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Studies on extraction of polyphenols from food wastes and its utilization for fortification of polyphenols

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ABSTRACT : Food processing is one of the most important industries over the world, however, byproducts of such industries, mainly organic material must be handled in appropriate manner to avoid any environmental violence. But these by products as well as the waste materials contain some good nutraceutical properties such as presence of polyphenols which can increased the antioxidant properties of the food materials. In this study the polyphenol contents from the wastes of some food materials such as cucumber peels, potato peels, pea nut hulls, pomegranate seed wastes, date seeds, pumpkin seeds are determined in mg GAE/g sample by using different solvents *viz.*, water, ethanol, methanol and acetone as extracting medium. It was observed that, among these samples potato peels, cucumber peels and pomegranate seeds exhibited maximum polyphenol content in water medium, such as 5.14, 6.05 and 4.70 mg GAE/g sample, respectively, whereas pumpkin seeds and date seeds showed maximum polyphenol content in acetone medium, like, 6.06 and 4.40 mg GAE/ g sample, respectively. As water is one of the main ingredients of most of the processed foods, potato peels and cucumber peels wastes can be utilized for fortifications of polyphenols in vegetable soups. It has been observed that the polyphenol content can be increased upto about 2.7 times in case of cucumber peel fortified soups. Therefore, it can be concluded that cucumber peel fortified soups showed the best result considering its functional quality in terms of polyphenol content as well as overall acceptability in terms sensory analysis.

KEY WORDS : Food wastes, Polyphenol, Nutraceutical, Fortified soups, Sensory analysis

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The increased consumption of fruits and vegetables is an effective strategy to increase antioxidant intake and to reduce oxidative stress and it may lead to lower risk of developing chronic diseases, such as cancer and cardiovascular disease (Song *et al.*, 2010). The fruit and vegetable wastes (e.g. peels, seeds) are the non-product flows of raw materials whose economic values are less than the cost of collection and recovery for reuse and therefore, discarded as wastes. Phenolics are found in a plenty of plants and consist of an aromatic ring within the molecular structure (Singh *et al*., 2012). The waste materials such as peels, seeds and stones produced from the fruit and vegetable processing unit can be successfully used as a source of phytochemicals and antioxidants. Higher amount of phenolic compounds and ascorbic acids has been reported in the peel than in pulp (Goulas and Manganaris, 2012) and in green form than in ripe for most of the fruits. The majority of fruit peels exhibited 2 to 27 fold higher antioxidant activity than the fruit pulp (Guo *et al*., 2003).

The leaves, stems, roots, seeds and peels of *Cucumis sativus* L., commonly known as cucumber are reportedly used in folk medicine as anti-diarrheal, de-toxicant, anti-gonorrheal, anti-inflammatory, hypertension reducing agent, diabetes mellitus and serum lipids regulator, antioxidant, and analgesic (Gill *et al.*, 2010). The phenolic constituents of cucumber have not been extensively investigated (Abou-Zaid *et al.*,2001). It was noticed that several analytical techniques had been used such as RP-HPLC–UV and GC–MS to identify flavonoids and other phenolic compounds in cucumber fruit (Abu-Reidah *et al*., 2012).

Potato flesh and peel both contains free and bound phenolic compounds, in which peel showed high DPPH radical scavenging activity, than flesh. Ferulic acid was identified as the active radical scavenging compound in the bound-form phenolic from the peel whereas; chlorogenic acid and caffeic acid are the free form of phenols responsible for DPPH radical scavenging activity (Nara *et al.*, 2014).

Pomegranate or *Punica granatum* L. is a fruit of tropical and subtropical regions, which originated in the Middle East and India and has been used for centuries in ancient cultures for its medicinal purposes. Pomegranate exhibits antivirus, antioxidant, anticancer, and antiproliferative activities. It consists about 27 per cent seeds (weight basis) which is a good source of antioxidant such as phenolics, proanthocyanidins and flavonoids (Wang *et al.*, 2011).

There is an increase in use of by products of food which contains considerable amount of antioxidants. Several studies on the components of peanut hulls have been done. Duh Pin-Der and Yen Gow-Chin (1997) reported that antioxidant compounds of metabolic extracts from peanut hulls had antioxidant efficacy in soybean and peanut oils.

Dates of date palm tree (*Phoenix dactylifera* L.) are popular among the population of the Middle Eastern countries. The fruit is composed of a fleshy pericarp and seed, which constitutes between 10 per cent and 15 per cent of date fruit weight. The date seeds considered a waste product of many date processing plants producing pitted dates, date syrup and date confectionery. Vayalil (2002) discovered that water extract of date can scavenge 50 per cent superoxide radicals and hydroxyl radicals.

Pumpkins belong to the family Cucurbitaceae. Pumpkin seed extracted oil contains four important fatty acids in significant quantities, such as palmitic, stearic, oleic and linoleic acids (Stevenson *et al*., 2007). Pumpkin seed extract has also been reported to have such medicinal properties like, antidiabetic, antitumor, antibacterial, anticancer, antimutagenic, antioxidant activities, strong hypotriglyceridemic and serum cholesterol-lowering effects (Fu *et al*., 2006).

The foods with nutraceutical properties have been the leading trend in human diet and in the food industry since the last decade of the past century. In different nutritional researches have provided some way regarding how foods or their supplements have the ability to optimize health and control diseases (Ali *et al.*, 2009). In a study regarding soup, it was found that the plasma carotenoid concentration increased by regular intake of fruit and vegetable in the form of soup or other beverages which were effective in reducing homocysteine in blood. The bioavailability of different soluble phytonutrients increases through juices (Paterson *et al.*, 2006).

In this recent study, polyphenols are extracted from different food wastes and food wastes such as potato and cucumber peel are utilized to enhance the nutraceutical properties of vegetable soups as source of polyphenols.

■ METHODOLOGY

Materials:

All waste materials like cucumber peels, peanut hulls, pomegranate seeds, date seeds, potato peels, pumpkin seeds were collected from local vendors of Sodepur, Kolkata. The waste materials were dried by using tray dryer (model number Omega Tray Drier) at $60\pm5\ ^0$C temperature. Then the dried samples were grinded and sieved individually so that it can get a particular particle size of 80 mesh.

Determination of polyphenol contents of the samples:

Four different solvents *viz.*, water, ethanol, methanol and acetone were used for polyphenol extraction. The polyphenol content was determined by using UV-Vis spectrophotometer (Jasco V 630 Spectrophotometer) by standard McDonald *et al*. (2001).

Preparation of control, potato peel fortified and cucumber peel fortified soups:

For control soup preparation, 5.5 g of instant soup powder was added to 75ml of water. Then, it was cooked at 120 ^{0}C for 2 minutes with constant stirring.

In case of fortified soups, 1.2 g of potato peel powder and cucumber peel powder were added to 75 ml of water separately, where 5.5 g of instant soup powder was also added. The soups were cooked at 120 ^{0}C for 2 minutes with constant stirring.

Determination of the polyphenol contents of soups:

The polyphenol contents (in water medium) of all three soup samples were determined by using UV-Vis spectrophotometer (Jasco V 630 Spectrophotometer) by standard McDonald *et al*. (2001).

Sensory evaluation:

Sensory analysis were done for all the three soup samples (control, potato peel fortified, cucumber peel fortified) by eight trained panel members of food technology department by using 9 point hedonic scale (Hooda and Jood, 2005).

RESULTS AND DISCUSSION

The polyphenol contents of the food wastes in different solvent are presented in Table 1 and it was observed that cucumber peel and potato peel exhibited maximum polyphenol content in water medium, *i.e.*, 6.05±0.45 and 5.14±0.42 mg GAE/ g of sample. This above observation is also supported by Singh *et al.* (2011) and Agarwal *et al.* (2012) on their studies on polyphenol content of potato peel and cucumber peel.

As, from the above results, it was found that, cucumber peels and potato peels produced maximum polyphenol content in water as extracting medium, they were fortified to vegetable soups (in water medium) for increasing the nutraceutical properties of the soups.

Polyphenol contents of the soups are presented in Fig. 1 which shows that the polyphenol content was increased about 1.2 and 2.7 times, respectively for potato peel fortified soup and cucumber peel fortified soup.

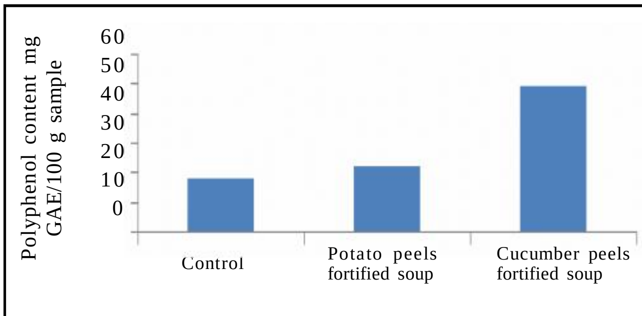

Fig. 1 : Polyphenol content of different soup samples

The comparative studies of sensory analysis of these three soups are given in Fig. 2.

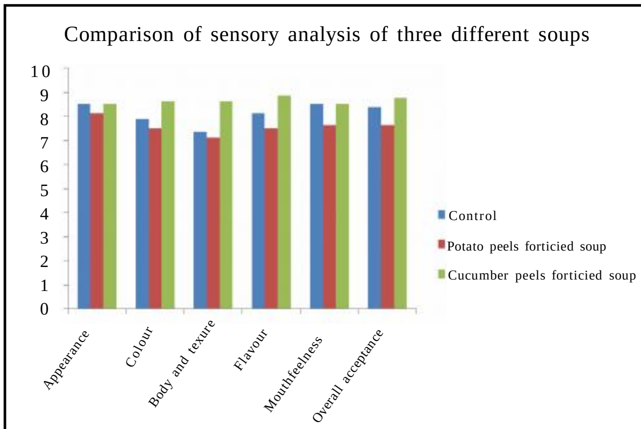

Fig. 2 : Comparative studies of sensory analysis of soups

In the study of sensory evaluation, cucumber peel fortified soup, scored maximum point in overall acceptance, colour, flavour and body and texture than the other two types of soups.

Therefore, it can be concluded that consumption of these vegetable soups with enhanced polyphenol content

Table 1 : Polyphenol content of different food wastes (mg GAE/g sample)

Samples	Water	Ethanol	Methanol	Acetone
Cucumber peels	6.05±0.45	1.66±0.09	1.20±0.07	4.79±0.29
Pea nut hulls	2.13±0.12	2.35±0.14	3.77±0.11	2.17±0.15
Pomegranate seed waste	4.70±0.31	1.64±0.07	4.12±0.18	2.44±0.21
Date wastes	1.60±0.11	0.65±0.004	3.38±0.25	4.40±0.28
Potato peels	5.14±0.42	1.97±0.16	4.39±0.33	5.55±0.46
Pumpkin seeds	1.97±0.08	1.21±0.08	1.88±0.21	6.06±0.39

avg+sd= Average+standard deviation, n=5 (average of five trials) may decreases oxidative stress which was also supported by Sánchez *et al.* (2004).

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