780 mg/kg per edible portion. The secondary metabolites are cucurbitane-type triterpenoids. These compounds and their glycones showed some biological effects that are beneficial in the treatment of diabetes and obesity. A scientific review on the antidiabetic and hypoglycemic effects of *M. charantia* in animal and clinical studies showed some promising protective abilities. The fruits and seeds of the bitter gourd possess medicinal properties such as anti-HIV, anticancer, anti-inflammatory, antileukemic, antimicrobial, antitumor, and antidiabetic properties [37]. Freeze-dried bitter melon capsules are widely available and marketed in health food stores worldwide. The low-calorie bitter gourd buccal tablet commonly has an auxiliary therapeutic use in the treatment of diabetes.

9.3.14 Lotus (Nelumbo nicifera)

The juice of the lotus is extracted from edible fruits and mixed with some edible medicinal herbs for health benefits. Fresh lotus (*Nelumbo nicifera*) leaves are a good example of hypolipidimic & hypoglycemic agent documented in the *Compendium of Metrica Medica* and *Pharmacopoeia* of the People's Republic of China (2005). Studies on the lotus leaf methanolic extract shows its hypoglycemic effects and may be useful in the control of hyperglycemia in non-insulin-dependent diabetes mellitus through their pharmacological action as insulin secretagogues in vitro and in vivo [38]. The total alkaloid extracts of the lotus leaf have the therapeutic function of regulating lipids of hyperlipidemic rats. Clinical observations showed that lotus leaves have a significant role in reducing the blood lipid profile after 3 months of treatment [39]. To further scientifically validate the data, reverse pharmacological approaches are needed.

9.3.15 Grapes (Vitis venifera)

Grapes are edible food, and the first grape extract was used for human health more than 2,000 years ago. The extract of grapes, a commercially available *drakchsava*, a

well-known Indian Ayurvedic herbal preparation whose main ingredient is *Vitis vinifera* L., is prescribed as a cardiotonic and is administered in the treatment of several disorders. The use of dried grapes (also called *manakka*) as a carditonic is well documented. A high-performance liquid chromatography analysis of *drakchsava* revealed the presence of polyphenols such as resveratrol and pterostilbene. Interest in this ancient formulation grew in light of the recent knowledge of resveratrol [40].

Besides its cardioprotective effects, resveratrol exhibits anticancer properties, as suggested by its ability to suppress the proliferation of a wide variety of tumor cells, including lymphoid and myeloid cancers, multiple myeloma, and cancer of the breast, prostrate, and colon. Reverse pharmacological studies suggest that the growth-inhibiting effects of resveratrol are mediated through cell-cycle arrest, upregulation of p21, p53, and Bax genes and downregulation of survivin, cyclin D1, cyclin E, bcl-2, and bcl-Xl, and activation of caspases. Resveratrol has been shown to suppress the activation of several transcription factors, including NF-kB and AP-1; inhibit protein kinases, including IkBα kinases, JNK, MAPK, PKC, and casein kinase-II; and downregulate products of genes such as COX-2, 5-LOX, VEGF, IL-1, IL-6, IL-8 androgen receptors, and prostrate-specific antigens. In vivo, resveratrol blocks the multistep process of carcinogenesis at various stages. Besides its chemopreventive effects, resveratrol appears to exhibit therapeutic effects against cancer [41]. Limited clinical data in humans have revealed that resveratrol is quite safe. Currently, structural analogs of resveratrol with improved bioavailability are being pursued as potential therapeutic agents.

Some of the food-based therapeutic molecular targets are given in Table 9.2.

9.4 Medicated Food

India and China have represented the hub of traditional medicines for treating and preventing diseases since ancient times. In the theories of traditional Chinese and Ayurvedic medicine, food and medicine are of equal importance in regulating the body's physiology, preventing disease, or promoting recovery. In China, such food is known as medicated diet/food [42]. With the development of the economy and the continuous increases in people's living standards, medicated diets are becoming increasingly valued by people, and a number of scientific works on medicated diets have been published recently [43]. Medicated food has therapeutic effects. Medicated/herbal tea is the mixed powder of tea with herbs, such as fruits, flowers, and vegetables, which are often used as ingredients of medicated tea [44]. Fresh ginger and sugar tea are used to treat the wind cold-type of common cold, cough, and gastrointestinal problems [45]. Repeated administration of aqueous constituents of ginger augments serum corticosterone levels, and this could gradually induce anti-inflammatory activity [22]. The volatile oil of ginger has protective antioxidant effects on carbon tetrachloride-induced damage in mice and antiplatelet activities in rats [24].

Table 9.2 Molecular therapeutic target of some Ayurvedic food plants

Plant name	Uses	Molecular target
Asal rai (*Brassica oleracea*)	Rheumatism, sciatica, body massage	↓NF-kB, ↓cdc25, ↓Bcl-2
Bail (*Aegel marmelos*)	Constipation, diarrhea, peptic ulcer respiratory disorders, diabetes	↓NO
Dalchini (*Cinamomun zelanicum*)	Cold, diarrhea, edema, flu, liver problem menorrhagia, menstrual pain, indigestion	↓PGE_2
Pomegranate (*Punica gratum*)	Cough, digestive disorders, piles, pimples, dysentery	↓NF-kB
Dhanyaka (*Coriandrum sativum*)	Menstrual disorders, skin diseases, conjunctivitis	↓NF-kB, ↓AP-1, ↓JNK, ↓MAPK
Draksha (*Vitis venefera*)	Constipation, blood circulation, cancer	↓COX-2, ↓iNOS, ↓JNK, ↓MEK, ↓AP-1, ↓NF-kB, ↑p53, ↑Caspases, ↑5-LOX
Jambulan (*Syzygium cumini*)	Diarrhea, inflammation	↓NF-kB
Mulethi (*Glycyrrhiza glabra*)	Constipation, mouth ulcers, sore throat	↓p21
Mustard (*Brassica compestris*)	Eczema, intestinal catarrah, colic pain, indigestion	↓NF-kB, ↓cdc25, ↓cdk1 ↓Bcl-2, ↓Bcl-xL
Sauf (*Foeniculum vulgare*)	Hookworm	↓NF-kB, ↓AP-1, ↓JNK, ↓MAPK
Soyabean (*Glycine max*)	Malnutrition, allergies, dandruff	↓NF-kB
Tulsi (*Ocimum sanctum*)	Anti-inflammatory, expectorant, analgesic antitumor, antibacterial	↓NF-kB
Turmeric (*Curcuma longa*)	Antiseptic, anti-inflammatory, antioxidant	↓NF-kB, ↓TNF, ↓AP-1, ↓IL-6, ↓ICAM-1, ↓VCAM-1 ↓iNOS, ↓COX-2

Aggarwal et al. [33]
COX Cyclooxygenase, *iNOS* Inducible nitric oxide synthase, *LOX* Lipoxygenase, *NF-kB* Nuclear factor B, *NO* Nitric oxide, *PGE* Prostaglandin E, *PKC* Protein kinase C, *cdc25* Cyclin-dependent calcium 25, *MAPK* Mitogen-activated protein kinase, *cdk* Cyclin-dependent kinase, *ICAM* Intracellular cell adhesion molecule, *IL* Interleukin, *TNF* Tumor necrosis factor, *VCAM* Vascular cell adhesion molecule

9.5 Future Trends

Ayurveda is an indigenous system of medicine based on science. Traditional food-based medicine is quite common in India and China. Traditional medicine in the developed world is known as complementary and alternative medicine (CAM). Chinese traditional medicine is based on herbs that can prevent diseases and strengthen an individual's body. In recent years, there has been an emphasis on

secondary metabolites in relation to dietary components that may have a considerable impact on human health. Reports from studies on animal models and in vitro systems will direct future research perspectives in this area. The action of spices on reproductive functions as well as their potential role as regulators of fertility or conception is an area that holds great promise. Synergy is an important concept in spice physiology and has a pharmacokinetic basis. The components of whole spices that are not active themselves can act to improve the stability, solubility, bioavailability, or half-life of the active components. Hence a certain chemical might in pure form have only a fraction of the pharmacological activity that it has in its plant matrix. This suggests that measuring an individual's food intake and assessing individual variations in the disposition, bioavailability, and metabolism of micronutrients might allow for more accurate and individualized nutritional approaches to dietary prescription. Dietary modifications will only work if they are in consonance with individual preferences, cultural values, and philosophical orientation toward health and disease. Traditional Indian and Chinese medicine will require extensive scientific research to further validate the therapeutic and preventive claims of food-based herbal medicines.

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