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Comparative Antioxidant Activity Study of Some Commonly Used Spices in Bangladesh

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Abstract: Many spices have been shown to impart an antioxidative effect in foods. This study summarized the literature on the antioxidativc effects of spices. The term spice is defined as dry plant material that is normally added to food to impart flavor. The methanolic crude extracts of *Allium sativum*, *Coriandrum sativum*, *Cuminum cyminum*, *Zingiber officinale*, *Cinnamomum verum*, *Elettaria cardamomum* and *Cinnamomum tamala* were screened for their free radical scavenging properties using ascorbic acid as standard antioxidant. Free radical scavenging activity was evaluated using 1,1-diphenyl-2-picryl hydrazyl (DPPH) free radical. The overall antioxidant activity of *Cuminum cyminum* was found to be the strongest, followed in descending order by *Z. officinale*, *C. sativum*, *A. sativum*, *C. tamala*, *C. verum*, *E. cardamomum*. The IC_{50} values of the extracts ranged between 15 .48 and 217.431 ($\mu g\ mL^{-1}$). The ascorbic acid levels was 22.78 ($\mu g\ mL^{-1}$) the present study revealed that the selected plants would exert several beneficial effects by virtue of their antioxidant activity and could be harnessed as drug formulation.

Key words: Antioxidant, 1,1-diphenyl-2-picryl hydrazyl, radical scavenger

INTRODUCTION

Free radicals and reactive oxygen species have been implicated in the induction of various types of oxidative damage to biomolecules that results aging, cancer, neurodegenerative diseases, atherosclerosis, malaria, several pathological events in living organisms and different other diseases associated with our life-style. (Shahidi and Naczk, 1995; Halliwell *et al*., 1992). These molecules can induce changes in different biological tissues and cell biomolecules such as lipids, proteins, DNA or RNA. Free radicals can also affect food quality; reducing its nutritional content and promoting the development of food deterioration (Nickavar and Abolhasani, 2009).

Many synthetic antioxidants have been used in the food industries, but recent publications have mentioned the disadvantages of them and their possible toxic properties for human and animal health. Therefore, natural antioxidant substances are required for the protection against the oxidizing agents (Tepe *et al*., 2006; Wagensteen *et al*., 2004). A great number of aromatic, medicinal, spice and other plants contain chemical compounds exhibiting antioxidant properties (Halliwell *et al*., 1992).

Garlic (*Allium sativum*) is among the oldest of all cultivated plants. It has been used as a medicinal agent for thousands of years. It is a remarkable plant, which has multiple beneficial effects such as antimicrobial, antithrombotic, hypolipidemic, antiarthritic, hypoglycemic and antitumor activity *Coriandrum sativum* (coriander) has traditionally been referred to as antidiabetic (Gray and Flatt, 1999), anti-inflammatory and cholesterol lowering agent (Chithra and Leelamma, 1997; Sabahat and Perween, 2007).

Cuminum cyminum L. belonging to the family Apiaceae is consumed in fairly large quantities by Indians. The widespread use of Cumin in Ayurvedic medicine for the treatment of dyspepsia, diarrhoea and jaundice has been reported. It also has stomachic, diuretic, carminative, emmanogogic and antispasmodic properties (Joshi, 2000).

Zingiber officinael has long been used in traditional medicine as a cure for some diseases including inflammatory diseases. Ginger contains active phenolic compounds such as gingerol, paradol and shogoal that have antioxidant, anti-cancer, anti-inflammatory, anti-angiogenesis and anti-artherosclerotic properties (Habib *et al*., 2008).

Cinnamomum verum belongs to the family Lauraceae. Cinnamaldehyde, one of the components *C. verum* has been found to possess significant antiallergic, antiulcerogenic, antipyretic, anaesthetic and antimutagenic activities (Sindhu and Abraham, 2006).

Cardamom spice consists of whole or ground dried fruit of *Elettaria cardamomum* (Linn.) Maton, a herbaceous perennial of the ginger family (Zingiberaceae) which is widely used for flavouring purposes ion food.

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Medically, they are used for flatulent indigestion and to stimulate the appetite in people with anorexia. Moreover the seeds were prescribed in Ayurvedic medicine for cough, colds, bronchitis, asthma and indigestion. Furthermore cardamom oil has antibacterial properties (Al-Zuhair *et al*., 1996).

Cinnamomum tamala belongs to the family lauraceae is effective as carminative, stimulant, diuretic, diaphoretic, lactagogue, deobstruent and aromatic (Ghani, 2003).

Spices-contribute much to the taste and flavor of our foods as natural food additives for thousands years. There are various medicinal properties of spices. Some of them include the beneficial influence on lipid metabolism, anti-diabetic efficacy, digestion stimulation, antioxidant property and anti-inflammatory potential (Srinivasan, 2005).

The current study had been done on seven spices. The free radical scavenging activity against 1, 1-diphenyl-2-picryl hydrazyl (DPPH) was evaluated during the course of work. The ascorbic acid with antioxidant activity was also determined. The assessment of such properties remains an interesting and useful task, particularly for finding new sources for natural antioxidants.

MATERIALS AND METHODS

DPPH was obtained from Sigma Aldrich Co. (St. Louis, USA). All other chemicals used were of analytical grade.

Collection of tested plant parts: Tested plant parts of the spices were collected locally or obtained from a local market. Plant material consisted of the fresh bulb part of *Allium sativum,* underground stem of *Zingiber officinal*, fruits parts of *Coriandrum sativum* and *Cuminum cyminum*, mature leaves of *Cinnamomum tamala*, bark of *Cinnamomum verum* and seeds of *Electaria cardamomum* in the month of June 2009 and identified by Dr. M. A. Razzaque Shah, Tissue Culture Specialist, BRAC Plant Biotechnology Laboratory, Dhaka, Bangladesh.

Preparation of crude plant extract: All the tested materials were sun dried for seven days and ground. Extraction was performed at room temperature. About 200 g of dried, ground plant material were soaked in 2 L of 98% methanol for 5-7 days, stirring every 18 h using a sterilized glass rod, separately. The final extracts were passed through No. 1 Whatman filter paper (Whatman Ltd., UK). The filtrates obtained were concentrated under vacuum in a rotary evaporator at 40°C and stored at 4°C for further use.

Antioxidant activity (DPPH free radical scavenging activity) of methanolic extract: Antioxidant activity of the plant extracts and the standards was assessed on the basis of the radical scavenging effect of the stable DPPH free radical, using Brand-Williams *et al.* (1995) method. In the experiment, 2.0 mg of each of the extracts was dissolved in methanol. Solution of varying concentrations such as 500, 250, 125, 62.50, 31.25, 15.62, 7.8125, 3.91, 1.95 and 0.98 μg mL^{-1} were obtained by serial dilution technique. Two milliliter of a methanol solution of the extract of each concentration was mixed with 3 mL of a DPPH-methanol solution (20 (μg mL^{-1}) and was allowed to stand for 20 min for the reaction to occur. Then the absorbance was determined at 517 nm and from these values the corresponding percentage of inhibitions were calculated by using the following equation:

$$\text{Inhibition (\%)} = 1-\frac{\text{ABS}_{\text{sample}}}{\text{ABS}_{\text{conlrol}}}\times 100$$

Then % inhibitions were plotted against respective concentrations used and from the graph IC_{50} was calculated by using ascorbic acid, a potential antioxidant, was used as positive control.

The result of antioxidant activity: In the DPPH assay, the ability of the investigated extracts to act as donors of hydrogen atoms or electrons in transformation of DPPH radical into its reduced form DPPH*-H was investigated. All the assessed extracts were able to reduce the stable, purple-coloured radical, DPPH*, into the yellow-coloured DPPH*-H reaching 50% of reduction (Biljana *et al*., 2008).

In the present study we have evaluated the free radical scavenger activity of methanolic extract of *Allium sativum*, *Zingiber officinal*, *Coriandrum sativum Cuminum cyminum*, *Cinnamomum tamala*, *Cinnamomum verum* and *Electaria cardamomum.* Here, we used Ascorbic acid as standard whose IC_{50} value was 22.78 μg mL^{-1}. In Fig. 1 showed the seven extracts and standard tested for the *in vitro* antioxidant activity using the DPPH method and the result of *C. cyminum*, *Z. officinal*, *C. sativum*, *A. sativum* was depicted in Table 1 having the IC_{50} values of 15.48, 30.35, 58.36, 89.25 μg mL^{-1}, respectively. *C. tamala*, *C. verum* and *E. cardamomum* (Linn.) showed weak antioxidant activity, with IC_{50} values of 157.58, 159.14, 217.43 μg mL^{-1}.

Among the seven studied spices *C. cyminum* showed highest activity having the IC_{50} value of 15.48 μg mL^{-1}, which was higher than the standard ascorbic acid on the other hand methanolic extract of *Elettaria cardamomum* exhibited the lowest antioxidant activity with IC_{50} value 217.43 μg mL^{-1}

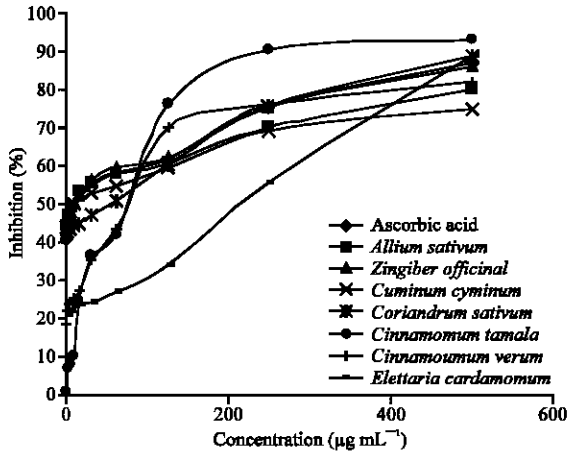

Fig. 1: Antioxidant activity of some common spices

Table 1: IC_{50} values of methanolic extract of different spices extracts and ascorbic acid

Samples	IC_{50} (µg mL^{-1})
Ascorbic acid	22.78
Cuminum cyminum	15.48
Zingiber officinale	30.35
Coriandrum sativum	58.36
Allium sativum	89.25
Cinnamomum tamala	157.58
Cinnamomum verum	159.14
Elettaria cardamomum	217.431

DISCUSSION

Determination of the natural antioxidant compounds of plant extracts will help to develop new drug candidates for antioxidant therapy. So, we have performed a research work to find out the anti-oxidative properties of some common spices, although there are previous reports on antioxidant activity of these spices.

The earlier studies revealed that-the antioxidant activity of *Zingiber officinal* is due to the presence of Curcumin, five gingerol-related compounds, [6]-gingerol and [6]-sbogaul compounds (Kikuzaki and Nakatani, 1993), aqueous and etheric Coriander extracts contain phenolics and carotenoids which exhibit a considerable antioxidant action (De Almeida *et al*., 2003), Cinnamon carries cinnamate that suppresses lipid per-oxidation via the enhancement of hepatic antioxidant enzyme activities (Lee *et al*., 2003), Cardamom contains quercetin, kaempferol, luteolin and pelargonidin that are responsible for its moderate antioxidant activity (Nair *et al*., 1998), *Cinnamomum* leaf contains three flavonoid compounds namely quercetin, kaempferol and quercetrin which are responsible for it's antioxidant activity (Prasad *et al*., 2009), The major unique organosulfur compounds in (aged garlic extract)AGE are water-soluble S-allylcysteine (SAC) and S-allylmercaptocysteine (SAMC), which have potent antioxidant activity (Imai *et al*., 1994), cumin seed contains cuminaldehyde, the responsible constituent for it's moderate anti oxidative property (Krishnakantha and Lokesh, 1993). In the present study we have just compared their antioxidant potency.

The plants may be considered as good sources of natural antioxidants for medicinal uses such as against aging and other diseases related to free radical mechanisms but further investigation is needed to find out side effects and contraindications if any.

CONCLUSION

Although, it is obvious that constituents like polyphenols, tannins, reducing sugars and proteins, which are present in the extracts, may be liable for antioxidant activity. Now our study will be explored to separate all the chemical constituents in the tested extracts which are responsible for such activity and doing research on their toxic effects if any. Currently there is considerable interest in new natural antioxidants to replace the synthetic ones that are used in foods and cosmetics.

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