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Comparison of Phenolic Compounds of Some Edible Plants of Iran and India

Ali Aberoumand[1] and S.S. Deokule[2]
[1]Department of Food Science, Ahvaz University, Ahvaz, Iran
[2]Department of Botany, Pune University, Pune, India

Abstract: Phenolic compounds, ubiquitous in plants are an essential part of the human diet and are of considerable interest due to their antioxidant properties. The antioxidant activity of phenolic compounds depends on the structure, in particular the number and positions of the hydroxyl groups and the nature of substitutions on the aromatic rings. *Alocacia indica sch., Asparagus officinalis DC.*, *Chlorophytum comosum Linn., Cordia Myxa Roxb., Eulophia Ochreata Lindl., Momordica dioicia Roxb., Portulaca oleracia Linn. and Solanum indicum Linn.* are the major sources of phenolic compounds in the human diet. Soluble phenolic acids were extracted with methanol. The aim of this study determination of the distribution and total phenolic compound in a wide range of vegetables consumed in India and Iran.

Key words: Phenolic, antioxidant, methanol and *solanum indicum linn*

Introduction

Phenolic compounds are secondary metabolites that are derivatives of the pentose phosphate, shikimate and Phenylpropanoid pathways in plants (Randhir *et al.,* 2004).

These compounds one of the most widely occurring groups of phytochemicals are of considerable physiological and morphological importance in plants. Phenolic compounds exhibit a wide range of physiological properties, such as anti-allergenic, anti-atherogenic, anti-inflammatory, anti-microbial, antioxidant, anti-thrombotic, cardioprotective and vasodilatory effects (Benavente-Garcia, 1997; Manach and Mazur, 2005; Middleton, 2000; Puupponen-Pimia, 2001; Samman, 1998).

Phenolic compounds have been associated with the health benefits derived from consuming high levels of fruits and vegetables (Hertog and Feskens, 1993) and (Parr and Bolwell, 2000). The beneficial effects derived from phenolic compounds have been attributed to their antioxidant activity (Heim *et al.,* 2002). Phenolic compounds could be a major determinant of antioxidant potentials of foods (Parr and Bolwell, 2000), and could therefore be a natural source of antioxidants. This review aims to examine the chemistry of phenolic compounds in relation to their antioxidant activity, the occurrence of phenolic compounds in various food and non-food sources, the bioavailability and metabolism of phenolic compounds and also explore the potential use of these compounds as food antioxidants.

Plant polyphenols are known to have multi functional properties such as reducing agents, hydrogen donating antioxidants and singlet oxygen quenchers and flavonoids and their derivatives are the largest and most important group of polyphenols. The most important property is their capacity to act as antioxidants protecting the body against reactive oxygen species and may have an additive effect to the endogenous (Shahidi and Naczk, 1995).

Among the variety of phenolic compounds, phenolic acids have attracted considerable interest in the past few years due to their many potential health benefits. As polyphenols, phenolic acids are powerful antioxidants and have been reported to demonstrate antibacterial, antiviral, anti-carcinogenic, anti-inflammatory and vasodilatory actions (Duthie, 2000; Breinholt, 1999; Shahidi and Naczk, 1995).

Food composition databases need to be established to assist in these investigations. The data compiled by (Radtke, 1998; Clifford, 1999) indicate that many vegetables are either moderate or good sources of phenolic acids. However, up-to-date research data on the contents of phenolic acids in vegetables are limited.

The chemistry of phenolic compounds: Structurally, phenolic compounds comprise an aromatic ring, bearing one or more hydroxyl substituents and range from simple phenolic molecules to highly polymerised compounds (Bravo, 1998). Despite this structural diversity, the groups of compounds are often referred to as ‘polyphenols’. Most naturally occurring phenolic compounds are present as conjugates with mono- and polysaccharides, linked to one or more of the phenolic groups and may also occur as functional derivatives such as esters and methyl esters (Harborne, 1989; Harborne, 1999; Shahidi and Naczk, 1995). Though such structural diversity results in the wide range of phenolic compounds that occur in nature, phenolic compounds can basically be categorized into several classes (Harborne, 1989; Harborne, 1999). Of these, phenolic acids, flavonoids and tannins are regarded as the main dietary phenolic compounds (King and Young, 1999).

Structure - activity relationships: The antioxidant activity of phenolic compounds is due to their ability to scavenge free radicals, donate hydrogen atoms or electron, or chelate metal cations (Afanas'ev*,* 1989 and Amarowicz*,* 2004). The structure of phenolic compounds is a key determinant of their radical scavenging and metal chelating activity and this is referred to as structure-activity relationships (SAR). In the case of phenolic acids for example, the antioxidant activity depends on the numbers and positions of the hydroxyl groups in relation to the carboxyl functional group (Rice-Evans, 1996) and (Robards, 1999). Monohydroxy benzoic acids with the -OH moiety at the *ortho*- or *para*-position to the -COOH show no antioxidant activity, though the same is not true for the m-hydroxybenzoic acid (Rice-Evans, 1996). The antioxidant activity of phenolic acids increase with increasing degree of hydroxylation, as is the case of the trihydroxylated gallic acid, which shows a high antioxidant activity. However, substitution of the hydroxyl groups at the 3- and 5-position with methoxyl groups as in syringic acid reduces the activity (Rice-Evans, 1996).

Food sources of phenolic compounds: Though phenolic compounds are present in almost all foods of plant origin, fruits, vegetables and beverages are the major sources of these compounds in the human diet (Hertog *et al.,* 1993).

Fruits and vegetables: There are wide variations between the total phenolics contents of the different fruits or vegetables, or even for the same fruits or vegetables reported by different authors these differences may be due to the complexity of these groups of compounds and the methods of extraction and analysis (Bravo, 1998; Kalt, 2001). For example, phenolic compounds present in fruits are found in both free and bound forms (mainly as $-glycosides), but as the latter are often excluded from analyses, the total phenolics contents of fruits are often underestimated (Sun *et al.,* 2002). Besides, phenolics contents of plant foods depend on a number of intrinsic (genus, species, cultivars) and extrinsic (agronomic, environmental, handling and storage) factors (Tomas-Barberan and Espin, 2001; Rapisarda, 1999). Species differences are also pronounced, as observed from the data in Table 2, which suggests that the phenolics content of some fruits, i.e., banana, litchi (lichee), mango and persimmon is considerably lower than that of berries and grapes. Asami *et al*., 2003, reported that organically grown strawberries were found to have higher phenolics content than conventionally grown crops, though another study could not establish such a correlation (Hakkinen and Torronen, 2000). Processing and storage may have varying impacts on different phenolic compounds, as seen in berry processing where myricetin and kaempferol were found to be more prone to losses than quercetin (Hakkinen *et al.*, 2000).

Table 1: Total phenolic compound (Antioxidant) of eight edible plants obtained from India and Iran

Samples	Total phenolic compound mg/100g
Alocacia indica Sch	87
Asparagus officinalis DC	317
Portulaca oleracia Linn	586
Momordica dioicia Roxb	396
Eulophia ochreata Lind	243
Solanum indicum Linn	702
Cordia myxa Roxb	402
Chlorophytum comosum Linn	136

Materials and Methods

Collection of samples: Eight different types of fruits and vegetables (*Alocacia indica Sch., Asparagus officinalis DC.*, Chlorophytum comosum Linn., Cordia Myxa Roxb., Eulophia Ochreata Lindl., Momordica dioicia Roxb., Portulaca oleracia Linn. and Solanum indicum Linn.) were purchased from were collected from various localities of Maharashtra (India) and Iran. Five wild edible plants were collected from Iran viz *Asparagus officinalis*, *Chlorophytum comosum,* Codia myxa, Portulaca oleracia and Solanum indicum were collected from Iran in October 2006 and April 2007. Efforts made to collect these plants in flowering and fruiting conditions for the correct botanical identification. Healthy and disease free edible plant part/s selected Each variety of fruit and vegetables was collected to assess total phenolic contents.

Samples preparation: Fresh fruits and vegetables were cleaned with water and external moisture wiped out with a dry cloth. The edible portion of the individual fruits was separated, dried in a hot air oven at 50°C for 1 h. The dried samples were then powdered in blander for further study.

Some of the plants dried under shade so as to prevent the decomposition of chemical compounds present in them.

Determination of total phenolic compound

According to method singleton and rossi: Preparation of Plant Extracts (Method B). Grounded dry plant material (500 mg) was weighed into a test tube. A total of 10 mL of 80% aqueous methanol was added and the suspension was stirred slightly. Tubes were sonicated 5 min and centrifugated for 10 min (1500g) and supernatants were collected. Plant materials were re-extracted twice.

Determination of total phenolics: The amount of total phenolics in extracts was determined according to the Folin-Ciocalteu procedure (Singleton and Rossi, 1965). Samples (0.5 ml, two replicates) were introduced into test tubes; 2.5 mL of Folin-Ciocalteu's reagent and 2 mL of sodium carbonate (7.5%) were added. The tubes were mixed and allowed to stand for 30 min. Absorption at 765 nm was measured. The total phenolic content was expressed as tanic acid equivalents in milligrams per gram dry material.

Results and Discussion

Results showed that total phenolic amounts of *Momordica dioicia Roxb* (396mg/100g) and of *Cordia myxa Roxb*(402 mg/100g) were comparable with total phenolic amount of Mint vegetable. (399.8 %), but the amounts were more than total phenolic amounts of other vegetables (Kaur and Kapoor, 2002). Total phenolic amount of *Solanum indicum Linn* (702 mg/100g) was more than total phenolic amounts of Black berry (417-555%) (Sellappan, 2002) and Cranberry (527.2%) (Sun, 2002).

Therefore, antioxidant capacity of *Solanum indicum Linn*. was high and antioxidant capacity of *Alocacia indica Sch*. was low.

Phenolic compounds could be a major determinant of antioxidant potentials of food plants and could therefore be a natural source of antioxidants and because Phenolic compounds have been associated with the health benefits derived from consuming high levels of fruits and vegetables, Therefore, *Solanum indicum Linn*. has high preservation capacity and nutritional values, because total phenolic compounds prevent from damage of nutrients contain double bonds such fatty acids, flavor compounds even proteins and amino acids and other compounds.

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