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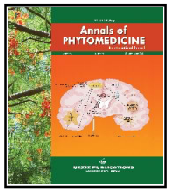

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Nutritional benefits of herbs and spices to the human beings

Jyoti Rani◆, Pavneet Kaur and Caresma Chuwa*

Department of Food Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan-173230, Himachal Pradesh, India

**Tanzania Agricultural Research Institute (TARI) Ukiriguru, P.O BOX 1433, Mwanza*

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Abstract

Herbs and spices are a essential component of human food regimen and are found similar all civilizations across the worldwide. The scientific literature outlines how they contribute to taste and lessen the need for salt and fatty condiments, promote digestion and give the body more antioxidants that prevent physiological and metabolic changes. Consumers, academics and the food business have shown a greater interest in how food items might assist preserve organism health in recent years and the significance of nutrition in the prevention and treatment of many ailments has been generally recognized. The usual concept of "adequate nutrition," *i.e.,* the nutrient delivery (carbohydrates, proteins, fats, vitamins, and minerals), is gradually being replaced by the concept of "ideal dietary balance" which, in addition to the components mentioned above, includes the potential foods to promote health and improve wellbeing. Foods that promote health have garnered the interest and support of consumers on numerous occasions. The usage of functional additives should be linked to consumer health, according to the industry. As a result, the science must be scientifically and comprehensively proven. Therefore, "health benefits of spices" are exceedingly costly and need significant investment. Human clinical studies are equally vital and the use of such trials for the food sector is apparent, but nutrients are frequently extracted from context and tested using the same approach as pharmaceuticals. The use of spices to treat diseases is common in many cultures and it might serve as a foundation for empirical data supporting health benefits. This review summarizes the list of herbs and spices that people can consume to increase health benefits and lower their chances of developing chronic diseases.

1. Introduction

Herbs and spices have always been regarded as therapeutic foods. The ability of spices to transmit biological activity is gradually resurfacing as an area of study in the field of human wellness. Seed spices are a vital category of agricultural commodities that make significant contributions to our nation's economic success. India has long been known as a spice-producing country. Rajasthan and Gujarat have supplied more than 80% of the country total spice production (Datta, 2022). Spices produce a wide range of secondary metabolites known as phytochemicals. Phytochemicals are naturally produced, chemical compounds with biological activity found in vegetation that act as an internal defense system for host plants and have previously been used as medication, smells, aroma compounds, dyes, and agrochemicals. Chemoinformatics will aid in the creation of new medications by utilizing contemporary biological and computer scientific technologies. These metabolites are still an important source of novel medications today. Herbs and spices may now be utilized to improve the acceptability of foods as well as their health. According to a World Health Organization research, 70-80 per cent of the global population seeks primary care from modern medicine, primarily herbal and natural sources (Chan, 2003). Furthermore, herbs and plants are used directly by as much as 60 per cent of the global population and 80 per cent of the population in developing countries for medical purposes (Shrestha and Dhillon, 2003). The antibacterial capabilities of cinnamon oil against *Bacillus anthracisspores* were demonstrated in the first scientific investigation on the influence of spices as preservatives in the 1880s (Tajkarimi *et al*., 2010). Population demographics, a greater emphasis on health vs. disease, the movement toward self-care, self-diagnostic and expanding consumer understanding of conventional treatments are the key driving forces for the global phytochemical firm's expansion. The use of herbs and spices as food additives has spread across the world, improving the organoleptic qualities of food as well as extending shelf-life by reducing or eliminating foodborne microorganisms (Lai and Roy, 2004). Several studies have suggested the use of dietary herbs and spices for their anti-inflammatory, immunological modulatory qualities, antimutagenic and antioxidative which have been shown to improve human health. Herbs may be used as excellent sources of antioxidants and salt substitutes, according to a dietary recommendation (Tapsell *et al.,* 2006). In today's nutrition food system, dairy products are unique carrier that has been effectively employed to transport phytochemicals and other nutrients for health advantages (El-Sayed *et al*., 2015). Furthermore, adding herbs, spices, or extracts to certain dairy products converts them into nutraceutical carriers. As a result, the dairy industry should devise new methods to improve the capabilities in conventional dairy products, which could add significant value and have a positive

Corresponding author: Ms. Jyoti Rani
Department of Food Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan-173230, Himachal Pradesh, India
E-mail: jyotichaudhary265@gmail.com
Tel.: +91-8901035491

impact on customers. These metabolites are now a significant source of novel medications. Plant-derived compounds have recently attracted a lot of attention due to their wide range of uses. The goal of this assessment is to provide a comprehensive report on the current state of research on possible human health benefits.

2. History

Spices and herbs have an extended tradition of culinary use, as well as health benefits and preservation properties. Fennel, juniper, coriander, cumin, thyme and garlic are all mentioned in ancient Egyptian papyri dating back to 1555 BCE. According to legend, Sumerians used thyme for its medicinal powers as early as 5000 BCE, while Mesopotamian farmers grew garlic as early as 3000 BCE. Spices were traded internationally from 4500 to 1900 BCE, mostly with Ethiopia. Garlic was adored by the ancient Egyptians and garlic cloves were discovered in King Tutankhamen's tomb. Other Egyptians buried wooden garlic bulbs in their graves to ensure that the afterlife's meals were good, nutritious, and long-lasting. Mint leaves, dried, have been discovered in Egyptian pyramids going back to 1000 BCE. The Egyptians allegedly fed their slaves vast quantities of radishes, onions, and garlic, apparently to keep them healthy. Cardamom and cinnamon (both imported from Ethiopia) were also widely utilized as spices in ancient Egypt, but not as much for therapeutic purposes. The Assyrians of Mesopotamia (modern-day Iraq and Iran) also gained an understanding of the healing advantages of plants, and juniper, saffron, and thyme are mentioned around this period (Freedman, 2020). Herbs appear to have been utilized more than spices in ancient Greece and Rome. Hippocrates (460-377 BCE) had 300 cures in his arsenal, including cinnamon and rosemary and garlic all of which were readily available in his hometown. Garlic has been reported to be one of his uterine cancer treatments. Mint was prized for its digestive benefits, while licorice was used as a sweet as well as a medicinal plant for chest difficulties, asthma and mouth ulcers. Rosemary was once believed to sharpen and increase memory and it is still occasionally burned in the homes of Greek students preparing for examinations (Sharangi and Acharya, 2018). Pedanius Dioscorides, a Greek physician, botanist, pharmacologist and surgeon produced the first plant monograph in the first century CE, which comprised 600 herbs and described how to pick store, and use plants for a variety of health advantages. Galen (131-200 CE), a Greek physician who resided in Rome from 162 CE, had a significant effect on the development of herbal treatments, although he utilized complex concoctions with up to 100 elements. Until the 17th century, Europe relied on Dioscorides' monograph as a primary source. Ayurveda, India's ancient medicine, emerged in the Himalayas more than 5000 years ago, with information passed down orally until it was written down in Sanskrit poetry-the Vedas - approximately 1500 BCE. It reached its pinnacle in the seventh century. Ayurveda is a system of medicine that focuses on illness prevention and health promotion, with a particular emphasis on nutrition. Turmeric for jaundice, basil for heart protection, mace for stomach infections, cinnamon to increase circulation and ginger as the universal remedy, particularly for nausea and indigestion, are examples of Ayurvedic uses of herbs and spices for health effects. It's been stated that he eats up to 50 g of garlic every week (Vladirmirescu, 2011).

3. Overview of spices

Spices are plant components including roots, buds, flowers, barks, and seeds that may be acquired from a wide variety of species. Spices have a taste that originates from volatile oils, fixed oils and minor quantities of resins. The flavour is sometimes influenced by a mixture of organic acids, alcohols, alkaloids phenols, sulphur and esters. Spices also include protein, carbohydrates, fibre, minerals, tannins, and vitamins, which are common in plant products. Natural colours produced from spices contribute significantly to the country exports. Spices have a significant human health impact and illness. The majority of organic chemicals derived from spices do not directly contribute to human growth or health. Certain chemicals, known as secondary metabolites, are extremely important (Kunnumakkara *et al.,* 2009). Due to their intricate chemical composition and biosynthetic processes, compounds that create volatile and nonvolatile natural products are usually assumed to be physiologically irrelevant. Scientific study into new hypotheses has led to the development in both chemistry and new synthetic medicines and practices in recent years, owing to the recently revealed abundance of hidden advantages in spices. Bioactive secondary metabolites found in most aromatic plants have multifunctional pharmacological and therapeutic effects. The domains of molecular biology and nanotechnology, when combined, may undoubtedly contribute to the fascinating new investigation of these molecules' chemical structures. Spices, in addition to playing an essential role in Indian food, are now showing promise in the prevention and treatment of diseases such as arthritis, cancer, rheumatic, diabetes, immunological problems and metabolic. Spices make up roughly a third of the medications or patent chemicals in the present western allopathic system (Vasanthi *et al*., 2010). Spices are still utilized as remedies and have an important part in the growth of the national economy today. The list of different types of herbs and spices,botanical name, active ingredient and medicinal use are described here under (Table 1).

Table 1: Different types of herbs and spices, botanical name, active ingredient and medicinal use

S. No.	Spices name	Botanical name	Part of plant	Active constituent	Medicinal use	References
1	Pepper	*Piper nigrum* Linn	Fruit	Piperine	Reduction of insulin resistance, anti-inflammatory effects, and improvement of hepatic steatosis.	Mehmood and Gilani (2010), Meghwal and Goswami (2013)
2	Cardamom (small) (large)	*Electtariacard amomum* Linn *Amomum subulatum* Roxb		Cineole, Fruit limonene, α-terpinyl acetate	As an abortifacient, laxative and carminative in asthma, bronchitis, hemorrhoids, strangury, scabies, pruritis; diseases of the bladder, kidney, rectum and throat; inflammation, headache, earache, snake-bite and scorpion sting	Sengupta and Bhattacharjee (2009)

3	Turmeric	*Curcuma longa* Linn	Fruit	Curcuminoids, Curcumin	Antiproliferative, anti-inflammatory, antihepatotoxic, antidiarrheal, carminative, diuretic, antirheumatic, hypotensive, antimicrobial, antiviral, antioxidant, larvicidal, insecticidal	Sharifi *et al.* (2020), Tanvir *et al.* (2017)
4	Ginger	*Zingiber officinale* Roscoe	Rhizome	Gingerols, shogaols, and paradols	Respiratory protective, antiobesity, antidiabetic, antinausea, and antiemetic activities, cardiovascular protective	Mao *et al.* (2019), Mele (2019)
5	Chilli	*Capsicum frutescens* Linn	Rhizome	Phenols and vitamin C	Prevent heart disease, promote weight loss, reduce duration of sickness	Montoya *et al.* (2014)
6	Coriander	*Coriandrum sataivum* Linn	Leaf and seed	p-cymene, alpha-pinene, camphor, geraniol, limonene	Lower blood sugar, prevent cellular damage, promote healthy digestion, improved memory	Rajeshwari and Andallu (2011), Ghazanfari *et al.* (2015)
7	Fennel	*Foeniculum vulgare, P. miller*	Fruit	Essential oil, anethole	Support healthy skin, anti-inflammatory, improve the symptoms of anemia	Alam *et al.* (2019)
8	Cumin	*Cuminum cyminum* Linn	Fruit	Cuminaldehyde	Anticancer properties, helps control blood sugar, fights bacteria and parasites. Has an anti-inflammatory effect, may help lower cholesterol	Sowbhagya (2013)
9	Fenugreek	*Trigonella foenum-graecum* Linn	Seed	Graecunins, fenugreek B, fenugreek in, trigofoenosides A-G	Reduce the risk of diabetes, improve weight loss, reduce inflammation	Wani and Kumar (2018)
10	Aniseed	*Pimpinella anisum* Linn	Fruit	Anethole, 4-anisaldehyde, estragole	May reduce symptoms of depression could protect against stomach ulcers	Shojaii and Abdollahi (2012)
11	Celery	*Apium graveolens* Linn	Fruit	Apiin and apigenin	Cancer prevention, blood pressure management, alzheimer's preventing	Sowbhagya (2014)
12	Cinnamon	*Cinnamom umzeylanicum* Blume	Bark	Cinnamaldehyde, Eugenol	Antiviral, antibacterial and antifungal properties, reduces blood pressure, lowers blood sugar	Rao (2014)
13	Caraway	*Carum carvi* Linn	Fruit	Carvacrol, carvone, α-pinene, limonene, α-terpinene, linalool	Used for digestive problems including heartburn, bloating, gas, loss of appetite, and mild spasms of the stomach and intestines	Keshavarz *et al.* (2014)
14	*Dill*	*Anethum graveolens* Linn	Fruit and seed	Carvone, α-phellandrene, limonene	Hypolipidemic and hypoglycemic effects and reduce the glucose level in blood	Yousaf and Shahid (2020)
15	Bishop's weed	*Trachysper mumanisum* Linn	Fruit	Methoxsalen	Used for digestive disorders, asthma, chest pain (angina), kidney stones, and fluid retention	Husain *et al.* (2019)
16	Mustard	*Brassica jaucea* Linn	Seed	Phenols, flavonoids, glucosinolates, thiocyanates, carotenoids	Protect against certain types of cancer, lower blood sugar levels, protect against psoriasis, reduce symptoms of contact dermatitis	Nawaz *et al.* (2018)
17	Kokam	*Garcina indica* Choisy	Fruit	Vitamin A, vitamin B3	Immunity booster, weight management, improved intestinal	Ananthakrishnan and rameshkumar

				vitamin C and minerals, Stearic acid and oleic acid	health, reduces risk of cancer	(2016)
18	Garlic	*Allium sativum* Linn	Bulb	Allicin	Help lower blood pressure, help quell inflammation, support immune function	Zhang *et al.*(2020)
19	Mint	*Mentha piperita* Linn	Leaf	Menthol, menthofuran, 1,8-cineol	Improve Irritable bowel syndrome, help relieve indigestion, improve brain function	Loolaie *et al.*(2017)
20	Curry leaf	*Murraya koenigii* Linn	Leaf	Linalool, elemol, geranyl acetate, allo-ocimene	Helps in the treatment of dysentery, diarrhea, diabetes, morning sickness, and nausea	Rajendran *et al.* (2014)
21	Cassia	*Cinnamom umaromaticum* Nees	Bark	Cinnamal-dehyde	Use for erectile dysfunction (ED), hernia, bed-wetting, joint pain, menopausal symptoms, menstrual problems	Wu *et al.*, (2017)
22	Greater Galanga	*Alpinia galanga* Linn	Rhizome	1,8-cineol, α-fenchyl acetate, β-farnesene, β-bisabolene, α-bergamotene, β-pinene	Boost male fertility and reduce inflammation and pain, maintains heart health· Relaxes muscle cramps· prevents cold and flu	Subramanian and Nishan (2015)
23	Vanilla	*Vanilla fragrans Ames* Syn.	Pod	Vanillin	It May offer antioxidant effects, May have anti-inflammatory properties, may benefit brain health, may help reduce added sugar intake	Vijayalakshmi *et al.* (2019)
24	Pepper long	*Piper longum* Linn	Fruit	Piperine	Improve appetite and digestion, as well as treat stomachache, heartburn, indigestion, intestinal gas, diarrhea, and cholera	Kumar *et al.* (2011)
25	Saffron	*Crocus sativus* Linn	Stigma	Safranal, e anthocyanin, α-carotene, β-carotene, and zegxantin	Reduce PMS symptoms, may act as an aphrodisiac, May improve eyesight in adults with age-related macular degeneration (AMD)	Rahmani *et al.* (2017)
26	Parsley	*Petroselinum crispum*	Seed	Myristicin,apiole, α-pinene	May help manage diabetes, may improve brain health, can help promote heart health	Marín *et al.* (2016)
27	Sweet flag	*Acoruscalamus* Linn	Rhizome	Asarones	Helps in clarity of voice, treats stomach disorders, effectively cures asthma	Rana *et al.* (2013)
28	Star anise	*Illicium verum* J D Hooker	Fruit	Flavonoid anethole	Helps improve digestion, alleviate cramps and reduce nausea	Wei *et al.* (2014)
29	Tejpat	*Cinnamom umtamala* Nees	Leaf	Cinnamaldehyde, linalool	Anticancer, anti-inflammatory and antibacterial properties	Satyal *et al.* (2013)
30	Pomegranate seed	*Punica granatum* Linn	Seed	Elagitannin, punicalagin, ellagic acid	Prevent from cancer, cardiovascular disease, osteoarthritis, rheumatoid	Zarfeshany *et al.* (2014)
31	Marjoram	*Marjorana hortensis*	leaf	Rosmarinic acid, sinapic acid, vanillic acid, ferulic acid	Anti-inflammatory, antimicrobial, and antioxidant properties	Bina and Rahimi, (2017)
32	Bay leaf	*Laurus nobilis* Linn	leaf	Eucalyptol, terpinyl acetate, methyleugenol	Treats type 2 diabetes, reduce hyperglycemia, reduce hyper-insulinemia (too much insulin in the blood), reduce blood glucose	Fidan *et al.* (2019)

33	Hyssop	*Hyssopus officinalis* Linn	Leaf	Luteolin, diosmin, quercetin, apigenin	Used for digestive and intestinal problems including liver and gallbladder conditions, intestinal pain, intestinal gas, colic, and loss of appetite.	Tahir *et al.* (2018)
34	Asafoetida	*Ferula asafoetida* Linn	Resin	Asaresinotannols A and B, ferulic acid, umbelli-ferone	Antibacterial, antifungal, and antimicrobial effects. Help lower blood pressure anticancer effects protect brain health	Amalraj and Gopi (2017)
35	Caper	*Capparis spinosa* Linn	Fruit	Rutin	Antioxidant powers, mineral mine,vitamin vitality, fiberlicious good, bad enzyme buster	Sonmezdag *et al.* (2019)
36	Horseradish	*Armoracia rusticana* Gaertner	Rhizome	Allylisothiocy anate.	Prevent cancer, strengthen immune system, treat urinary tract infections, treat sinus infections	Agneta *et al.* (2013)
37	Lovage	*Levisticum officinale* Koch	Leaf	Phthalides and terpenoids	Fights the risk of kidney stones, lung support, soothes rough spots, promotes healthy skin, fights harmful organisms	Zlotek *et al.* (2019)
38	Juniper berry	*Juniperus communis* Linn	Berry	Myrcene, sabinene, limonene and β-pinene	Improves skin conditions, may help improve digestion, may help treat leishmaniasis	Bais *et al.* (2014)
39	Cambodge	*Garcinia cambogia* Gaertner	Pericarp	Hydroxycitric acid	Reduce high cholesterol and also high Triglycerides levels in our body.	Hayamizu *et al.* (2008)
40	Clove	*Syzgiumar omaticum* Linn	Bud	Eugenol	Contain important nutrient, high in antioxidants, may help protect against cancer, can kill bacteria	Cortés *et al.* (2014)
41	Tamarind	*Tamarindus indica* Linn	Fruit	Limonene, geraniol, safrole	A rich source of antioxidants, may have anticancer properties, may improve heart health.	Bhadoriya *et al.* (2011)
42	Oregano	*Origanum vulgare* Linn	Leaf	Carvacrol	Treats kidney stones, antibacterial effects, cures dental caries, treats gut problems. Relieves pain, fights cold	Coccimiglio *et al.* (2016)
43	Savory	*Satureja hortensis* Linn	Stem, leaf	Carvacrol	Cramps, indigestion, gas, diarrhea, nausea, and loss of appetite	Dzida *et al.* (2015)
44	Rosemary	*Rosmarinus officinalis* Linn	Leaf	Rosmarinic acid, carnosic acid, rosmanol, carnosol, ursolic acid	May improve brain function, stimulates hair growth, may help relieve pain	Rahbardar and Hosseinzadeh (2020)
45	Poppyseed	*Papaversomni ferum* Linn	Seed	Morphine, codeine, thebaine, noscapine, and papaverine	Strengthen your bones, enhances mental functioning, treats insomnia, improves digestion, promote heart	Carlin *et al.* (2020)
46	Mace	*Myristica fragrans* Houttuyn	Aril	Narcotic myristicin	Diarrhea, nausea, vomiting, stomach spasms and pain, and intestinal gas	Assa *et al.* (2014)
47	Tarragon	*Artemisia dracunculus* Linn	Leaf	α-trans-ocimene, limonene, α-pinene	Help individuals with type 2 diabetes, may help protect against cholera, Improves heart health, prevents cancer, protects intestinal mucosa, manages diabetes	Nurzyñska *et al.* (2014)

48	Thyme	*Thymus vulgaris* Linn	fruit	Borneol, carvacrol, thymol, linalool, thymol.	Boosts the immune system, promotes healthy blood pressure levels, helps stop dry coughing	Borugã *et al.* (2014)
49	Sage	*Salvia officinalis* Linn	Leaf	Camphor, 1,8-cineole, alpha- and beta-pinene	Reducing gas and improving digestion, relieving nausea, easing a cold or the flu, relieving pain reducing inflammation, supporting cardiovascular	Hamidpour *et al.* (2014)
50	All spices	*Pimenta dioca* Linn	Fruit	Eugenol, Trans-cinnama ldehyde	Reduce inflammation. inflammation can aggravate injuries or infections, prevent Infection.	Zhang and Lokeshwar (2012)
51	Basil	*Ocimum basilicum* Linn	Leaf	Linalool, methyl chavicol, eugenol, bergamotene	Contains disease-fighting antioxidants, acts as an anti-inflammatory, helps fight cancer, contains antibacterial	Joshi (2014)
52	Nutmeg	*Myristica fragrans* Houttuyn	Seed	Sabinene, 4-terpineol and myristicin	Help protect against the signs of aging and serious conditions such as cancer, heart disease, and liver disease	Subarnas *et al.* (2010)

4. Nutraceutical attributes of spices

Diets from Asia, notably India and the Mediterranean, are heavy in vegetables and fruits and typically contain a significant number and diversity of herbs and spices. They are linked to a decreased risk of developing several age-related chronic illnesses, such as cardiovascular disease and some types of cancer. The health-promoting effect of vegetables and fruits is thought to be related not only to their general nutritional profile, which is high in dietary fibre, low in fat and salt, low energy density, and high in vitamin A, C, and folate, but also to their specific nutritional profile, which is high in vitamin A, C, and folate, as well as a variety of non-nutrient phytochemicals found in herbs and spices, such as flavonoids, other phenolics, and organosulfur compounds. The diverse variety of phytochemicals in vegetables, fruits, herbs, and spices is thought to be substantially responsible for their health impacts due to their additive and synergistic effects (Shylaja and Peter, 2007; Rani and Prabhu, 2022; Srinivasan, 2005).

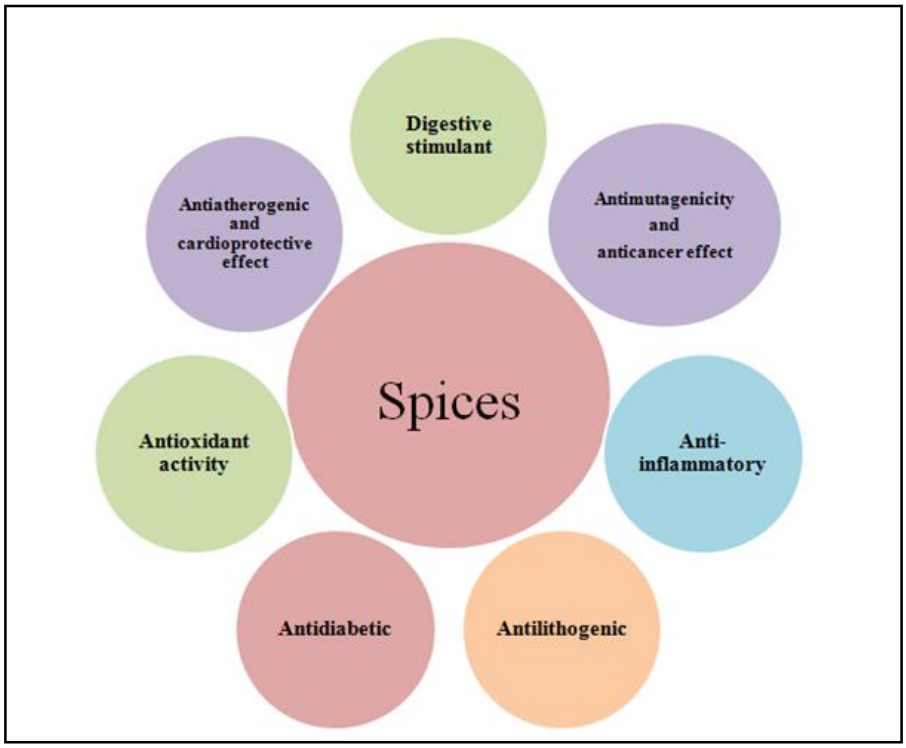

Figure 1: Multiple health effects of spices (Srinivasan, 2008).

4.1 Action as a digestive stimulant

Spices digestive stimulating effect is perhaps the most typical occurrence. Several spices, including mint, ginger, ajowan, fennel, cumin, garlic and coriander are commonly employed in traditional treatments or as constituents in pharmaceutical formulations to treat digestive issues. Extensive animal researches have lately shed light on the mechanism of spices' gastric stimulating activity (Platel and Srinivasan, 2004). Many regularly eaten spices (ginger, curcumin, fenugreek, capsaicin, cumin, onion, mustard, ajowan, coriander, and tamarind) have been shown to enhance the liver's synthesis of bile acid. Bile acids are essential for the breakdown of fat and digestion (Adefegha and Oboh, 2013).

4.2 Antidiabetic potential

Diet has long been recognized as being important in the management of diabetes mellitus. There has been an ongoing hunt for new antidiabetic medications derived from plants. Among the natural food adjuncts studied in this context are fenugreek seeds, onion and garlic, and their sulfur compounds, turmeric and its yellow principle curcumin, which are effective in improving glycemic status and glucose tolerance in diabetic animals/type 2 diabetic patients (Srinivasan, 2005). Turmeric is another spice that has been shown in a small number of trials to have a positive hypoglycemic impact and enhance glucose tolerance (Tank *et al*., 1990). Chronic diabetic nephropathy is a prevalent problem. High blood cholesterol is an additional risk factor that influences the rate at which kidney function deteriorates in diabetics. In streptozotocin-diabetic rats, dietary curcumin (turmeric) and onion have been demonstrated to have a potential ameliorating effect on the severity of kidney lesions (Srinivasan, 1998). The potential of these spices to minimize lipid peroxidation under diabetic conditions, as well as their hypocholesterolemic action, has been linked to the improvement of renal lesions. The spicy ingredient of red chilies, capsaicin, has been demonstrated to help diabetic neuropathy. Capsaicin has been demonstrated to help diabetic patients.Topical application of 0.075 per cent capsaicin cream was beneficial in pain management in an eight-week double-blind placebo-controlled research with parallel randomized therapy undertaken by 12 independent investigators comprising 219 patients (Head, 2006). The spices listed above can be used with antidiabetic medications to improve the therapeutic potential and reduce drug dose. Incorporating garlic (2-3 cloves), onion (50 g), fenugreek seeds (25-50 g) and turmeric powder (1 pinch) into diabetics regular diets might be a useful supportive treatment in the prevention and control of diabetes for a long time problems (Dludla *et al.,* 2022).

4.3 Antiatherogenic and cardioprotective effect

4.3.1 Hyper lipidemic influence

High blood cholesterol levels have long been associated with coronary heart disease and atherosclerosis. Several popular spices have been tested in a variety of experimental circumstances in both animals and people for a putative cholesterol-lowering impact, and these researches have recently been reviewed (Srinivasan *et al*., 2004). In individuals with fenugreek, hyperlipidemia, onion and garlic are beneficial. Garlic oil or garlic consumption has been linked to low-density lipoprotein cholesterol, lower total cholesterol and triglyceride levels. Garlic and its preparations have been the subject of more than 25 clinical studies (Kleijnen *et al*., 1989). Effective clinical work may be done with a relatively modest and tolerable daily dosage of 300-900 mg after the introduction of dehydrated garlic powder carrying a standardized Under diverse circumstances of experimentally produced hypercholesterolemia/hyperlipidemia, onion, fenugreek, garlic, red pepper and turmeric have been proven to be effective as hypocholesterolemic agents quantity of the parent sulphur component (Srinivasan, 2010).

4.3.2 Antithrombotic property

Several spices anti-platelet adhesion and anti-platelet aggregation capabilities contribute to cardiovascular protection in addition to their favourable effect on serum lipid profile (lowering of low-density lipoprotein cholesterol and triglyceride levels). Onion, garlic curcumin, eugenol, cuminaldehyde, and zingerone are the spice compounds that have been shown to suppress platelet aggregation. Garlic, in particular, has hypotensive qualities and antithrombotic which, in addition to the hypolipidemic capabilities, help to protect the heart (Fosslien *et al.,* 2005).

4.3.3 Thermogenic influence

Insulin resistance linked to obesity has emerged as a significant risk factor for cardiovascular disease. Dietary variables that influence satiety and thermogenesis might have a big impact on the prevalence and severity of this condition. Red pepper (or its pungent ingredient capsaicin) (Kawada *et al*., 1986) and garlic are among the spices that may have a role to play in this area, although additional evidence is needed to confirm the benefit. Spices can help to minimize cardiovascular risk by replacing lipids and salt in the diet (Zhao *et al.,* 2023).

4.4 Antilithogenic effect

A lithogenic diet that is followed for a long time causes cholesterol saturation in the bile, leading to the production of cholesterol crystals in the gall bladder, which are known as gallstones. It was discovered that a curcuma combination inhibited lithogenesis in rabbits (Beynen *et al*., 1987). The development of cholesterol gallstones in mice and hamsters using a lithogenic diet revealed that when the animals were fed diets containing 0.5 per cent curcumin or 0.015 per cent capsaicin, the incidence of gallstones was reduced by 40-50 per cent (Hussain and Chandrasekhara, 1992). In a 10-week feeding trial, these spice components also showed considerable regression of produced cholesterol gallstones in animals. Other recognized hypocholesterolemic spices, such as onion, garlic, and fenugreek seeds, have recently been shown to have antipathogenic properties in animal research. The antipathogenicity of these spices is thought to be owing to their ability to lower cholesterol levels while also increasing bile acid levels, both of which help to reduce cholesterol saturation index and therefore crystallization. The antilithogenecity of these spice components may be attributed to their action on biliary proteins in addition to their capacity to reduce cholesterol saturation index (Vidyashankar *et al.,* 2010).

4.5 Anti-inflammatory property

Food-based techniques are becoming more popular as an alternative to nonsteroidal anti-inflammatory drugs in the treatment of chronic inflammation. In arthritis and other inflammatory illnesses, lipid peroxides play a critical role. The first anti-inflammatory drug found in India's traditional medical system is turmeric. In various investigations including mice, rats, rabbits, and pigeons, curcuminoids,

turmeric extract and volatile oil of turmeric were proven to be efficient as anti-inflammatory agents. Curcuminoids have also been shown to be effective in carrageenan-induced foot paw edema in mice and rats, as well as cotton pellet granuloma pouch tests in rats (Srimal, 1997). Because, it specifically inhibits the production of the anti-inflammatory prostaglandin T × A2 without affecting the production of prostacyclin (PgI2), which is a crucial component in preventing arterial thrombosis, curcumin was thought to be superior to aspirin.. Both *in vitro* and *in vivo* animal tests (of clove) have demonstrated the anti-inflammatory effects of curcumin (from turmeric), capsaicin (from red pepper), and eugenol. In animal studies, curcumin and capsaicin have been shown to lessen the frequency and severity of arthritis and to delay the onset of adjuvant-induced arthritis. The synthesis of arachidonate metabolites was likewise prevented by these spice ingredients (Fosslien *et al.,* 2005).

4.6 Antimutagenicity and anticancer effect

Recently, there has been a lot of interest in finding naturally occurring chemopreventive agents that can suppress, delay, or reverse multi-stage carcinogenesis. In recent years, extensive reviews have been published on the possibility of dietary intervention in cancer development (Milner, 1994; Conney *et al*., 1997). A wide range of phenolic compounds, including several found in spices, have been shown to have significant ant carcinogenic properties. Anti-inflammatory and antioxidant activities are found in the bulk of these naturally occurring phenolics, which seem to contribute to their ability to prevent and protect against cancer. Several *in vitro* and rodent *in vivo* investigations have suggested that spices may have a chemopreventive impact against cancer in its early stages. There is no evidence that spices have an anticarcinogenic effect in humans at this time. Spices may promote cancer prevention through a variety of methods. Spice phytochemicals have been demonstrated to inhibit one or more stages of the cancer process (initiation, promotion, growth and metastasis). The chemopreventive efficacy could be attributed to the inhibition of phase I metabolic enzymes (involved in the activation of procarcinogens) and stimulation of phase II metabolic enzymes (involved in carcinogen deactivation). Spices can additionally defend against inflammation and oxidative stress, both of which are risk factors for cancer onset and progression (as well as other pathological conditions). Spices contain naturally generated lipid-soluble antioxidant biomolecules that may protect against the development of genotoxic lipid peroxides (Pisoschi *et al.,* 2021).

4.7 Antioxidant activity

The production of reactive oxygen species and other free radicals during metabolism is a natural process that is best mitigated by an extensive endogenous antioxidant defense mechanism. Oxidative stress occurs when the pace at which free radicals are produced exceeds the rate at which they are removed. The genesis of disease processes such as cardiovascular disease, inflammatory illnesses, neurological disorders, cancer and other degenerative diseases has been linked to oxidative damage. Antioxidants are substances that slow or prevent oxidative damage by inhibiting oxidative processes. Natural antioxidants found in herbs and spices are gaining popularity. Spices contain bioactive compounds that have potent anti-mutagenic, antiatherogenic, anti-inflammatory, and cancer-preventive properties. These bioactive compounds are antioxidants that have been shown in studies to control cellular oxidative stress and thus play a beneficial role in preventing oxidative stress-related diseases. Spices' high antioxidant activities may mediate the majority of their beneficial impacts on cancer, cardiovascular disease, inflammatory illnesses, and neurological diseases. Because of the role of oxidative alterations of low-density lipoprotein cholesterol in the development of atherosclerosis, the antioxidant capabilities of spices are of special relevance. Because both oxidative stress and inflammation are risk factors for cancer start and progression, spices that reduce oxidative stress and inflammation are significant in their cancer-prevention role (as well as other pathological conditions). Spices include a variety of natural antioxidant biomolecules, both water-soluble and lipid-soluble, that can scavenge reactive oxygen species and protect against the formation of genotoxic lipid peroxide (Yashin *et al*., 2017; Shobana, 2000; Asim *et al*., 2013).

5. Spices production and prospects

Spices and herbs are plant-based ingredients that enhance the flavour of any meal. It's tough to tell the difference between the two. Roots, rhizomes, stems, leaves, bark, flowers, fruits, and seeds are all examples of plant components that may be used to make spices. Herbs are usually considered non-woody plants. By 2027, the global spice and seasonings market is expected to reach 3.2 million metric tonnes. Despite the COVID-19 situation, the worldwide market for spices and seasonings; this was forecast to be 2.5 million metric tonnes in 2020 is expected to grow to 3. India produces more than 50 spices and is the world's top producer, user, and exporter of spices and spice products. Spice utilization is expected to exceed 11 million metric tons by 2026, an increase of 0.8 per cent year on year from 10.6 million tons in 2021. Since the 2017, worldwide demand has increased at a 0.5 per cent annual rate. With 4.6 million metric tons, India consumed the most spices in 2021, followed by Bangladesh, Indonesia, and China. Indian cuisine is completed without the use of a variety of spices, hence the country imports diverse spices to fulfill its native flavour requirements. Andhra Pradesh is India's leading spice-producing state. Other important spice-producing states in India are Gujarat, Karnataka, Rajasthan, Tamilnadu, Assam, Kerala, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh, and West Bengal. Chilli is the most important spice crop in the country, accounting for around 29 per cent of total spice output and 34 per cent of overall spice production. Turmeric is responsible for 14 per cent of output and 6 per cent of the area, whereas garlic is responsible for 19 per cent of production and 5 per cent of the area. Seed spices account for 17 per cent of overall output and 41 percent of total area, whereas pepper accounts for 2 per cent of total production and 9 per cent of the total area of all spices in the nation (Shimelis, 2021; Schweiggert *et al.,* 2007).

6. Conclusion

Good health is a key determinant of wellbeing and protector of chronic diseases including cancer, diabetes, cholesterol, oxidative stress, inflammation, *etc.* Bioactive compounds present in different spices have shown a positive association with chronic diseases and have shown high capability in the prevention of cancer, cardiovascular, diabetes, inflammation, cholesterol, diabetes, microbial, *etc.* Spices and herbs rich in phenolic compounds, such as clove, rosemary, sage, oregano, and cinnamon, are excellent sources of antioxidants. Spices also stimulate the digestive system and therefore promote appetite. Studies to date have demonstrated that bioactive compounds in common spices can have complementary and overlapping

mechanisms of action, including modulation of detoxification enzymes, scavenging of oxidative agents, stimulation of the immune system, regulation of gene expression in cell proliferation and apoptosis, hormone metabolism, antibacterial and antiviral effects.

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Conflict of interest

None.

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