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A Review on Antioxidant Benefits of Aromatic Spices

PRACHI AVINASH*[1] AND KUSUM MITTAL[2]
[1]Post Doctoral Fellow (UGC) and [2]Head
Department of Home Science, GMG College, MLSU, Udaipur (Rajasthan) India

ABSTRACT

India is considered as the "Home of Spices". They are a prized group of minor components and have been an integral ingredient of Indian diet.Spices are potent plant foods that possess a wide range of nutrient bioactive compounds that contribute to improve health, while adding variety, colour, flavour and aroma to daily diet. Spices are accessory foods mainly used for flavouring food preparations to improve their palatability.Incorporation of spices in our regular diet may prove to be beneficial for our health.

Key Words : Antioxidant benefits, Aromatics spices, Home of spices, Foods, Health

INTRODUCTION

India is considered as the "Home of Spices". They are a prized group of minor components and have been an integral ingredient of Indian diet. Since antiquity, spices form an important part of the Ayurvedic Pharmacopoeia (The Indian System of Medicine), with their widespread traditional use. With its wide climatic conditions and topographical features, India naturally possesses wide variety of medicinal flora. The country enjoys the distinction of being the largest producer and consumer of spices as well as the fastest growing spice market in the world.

Spices are potent plant foods that possess a wide range of nutrient bioactive compounds that contribute to improve health, while adding variety, colour, flavour and aroma to daily diet. The term spice or condiment applies to "such natural plant or vegetable products or mixtures thereof, in whole or ground form, as are used for imparting flavour, aroma and piquancy to and for seasoning food" (Sikri and Berwal, 2008).

Webster (2011) describes spices as 'Any of various aromatic vegetable productions as pepper, cinnamon, nutmeg, mace, allspice, ginger, cloves, etc., used in cookery to season and to flavour sauces, pickles, etc.; a vegetable condiment or relish, usually in the form of a powder; also, as condiments collectively'.

India alone contributes 25-30 % of the total world trade in spices. It is interesting to note that nine spices namely pepper, ginger, clove, cinnamon, cassia, mace, nutmeg, pimento (allspice) and cardamom alone contributed as much as 90% of the total world trade. Of the 109 useful spices listed in the ISO, India produces 63 spices and exports approximately 10% of its produce to about 150 countries worldwide (Zachariah and Jayashree, 2011). Among the importing countries USA is the largest importer of spices. Several other countries like Australia, Britain, Canada, Russia, and some European countries also import spices (Panda, 2010).

Origin of spices:

The fame of Indian spices is older than the recorded history. Centuries before Greece and Rome had their birth sailing ships were carrying to Mesopotamia, Arabia and Egypt the Indian spices, perfumes and fine textiles. It was the lure of these spices that brought many seafarers to the shores of India. Long before the Christian era the Greek merchants thronged the markets of South India buying spices among other precious things.

It was in the year 1492, that Christopher Columbus discovered the New World. Five years later, four tiny ships sailed southward from the port of Lisbon Portugal

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under the guidance of Captain Vasco Da Gama. Like Columbus Vasco Da Gama too was searching for a new route to the spice lands of Asia. While Columbus failed to achieve that goal, Da Gama succeeded. In a two year 24,000 mile round trip, he took his ships around the continent of Africa to India and back to Lisbon. Only two of the four ships survived to reach their homeport. These two ships brought back a cargo of spices and other products worth 60 times the cost of the said voyage (Panda, 2010).

During these middle ages, a pound of ginger was worth a sheep, a pound of mace worth three sheep or half a cow. Pepper, the most valuable spice of all was counted out in individual peppercorns and a sack of pepper was said to be worth a man's life. Vasco Da Gama's successful voyage intensified an international power struggle for control over the spice trade. For three centuries afterward the nations of Western Europe, Portugal, Spain, France, Holland and Great Britain fought bloody sea was over the spice producing colonies. Writers acknowledge the fascinating history of spices as a story of adventure exploration conquest and fierce naval rivalry.

Classification of spices:

As per the agricultural classification of plants based on primary use, spices have been categorized as spice crops as plants grown for the production of aromatic materials or substances which are used as food flavouring or for other purposes because of their fragrance or preservative qualities. Spices are in solid or liquid forms (Bareja, 2010).

The taxonomic classification of spices is shown in Table 1. A conventional classification of spices (Table 2) based on degree of taste classifies spices into four categories, *viz.,* hot spices, mild spices, aromatic spices and herbs and aromatic vegetables (Peter, 2001; Aggarwal, 2008).

The nutritive value of spices:

According to the Gopalan *et al.* (2007), spices are accessory foods mainly used for flavouring food preparations to improve their palatability. Some spices are however rich in iron, trace metals and potassium and also may provide β-carotene and vitamin-C. Most spices contain high levels of tannin (turmeric) which interferes

Table 1: Taxonomic classification of spices

Angiospermae	Dicolyledoneae	Sympetalae		*Solanaceae*	Chilli, paprika, red pepper
				Pedaliaceae	Sesame
			Campalunatae	*Compositae*	Camomile, chicory, tarragon
		Archichlamydaeae	Piperales	*Piperaceae*	Cubeba, long pepper, pepper
			Ranales	*Myristicaceae*	Mace, nutmeg
				Lauraceae	Bay leaf, cassia, cinnamon
				Magnoliaceae	Star-anise
			Rhoeadales	*Cruciferae*	Mustard, wasabi
			Myrtiflorae	*Myrtaceae*	Allspice, clove
			Umbelliflorae	*Umbelliferae*	Anise, caraway, celery, chervil, coriander, cumin, dill, fennel, parsley
	Monocotyle-doneae		Liliiflorae	*Liliaceae*	Garlic, onion
				Iridaceae	Saffron
			Scitamineae	*Zingiberaceae*	Cardamom, ginger, turmeric
			Orchidales	*Orchidaceae*	Vanilla

Table 2: Conventional classification of spices

Classes	Spices
Hot spices	Capsicum (chilies), Cayenne pepper, black and white peppers, ginger, mustard
Mild spices	Paprika
Aromatic spices	Allspice, cardamom, cassia, cinnamon, clove, cumin, dill, fennel, fenugreek, mace and nutmeg
Herbs	Basil, bay, dill leaves, marjoram, tarragon, thyme
Aromatic vegetables	Onion, garlic, shallot, celery

with absorption of iron. Phenols are the beneficiary antioxidant compounds found in spices in significant amounts. Halliwell (2002) and Aggarwal *et al.* (2002) revealed that owing to their antioxidant properties, various therapeutic effects have been assigned to spices and spice-derived ingredients.

Seed spices contain variable amounts of protein, fat, carbohydrate, fibre, minerals and vitamins. However, owing to the very small quantity used in the food, their contribution to the nutrient requirement is not significant. Proteins, carbohydrates, minerals and vitamins are thus relatively less important in delineating the quality of spices (Agarwal, 2001).

Spices are rich in essential oils which, in addition to be used in the food industry, are also used in cosmetic and medicinal preparations. The nutritive value of spices is insignificant, but their commercial value is high (Bareja, 2010).

Results of a survey related to the consumption of spices done by Avinash and Sankhla (2012a), revealed that though consumption of aromatic spices was noteworthy among the studied population, the use was largely attributed to the taste and flavour imparted by spices in food and the therapeutic or medicinal value of spices was not recognized by the majority of respondents.

Antioxidant benefits of spices:

Extensive work is being conducted all over the world to demonstrate the anti-mutagenic and anti-carcinogenic potential of some of the commonly consumed spices. This renewed interest in natural medicines today is mainly due to the fact that many chronic diseases including cancer still remain difficult to cure. As such, attempts are being made to identify naturally occurring anticarcinogens, which may lead to new strategies for cancer prevention. In humans, phytoprotectants can have complementary and overlapping actions, including antioxidant, antimutagenic and anti-inflammatory effects, modulation of detoxification enzymes, and induction of apoptotic activity and so on. Thus, incorporation of spices in our regular diet may prove to be beneficial for our health. Nevertheless, the effect of spices in the context of total diet still remains to be evaluated. It is still not clear that mechanisms that appear to influence disease risk in animals, often fed high doses of these spices, can be extrapolated to humans consuming realistic amounts of these spices as part of their daily diet (Bhattacharjee and Sengupta, 2009). It is still unclear whether chronic consumption can lead to health risks (Hinneburg *et al.*, 2006).

According to Tapsell *et al.* (2006) herbs and spices have a traditional history of use, with strong roles in cultural heritage, and in the appreciation of food and its links to health. Demonstrating the benefits of foods by scientific means remains a challenge, particularly when compared with standards applied for assessing pharmaceutical agents. Pharmaceuticals are small-molecular-weight compounds consumed in a purified and concentrated form. Food is eaten in combinations, in relatively large, unmeasured quantities under highly socialized conditions. The antioxidant properties of herbs and spices are of particular interest in view of the impact of oxidative modification of low density lipoprotein cholesterol in the development of atherosclerosis. A range of bioactive compounds in herbs and spices have been studied for anti-carcinogenic properties in animal research on the effects of herbs and spices on mental health should distinguish between cognitive decline associated with ageing and the acute effects of psychological and cognitive function. There is level I and II evidence for the effect of some herbal supplements on psychological and cognitive function. There is very limited scientific evidence for the effects of herbs and spices on type 2 diabetes mellitus.

A study by Jain *et al.* (2011) showed the antioxidant properties of 37 medicinal plants playing part significantly in postnatal recovery. The investigation supported the traditional use of these plants in postpartum care. It was quoted that some medicinal plants are potent antioxidants and may be efficient as preventive agents in many diseases.

Spices are an important group of agricultural commodities being used by many civilizations all over the world to aid flavour, taste and nutritional values in the food. In traditional medical systems, their ability to heal various physical, mental and emotional problems has widely been reported. With this view, HPLC analysis was performed to estimate phenolic acids in 21 spices (asafoetida, bishop's weed, black mustard, coriander, cinnamon, clove, curry leaf, cumin black, cumin, fennel, fenugreek, garlic, ginger, Indian cassia, Indian dill or dill large cardamom, onion, saffron, tamarind, true cardamom, yellow mustard) commonly used in India in different forms. Several parts of the spices, for instance, seeds, leaves, barks, rhizomes, latex, stigmas, floral buds and modified stems were used in the study. It was reported that spices are known to significantly contribute to the flavor, taste, and medicinal properties of food because of phenolics (Singh *et al*., 2004).

Spices used in Indian foods such as cloves (*Syzygium aromaticum*), licorice (*Glycyrrhiza glabra*), mace (aril of *Myristica fragans*), and greater cardamom (*Amomum subulatum*) were tested for their antioxidant properties *in vitro* by Yadav and Bhatnagar (2007). Cloves showed the highest DPPH radical scavenging activity, followed by licorice, mace and cardamom. FRAP values for cloves were also the highest, while other spices showed comparatively lesser FRAP values. The results show that the spices tested are strong antioxidants and may have beneficial effects on human health.

A study published by Avinash and Sankhla (2012b) on antioxidant activity of seven aromatic spices and three nuts revealed that the locally available aromatic spices and nuts possessed significant antioxidant activity. Clove among selected aromatic spices (ajowan, cardamom, cinnamon, clove, coriander, cumin and fennel) showed the highest antioxidative potential for all the three methods of analysis namely TPC, DPPH scavenging activity and FRAP activity. It was recommended that the general public should be made aware about the antioxidant benefits of these aromatic spices and should be encouraged for their regular consumption.

In a study by Souri *et al.* (2008) on the antioxidant activity and phenolic content of twenty four medicinal plant extracts, it was concluded that medicinal plants were promising sources of potential antioxidants and may be efficient as preventive agents in the pathogenesis of some diseases. Seven plant materials (cumin, fennel, lettuce, nutmeg, great plantain, common purslane and bishop's weed) showed high antioxidant activities.

Radical scavenging activity (RSA), antioxidant activity (AA), reducing power, total polyphenol (TP) and flavonoid con- tents (TFC) of oregano (*Oreganum vulgare* spp.), ajowan (*Trachyspermum ammi*) and Indian borage (*Plectranthus amboinicus*) extracts were evaluated by Khanum *et al.* (2011). Oregano exhibited maximum radical scavenging activity (88.2%, 82.3%) for aqueous and ethanolic extracts at 50 ppm concentration, respectively, followed by ajowan (86.9%, 68.4%) and Indian borage (30.5%, 30.4%). Extracts of oregano and ajowan showed better antioxidant activity and reducing power than that of Indian borage. Aqueous extracts of oregano had highest TP (Gallic acid equivalents) and TFC (Catechin equivalents) of 27.7% and 50.6%, respectively compared to ajowan (6.7%, 24.4%) and Indian borage (4.2%, 5.5%). Synergistic studies showed that the addition of oregano extract appreciably enhanced the RSA of ajowan and Indian borage extracts even at 50 ppm concentration.

The relative levels of antioxidant activity, total flavonoid content, total phenolic content and reducing power of different organic and aqueous extracts with hexane sequentially extracted, dichloromethane, ethyl acetate, methanol and water of four different varieties of cardamom *viz.,* Mysore, Malabar, Vazhukka and Guatemala were studied by Amma *et al.* (2010). Based on the results Malabar variety was identified as the best source of antioxidant compounds.

Skulas-Ray *et al.* (2011) found in an *in vivo* study that seasoning a meal high in fat with antioxidant-rich spice blend could enhance antioxidant defences and reduce the body's negative responses. Adding spices to the meal significantly increased the ferric reducing antioxidant power, such that postprandial increases following the spiced meal were 2-fold greater than that after the control meal.

A study presented at the national conference of Indian society of clinical nutrition, AIIMS, New Delhi by Avinash and Mittal (2018) emphasised on formulating mixes from aromatic spices, which could be conveniently incorporated in daily diets. Two mixes A and B were prepared and assessment of antioxidant activity revealed high potential of these mixes in imparting benefits to consumers. Composition was standardized for Mix A (Ajowan, Fennel, Clove) and Mix B (Cardamom, Fennel, Cinnamon, Clove). TPC for Mix A and B was 53.05 and 66.86 mg GAE/g; % DPPH scavenging activity 63.64 and 84.91 per cent and FRAP values were 21.05 and 12.04 mg/g, respectively.

In a study by Ninfali *et al.* (2005), twenty-seven vegetables, fifteen aromatic herbs and some spices consumed in Central Italy (the Marches region) were studied to reveal total phenolic, flavonoid and flavanol content as well as their antioxidant capacity measured by the oxygen radical absorbance capacity (ORAC) method. A comparison in terms of antioxidant capacity was made between different salads, as well as between salads to which aromatic herbs had been added. Among the spices tested, cumin and fresh ginger made the most significant contribution to the antioxidant capacity. It was concluded that spices and aromatized salts should be regarded as supplement seasonings capable of providing a marked increase in phenolic and antioxidant capacity. The addition of aromatic herbs to salads, at a percentage compatible with palatability, markedly increases their antioxidant capacity.

Muchuweti *et al.* (2007) investigated aqueous methanolic extracts of 9 spices for their phenolic compounds composition and their antioxidant properties. The phenolic compound contents were determined by Folin Ciocalteau, tannin binding assay and HPLC. Antioxidant properties were determined by the reducing power assay, radical scavenging assay, and β-carotene linoleic model system. Among the spices investigated, cinnamon and oregano had the highest antioxidant activities of 61.76 and 58.28%, respectively. It was concluded that spices had antioxidant activities better than ascorbic acid.

In a study by Hossain *et al.* (2008) the antioxidant capacity of 30 spices used frequently in ready meals and a selection of key compounds from spices were investigated using ferric reducing antioxidant properties (FRAP), 2,2'-azinobis (3-ethylebenzothiaziline-6-sulfonate) (ABTS) and microsomal lipid peroxidation (MLP) assays. Antioxidant capacities of the spice extracts were compared to 5 popular synthetic antioxidants [buylatedhydroxyanisole (BHA), butylatedhydroxytoluene (BHT), tert-butylated hydroquinone (TBHQ), propyl gallate (PG) and octylgallate (OG)]. Results showed that clove extracts had the highest antioxidant capacity as measured by FRAP, ABTS and MLP assays. Extracts from garlic powder were the lowest ranked of all the spices examined. Synthetic antioxidants were ranked in the following decreasing order of antioxidant activity PG > BHA > TBHQ > OG > BHT. Rosmarinic acid, a polyphenol commonly found in lamiaceae spices and eugenol from clove had higher antioxidant capacities than that of all synthetic antioxidants investigated. Antioxidant capacities of kaempferol from apiaceae spices, capsaicin from chilli, curcumin from turmeric, thymol from thyme and gingerol from ginger were also comparable to most of the synthetic antioxidants.

A study by Wang *et al.* (2010) was conducted to examine the in vitro antioxidant activities of forty-five commonly used essential oils and their major components. The oils and major components were subjected to screening for their possible antioxidant activity by measuring the ABTS+ radical scavenging ability, reducing power and metal chelating activity. The ABTS+ radical scavenging ability and reducing power of cinnamon leaf and clove bud essential oils were the best two among these essential oils. Cinnamon leaf (96.45 ± 0.01%) and clove bud (96.33 ± 0.01%) essential oils showed the strongest ABTS+ radical scavenging ability. The EC50 values of cinnamon leaf and clove bud essential oils are 12 μg/mL and 10 μg/mL, respectively. Cinnamon leaf and clove bud essential oils showed reducing power of 119.42 ± 0.68% and 112.92 ± 0.87% relative to butylatedhydroxyanisole (BHA), respectively.

Conclusion:

The inclusion of nuts and spices in Indian cookery has been since the times immemorial. But, recognition of potential of these natural sources of antioxidants to affect markers associated with chronic degenerative diseases is only recent. Inclusion of spices in our regular diet may prove to be beneficial for our health as they have been found to possess antioxidant, antimutagenic and anti-inflammatory effects, modulation of detoxification enzymes, etc. The need is spread the word of awareness so that not only the commonly consumed spices, but also the aromatic spices are used more often by the general public.

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