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Antioxidant Rich Spices And Herbs

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ABSTRACT

Antioxidants are substances that prevent oxidation of other compounds or neutralize free radicals. Spices and herbs are rich sources of antioxidants. Spices are rich in antioxidants, and scientific studies suggest that they are also potent inhibitors of tissue damage and inflammation caused by high levels of blood sugar and circulating lipids. They have been used in food and beverages to enhance flavor, aroma and color. Due to their excellent antioxidant activity, spices and herbs have also been used to treat some diseases. In this review article, the chemical composition and antioxidant activity of spices and culinary herbs are presented. Lipid oxidation has been identified as the major deterioration process of vegetable oils. Undesirable effects are even more profound when food processing involves high temperatures in the presence of oxygen. Natural ground herbs (black pepper, ginger, turmeric, rosemary and oregano) were assessed for their antioxidant capacity, phenolic content and ability to improve the oxidative stability of vegetable oils. In the current set-up, the anti-proliferative, anti-hypercholesterolaemic, anti-diabetic, anti-inflammatory effects of spices have overriding importance is discussed. Spices have very low calorie content and are relatively inexpensive; they are reliable sources of antioxidants and other potential bioactive compounds in diet.

Keywords: Antioxidants; spices; herbs; flavonoids; polyphenols, anti-hypercholesterolemia, cardiovascular disease, diabetes.

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INTRODUCTION

Herbs and spices have been used in many different ways. Since the ancient times, spices and culinary herbs have been added to food to enhance flavor and improve their organoleptic properties. Spices and herbs have also been widely used as preservatives and medicine. Spices and herbs have been extensively studied in different countries because of the high antioxidant activity in certain spices and their beneficial effects on human health.² As part of our diet, spices and herbs, in addition to fruits and vegetables, could provide us with additional sources of natural antioxidants. Antioxidants from spices are a large group of bioactive compounds which consist of flavonoids, phenolic compounds, sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes, and vitamins.⁷ These compounds demonstrate different antioxidant activities. For example, flavonoids have the ability to scavenge free radicals and can form complexes with catalytic metal ions rendering them inactive. Studies have shown that spices and herbs such as rosemary, sage, and oregano are excellent sources of antioxidants with their high content of phenolic compounds.⁹ Antioxidants can protect lipids and oils in food against oxidative degradation. When added to food, antioxidants control rancidity development, retard the formation of toxic oxidation products, maintain nutritional quality, and extend the shelf-life of products. Because of safety concerns, synthetic antioxidants are limited to be used as food preservatives. Natural antioxidants obtained from edible materials such as spices and herbs, have been of increasing interest. Several herbs and spices of culinary origin were included in the “approved” monographs, such as caraway oil and seed, cardamom seed, cinnamon bark, cloves, coriander seed, dill seed, fennel oil and seed, garlic, ginger root, licorice root, mint oil, onion, paprika, parsley herb and root, peppermint leaf and oil, rosemary, sage, thyme, turmeric root, and white mustard seed.⁶ Spices are rich in antioxidants, and a scientific study suggests they are also potent inhibitors of tissue damage and inflammation caused by high levels of blood sugar and circulating lipids.¹⁰ Due to their phenol content these are able to block the formation of compounds that contribute to damage caused by metabolic disorders.⁸ Several secondary products of lipid oxidation, such as malondialdehyde and 4-hydroxynonenal, can react with biological components such as proteins, amino acids, and DNA. Malondialdehyde has been shown to be formed both enzymatically and non-enzymatically, and has been implicated in health problems such as mutagenesis and carcinogenesis. Spices and culinary herbs are rich in antioxidants. Therefore, spices could potentially be used as ameliorative or preventive agents for some health issues.¹¹ Antioxidants can protect lipids and oils in food against oxidative degradation. When added to food, antioxidants control rancidity development, retard the formation of

toxic oxidation products, maintain nutritional quality, and extend the shelf-life of products. Because of safety concerns, synthetic antioxidants are limited to be used as food preservatives. Natural antioxidants obtained from edible materials such as spices and herbs, have been of increasing interest¹². Chronic oxidative stress has been reported to lead to a variety of diseases, including cancer, heart related diseases, and the acceleration of aging. Several secondary products of lipid oxidation, such as malondialdehyde and 4-hydroxynonenal, can react with biological components such as proteins, amino acids, and DNA. Malondialdehyde has been shown to be formed both enzymatically and non-enzymatically, and has been implicated in health problems such as mutagenesis and carcinogenesis. Spices and culinary herbs are rich in antioxidants. Therefore, spices could potentially be used as ameliorative or preventive agents for some health issues⁸. To have a better understanding of the antioxidant activity from spices, we present the bioactive compounds, the content of flavonoids, and the total polyphenols in different spices. The therapeutic effects of various spices for different diseases are summarized.

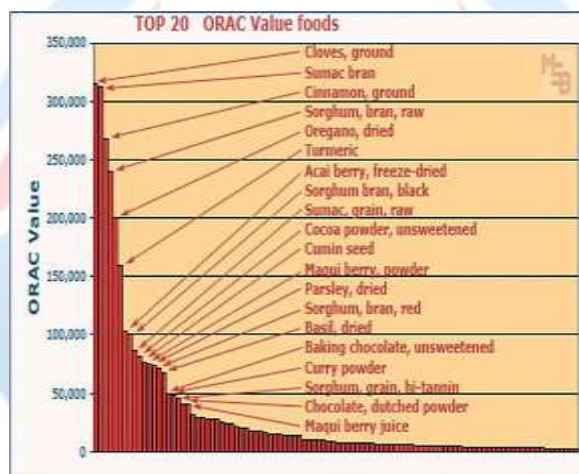


Figure 1: Oxygen Radical Absorbance Capacity



Figure 2: Depicts six prominent antioxidant action.

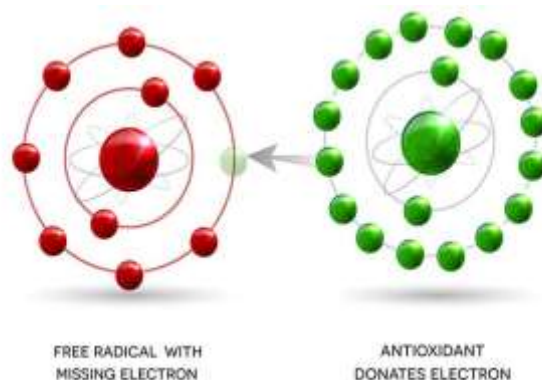


Figure 3: Moe of Action of antioxidants

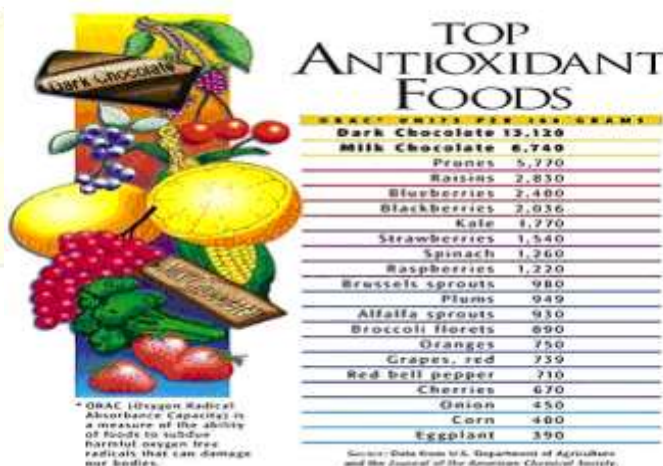


Figure 4: Top antioxidants Foods

Types of Antioxidants

Rosmarinic Acid in Spices

Among these biologically active compounds found in spices, rosmarinic acid was the dominant phenolic compound in the six spices of the family Labiatae which contributed significantly to the antioxidant capacity of these spices. Shan et investigated the total equivalent antioxidant capacity and phenolic content of 26 common spice extracts from 12 botanical families. In their study, major phenolic compounds were identified and quantified in different spices. Rosmarinic acid was found in mint, sweet basil, oregano, rosemary, sage, and thyme¹⁰. The spices with the highest content of rosmarinic acid were oregano (2562.7, mg per 100 g of dry weight), sage (2186.1), rosemary (1286.1), mint (1908.5), sweat basil (1086.1), and thyme (681.1) respectively. Vallverdú-Queralt et al.⁵ studied the phenolic profile of widely used culinary herbs and spices, which included rosemary, thyme, oregano, cinnamon, cumin and bay. The main phenolic acid in the studied culinary herbs was found to be rosmarinic acid, which varied from 0.39 g/g dry weight in bay, to 157 g/g dry weights in rosemary, being the dominant phenolic compound in oregano, thyme and rosemary⁵. The concentrations of

rosmarinic acid in rosemary, oregano, cumin, cinnamon, thyme and bay are quite significant. Nagy et al.³ analyzed the phenolic components in dried spices and found that rosmarinic acid was one of the main constituents in the methanolic extracts of oregano, sage and thyme, which was consistent with other research. Antioxidant activity and phenolic compounds in selected herbs were investigated & Rosmarinic acid and hydroxycinnamic acid compounds have been demonstrated to possess strong antioxidant activity⁸. Rosmarinic acid was the most abundant phenolic constituents. It was found that certain species of oregano had extremely high total phenolic contents and oxygen radical absorption capacity (ORAC) values as well.

Flavonoids in Spices

Ten flavonoids with significant quantity have been identified in different spices. The most frequently found compounds were quercetin, luteolin, and kaempferol. The highest flavonoid contents were as follows: apigenin in dried parsley, luteolin in Mexican oregano, luteolin in celery seeds and cyanidin in Tasmanian pepper. The greatest amount of kaempferol and quercetin was found in capers. Typically flavonoids and phenolic acids are the main phenolics in spices that possess antioxidant activity. The antioxidant activity of phenolic compounds is mainly due to their redox properties such as adsorbing and neutralizing free radicals, quenching singlet and triplet oxygen, or decomposing peroxides. In general, flavonoids have higher antioxidant activities against peroxy radicals than do phenolic acids due to multiple hydroxyl groups. In further followup It was indicated that cumin and peppermint were good sources of flavanones (Naringenin, eriodictyol); parsley and thyme are sources of flavones (apigenin, chrysin, luteolin, diosmetin), and onions are sources of flavonols. Shan et al.⁴ found that cloves have the highest amount of flavonoids (366.5 as mg per 100 g), followed by dill (241.2), caraway (171.9), coriander (167.2), oregano (51.3), rosemary (37.8), mint (23.2), basil (21.0), and sage (20.5). It is not a surprising that spices and herbs are at the top of the list of 100 products with the highest antioxidant content⁴. Their antioxidant activities are ten times higher than that of fruit and vegetables. The antioxidant capacities of some spices showed a positive correlation with their corresponding total polyphenol concentrations.

Garlic

Certain diets are associated with low risk of cardiovascular disease and that these diets are rich in fruits, herbs and spices; the common spice among them is garlic . It is used universally as a flavoring agent, traditional medicine, and a functional food to enhance physical and mental health. Over the centuries, garlic has acquired a unique position in the myths of many cultures as an appalling prophylactic and therapeutic medicinal agent. It has been found to be useful in the treatment of heart disorders, tumors, worms, bites and other ailments.

Hippocrates and Pliny the Elder were both promoters of the intrinsic worth of garlic¹. The first-century Indian physician Charaka (3000 BC), the father of Ayurvedic medicine, claimed that garlic acts as a heart tonic by maintaining the fluidity of blood and strengthens the heart^{1,2}. Over the last 20 years, this important and exciting role of garlic has been and continues to be confirmed by basic and clinical research reports from around the world. Garlic has been advocated for the prevention of heart disease, controls serum cholesterol, decreases LDL and an increase in LDL oxidation, increased platelet aggregation, hypertension, and smoking, inhibit enzymes involved in lipid synthesis, decrease platelet aggregation, prevent lipid peroxidation of oxidized erythrocytes and LDL, increase antioxidant status, and inhibit angiotensin-converting enzyme, S-allyl cysteine present in aged garlic extract is a potent inhibitor of cholesterol synthesis, consuming a half to one clove of garlic (or equivalent) daily may have a cholesterol-lowering effect of up to 9%. It increases high-density lipoprotein (HDL) levels, which may help to remove excess cholesterol from arterial tissue. Recently, Subhendu *et al.*^{2,4} have observed that freshly crushed garlic exerts superior cardioprotective activity than processed garlic. Both turmeric and Curcumin, due to their antioxidant and anti-inflammatory activity, have been demonstrated to counteract several disorders such as myocardial infarctions, chronic inflammatory lung diseases, pancreatitis, inflammatory bowel diseases, neurodegenerative diseases, hepatic and lung damages as well as muscle injuries and cystic fibrosis^{2,6}. Curcumin can also impact on the process of cataractogenesis and delays galactose-induced cataracts formation in rats^{2,7}.

Curcumin

Turmeric was used as an anti-inflammatory agent to treat gas, colic, toothaches, chest pains, and menstrual difficulties. This spice was also used to help with stomach and liver problems, to heal wounds and lighten scars, and as a cosmetic^{2,5}. In a natural mutant model of obesity, turmeric (at 1 and 5% of the diet) had significantly reduced cholesterol and triglyceride concentrations while increasing HDL cholesterol, within 4 weeks. Further evidence indicates that it reduces the oxidation of LDL, blood glucose and renal lesions in diabetes. In addition, it has been demonstrated to reduce platelet aggregation, cyclooxygenase, thromboxane, smooth muscle cell proliferation and endothelial dysfunction. Studies show that the preventive mechanisms of Curcumin regarding heart disease is multi-targeted. The antioxidant effects of Curcumin have been shown to attenuate adriamycin-induced cardiotoxicity^{2,8} and may prevent diabetic cardiovascular complications^{2,9}, antithrombotic,⁶ anti-proliferative and anti-inflammatory effects of Curcumin and the effect of Curcumin in decreasing the serum cholesterol level may protect against the pathological changes seen in atherosclerosis². Curcumin, present in turmeric inhibits NF- κ B transcriptional factor, through

inhibition of IKK, a kinase which is needed for NF- κ B activation; improve the surge of pro-inflammatory cytokines during cardiopulmonary bypass (CBP) and decreases cardiomyocytic apoptosis after global cardiac ischemia/reperfusion injury ³.

Ginger

It's useful in unrelated ailments that include arthritis, rheumatism, sprains, muscular aches, pains, sore throats, cramps, constipation, indigestion, vomiting, hypertension, dementia, fever, infectious diseases and helminthiasis ³. It relaxes blood vessels, stimulate blood flow and relieve pain. Other potentially active compounds present in ginger are phenolic compounds. It is useful in anti-inflammatory agent, which means it may be useful in fighting heart disease, cancer, Alzheimer's disease and arthritis. Antimicrobial, anti thrombotic, anti-inflammatory and anticancer activity have also been reported ^{3, 6}. It significantly reduces in the plasma and LDL cholesterol levels, with a parallel reduction in the oxidative response of macrophages, and reduced LDL atherogenic modifications (oxidation and aggregation). The anti-atherogenicity of ginger extract could also be attributed to its direct antioxidative effects on macrophages as well as on plasma LDL.

Black pepper

It decrease in the levels of cholesterol (both the free and ester cholesterol fractions), free fatty acids, phospholipids and triglycerides. It decreases LDL but increases HDL cholesterol.

Cinnamon

Studies have shown the antioxidant and antimicrobial potential ⁵, the antidiarrhoeal activity of Cinnamon is also well documented. Also it reduced peripheral vascular resistance, suggesting an undeviating vasodilatation of peripheral vessels. Dietary cinnamon increases biliary secretion of cholesterol and phospholipids without affecting the bile content. Suppression of total serum cholesterol, triglycerides, phospholipids and low density lipoprotein levels also observed. It also hampers HMG-CoA reductase activity in liver thereby lowering the Cholesterol levels. Cinnamon demonstrated significant ability to inhibit initiation as well as propagation of lipid peroxidation due to their polyphenols content, strong reducing power and superoxide radical scavenging activity ⁶. Cinnamon exhibited linear dose-dependent Nitric oxide suppressing effect without any effect upon cell viability ^[8].

Coriander

The seeds of coriander have a remarkable hypolipidemic action. The levels of total cholesterol and triglycerides decreased significantly in the tissues. Significant increases in -hydroxy, -methyl glutaryl CoA reductase and plasma lecithin cholesterol acyl transferase activity were noted in the experimental group. The increased activity of plasma LCAT enhanced hepatic bile acid synthesis and the increased degradation of cholesterol to fecal bile

acids and neutral sterols appeared to account for its hypercholesterolaemic effect ^{6, 3}. Thrombosis, an important event in cardiovascular diseases, can be fatal if platelet aggregation takes place in the narrowed lumen of arteries, causing an impairment of blood flow to the heart.

Therapeutic Effect of Spices on Human Health and Other Applications



Figure 5: Wonder food supplement.

Spices have been reported to have various beneficial effects on human health which include anti-sclerotic, antithrombotic, anti-carcinogenic, anti-inflammatory, antiarrhythmic, anti-rheumatic, gastroprotective, and lipid-lowering action. In addition, spices have radioprotective (protects against radiation), anti-allergic, and antimalarial effects. Spices inhibit the oxidation of low-density lipoprotein and protein glycation. Many spices are highly potent antiseptics because they have an antibacterial, antimicrobial, and even antiviral effect. A synergistic effect on oral bacteria was observed when cloves were used along with antibiotics. The therapeutic effects of certain spices are so significant that they have often been included in non-clinical, clinical, and therapeutic studies. A non-clinical trial of rosemary showed that rosemary could act as a cancer prevention agent. Some clinical and therapeutic trials for evaluation of spices against several diseases have been conducted. Studies show that Curcumin possesses anti-inflammatory effects and therapeutic effect in gastrointestinal diseases. It is an inhibitor of low density lipoprotein oxidation and also showed effects against neurodegenerative diseases. Ginger and garlic have extensively therapeutic effects, especially for cardiovascular diseases. These will be reviewed in following section. Cloves, Nigella, black pepper, garlic, and ginger have been used against cancer. Aged aqueous-alcoholic extract of garlic was also reported to be potentially effective against certain cancers summarizes anticancer actions of some spices. The following compounds contained in spices have anti-carcinogenic properties: curcumin, apigenin,

luteolin, quercetin, thymoquinone, and isothiocyanate. Some spices play a critical role in the management of heart disease because these spices have been shown to inhibit enzymes involved in lipid synthesis, decrease platelet aggregation, prevent lipid peroxidation, reduce LDL (low-density lipoprotein) levels and increase coronary blood flow. Spices have been used to preserve food to inhibit or delay lipid oxidation and rancidity in foods. Since ancient times it has been known that spices help preserve many foods. Now the application of spices have become even more broad: extension of cheese shelf-life by adding cinnamon; preservation of vitamin E in sunflower oil by adding different spices; inhibition of omega-3 fatty acid oxidation in vegetable oils by oregano and rosemary as well as sterol oxidation in extra virgin olive oil; extension of meat shelf-life by various spices. Due to high antioxidant activity, spices suppress harmful effects of carcinogenic pollutants that may be present in foods and beverages, especially aflatoxins, heterocyclic amines, acrylamide, 1, 2-Dimethylhydrazine and cadmium. Spices can also neutralize the harmful effects of hazardous solvents and motor exhaust emissions from road transport in urban areas.

Therefore, it is important and reasonable to encourage people to consume spices regularly in order to protect them from harmful environmental impacts, especially in large, polluted cities.

SUMMARY

To summarize, spices are heterogeneous collections of a wide variety of volatile and non-volatile staple dietary additives. India with its wide climatic conditions and topographical features naturally possesses wide variety of spices which are being used in the diet. The above discussed spices namely garlic, pepper, coriander, ginger, turmeric, cinnamon are commonly used spices in Indian delicacies. These spices turn an ordinary meal to an extraordinary experience. They have a diverse array of natural phytochemicals that have complementary and overlapping actions. As several metabolic diseases and age-related degenerative disorders such as cardiovascular disorders are closely associated with oxidative processes in the body, the use of herbs and spices as a source of antioxidants to combat oxidation warrants further attention. From a dietary perspective, the functionality of herbs and spices will be exposed through consideration of their properties as foods. As with most foods, the real benefits of including them in the diet are likely to emerge with a better understanding of the attributes of health that are best supported by food, and in methodological developments addressing the evidence base for their effects. These developments are well underway through evidence-based frameworks for substantiating health claims related to foods for a healthy heart. At present, recommendations are warranted to support the consumption of foods rich in bioactive components, such spices. With time, we can expect to see a greater body of scientific evidence supporting the benefits of spices in the

overall maintenance of a healthy heart which is the most important organ for every beat of life and protection from diseases of the heart.

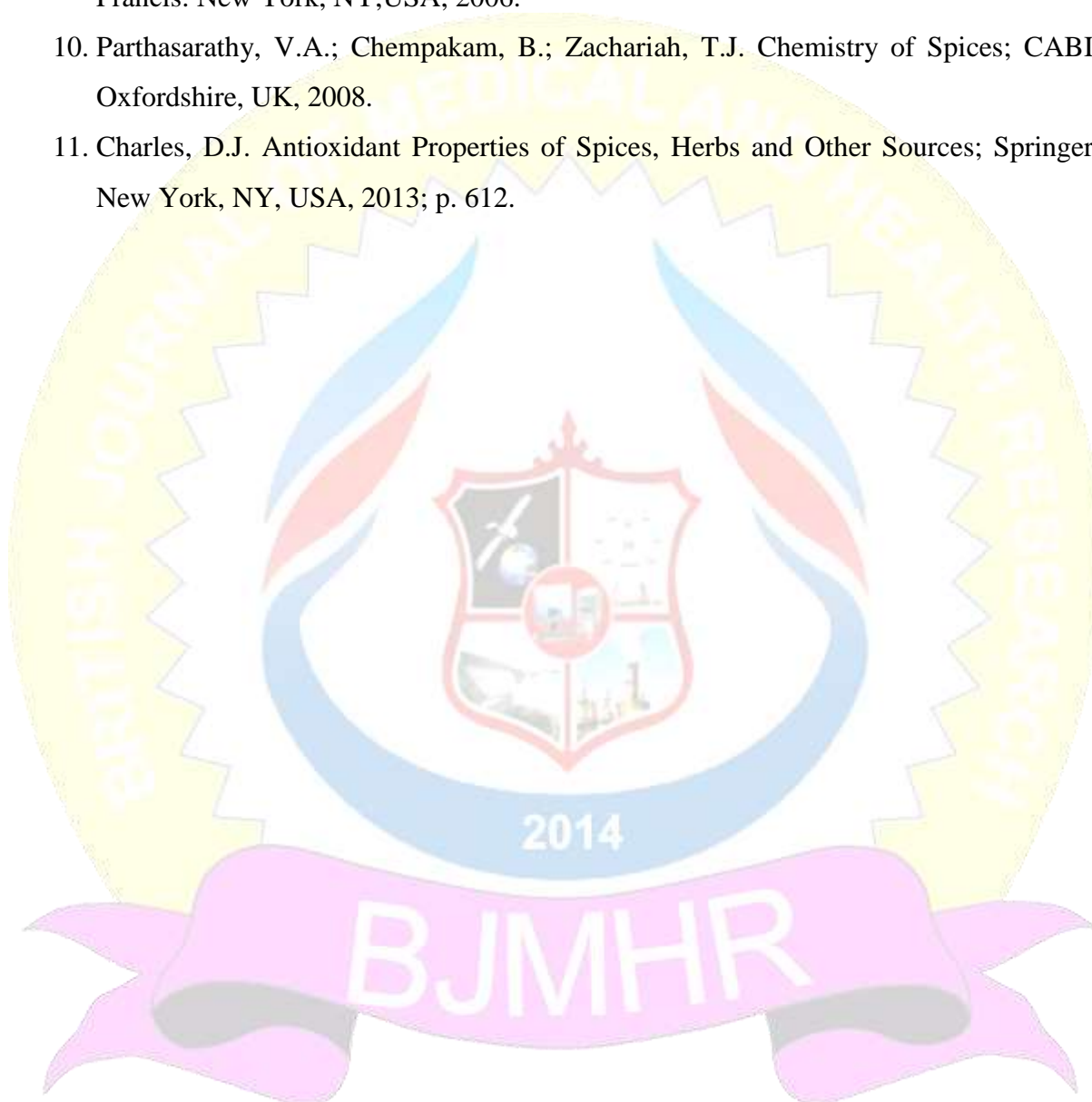
CONCLUSION

Based on the reviewed literature, we know that spices not only enhance the flavor, aroma, and color of food and beverages, but they can also protect people from acute and chronic diseases, due to their high antioxidant activity. This review presents abundant data on the antioxidant activities of spices and culinary herbs, as well as information related to their content of flavonoids and total polyphenols. Many of the antioxidants contained in spices have significantly high biological activities and are actively used in preclinical, clinical, and therapeutic trials investigating new treatments of diseases. It is possible that new spice-based drugs may be developed. This review also presents a strong body of evidence that spice consumption can reduce or even eliminate the harmful effects on humans from contaminants in foods and from the environment; this is even more important for people living in polluted cities. All of this information will hopefully add to an already high level of interest toward spices and culinary herbs. Spices and herbs should certainly be incorporated as integral parts of healthy, nutritious eating, and as functional food ingredients.

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