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FRUITS AND VEGETABLES PEELS THE SOURCE OF NATURAL ANTIOXIDANTS: A REVIEW

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ABSTRACT

Antioxidant is a substance capable to neutralize the free radicals so reducing its ability to damage. Antioxidants are able to inhibit oxidation processes in human body and also prevent the food from spoilage. . The synthetic as well as natural antioxidants are used in food industries as a food preservatives. Synthetic antioxidants have been widely used because they are more effective and less expensive than natural antioxidants. But the application of synthetic antioxidants has been suspected due to its potential to carcinogenic effects. Hence the researchers have shifted their focus towards natural antioxidants. The fruits and vegetables waste materials such as peels, seeds and stones produced from processing unit can be used as a source of natural antioxidants. The natural extracts acts as a health friendly substitute for synthetic antioxidants because of its no harmful effects on consumers' health. The growing consumer demand for food devoid of synthetic antioxidants has focused efforts on the discovery of new natural preservatives. The present short review has focus on natural antioxidant from fruits and vegetables peel.

Keywords: *Natural antioxidants, peels, Bioactive compounds, preservatives*

I. INTRODUCTION

Antioxidants are substances that protect cells from the damage caused by free radicals (i.e.an unstable molecules).Oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent. Oxidation reactions can produce free radicals, which start chain reactions that damage cells. Antioxidants are agents, which scavenge the free radicals and prevent the damage caused by them. Free radicals are continuously produced in our body either naturally or on exposure to environmental stress, food habits and can be implicated in many diseases like cancer, atherosclerosis, arthritis, Parkinson's disease, Alzheimer's disease, aging and other age related problems (Halliwell and Gutteridge, 1989).

Antioxidants terminate these chain reactions by removing free radical intermediates and retard other oxidation reactions. As a result, antioxidants are often reducing agents such as thiols, ascorbic acid or polyphenol (Sies, 1997). Antioxidants are used as food additives to protect against food deterioration. These are added to food products like fat and oil, bakery and dairy products to enhance their shelf life by preventing lipid per oxidation and protecting from oxidative damage.

Synthetic antioxidants are used far less in edible food products, especially vegetable oils, because of serious health and safety concerns. So there is a much greater dependence on natural antioxidants. Waste materials from food processing units and value addition units of horticultural produces like vegetable and fruit peels, seeds, stones etc. proved to use as safe antioxidants for food preservation owing to their antioxidant and antimicrobial activities (Sonia *et al.,* 2016). Food industries wastes can also be used as a source of nutraceuticals (Rudhra *et al*. 2015). The natural antioxidants from plants show the potentials in human health protection, as well as food preservatives and additive.

Regarding food safety, one of the major cause of quality deterioration is lipid per oxidation. The oxidative deterioration of fats and oils in food products is responsible for rancidity and off flavors and thus leads to decrease in nutritional quality and safety due to the formation of secondary potentially toxic compounds (Negi and Jayaprakash, 2003).

In industrial practices, synthetic antioxidants have been used as food additives for more than fifty years to prevent per oxidation of fats and oils. Recent literature has expressed safety concerns and health risks associated with their use in food products (Han,et al.,2008). So the attention is now increasing to the development and utilization of more effective, natural and non-toxic biologically-active materials including antioxidants from natural sources such as plants source (Iqbal et al.,2008).

II. MECHANISM OF ANTIOXIDANTS

Antioxidants may exert their protective role by several mechanism , including free radicals inactivating, the hydrogen atom transfer, prooxidative metals chelating, the single electron transfer, quenching of singlet oxygen as well as photo sensitizers and lipoxygenase inactivation**.** Antioxidants are the molecules that can neutralize free radicals by accepting or donating electron. Antioxidants may also slow down oxidation by chelating transition metals, which is a major catalyst for oil degradation. EDTA and citric acid are the most common chelators; flavonoids, phospholipids, polyphenols, and amino acids can also chelate metals. Antioxidant synthesized in body or supplied from outside like phyto constituents plays an important role to protect the body from free radical induced injury.

Natural antioxidants from plant source : In the recent past, some toxicological studies regarding the use of synthetic antioxidants have shown their unwanted or adverse effects. These reports have urged the researchers to focus their study on exploring the natural sources with reasonable antioxidant potential (Ramalakshmi *et al.,* 2008). Natural antioxidants are primarily phenolics that may occur in all parts of plants such as fruits, vegetables, nuts, seeds, leaves, roots, and barks (Asif M, 2015).
Several plants have been studied as a source of safe natural antioxidants for the food industries; various phytochemical compounds have been isolated from them. Natural antioxidants are found in various parts of plant and consists of an aromatic ring as part of the molecular structure. Typical molecules of the natural antioxidants are derivatives or isomers of flavones, isoflavones, flavonols, catechins, eugenol, coumarin, tocopherols, cinnamic acid, phosphatides and polyfunctional organic acids. Fruits and vegetables as well as their waste materials (like peel, seed & stone etc.) are very good source of natural antioxidants which consist of many different phytochemical like carotenoids, vitamins, phenolic compounds, flavonoids, dietary glutathione and endogenous metabolites.

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 *et al*., 1999). Fortification with natural antioxidants (culinary herbs) was used to inhibit lipid oxidation in raw and cooked minced meat patties during storage (Souzan *et al*., 1999). The functional properties of some peel components such as pectin, flavonoids, carotenoids, limonene and polymethoxy flavones should be considered accordingly (Lia, 2007). Higher amount of phenolic compounds and ascorbic acids has been reported in the peel than in pulp (Goulas and Manganaris, 2012). Crude extracts of fruits, herbs, vegetables, cereals and other plant materials rich in phenolics are increasingly of interest in the food industries because they prevent oxidative degradation of lipids and thereby improving the quality and nutritional value of food (Marja *et al*., 1999). Natural aromatic plants and spices have been widely used in many food products such as meat and meat products, dairy and bakery products (Jan Pokorny, 1991).

III. FRUITS PEELS

Along with the juice, fruit peel which is a waste to the juice industry is the main sources some phytochemical such as flavonoids, pectin and essential oils (Manthey and Grohmann, 1996).Fruit peel oil have a strong aroma and used as flavoring agent in different industries like food, beverages and pharmaceutical industries. Antioxidant property of peels of different fruits that are commonly available and mostly consumed in India, can become a new source of natural antioxidants for food, nutraceutical and pharmaceutical industries. Natural antioxidants have gained considerable interest in recent years for their role in preventing the auto oxidation of fats, oils and fat containing food products. In the present study it review the peel of most commonly used fruits which have a great burden of waste as a peel for their antioxidant property. Peels of **pomegranate**, **sweet lime** and **banana** are as source of natural antioxidants.

a) Pomegranate peel- Pomegranate (*Punica granatum* L.) has gained commercial importance in food and health industries due to increasing scientific evidence linking its consumption to better health outcomes (Sarkhosh *et al.,* 2007). The peel makes up to 50% of the fruit (Viuda-Martos *et al.,*2010). Pomegranate peel is normally used as cattle feeds with low value or directly disposed in the field that could cause environmental problem. However, pomegranate peel could be a good raw material for producing natural antioxidants because of its high content of antioxidants (Que *et al.,*2009). Pomegranate peels due to its high antioxidant activity and phenolic content may prove to be a better substitute in place of synthetic antioxidants in extending the shelf life of food product by preventing the peroxide formation in the product containing fat and oil (Singh and Immanuel, 2016).

Although several studies have shown that pomegranate peels proved to be important source of phenolic compounds, with several health benefits, its use remained very limited (Cai *et al.,*2004).

Pomegranate fruit peels are by-products of the food industry. Added-value products could be made from those wastes. Phenolics from peel extracted exhibited a potent antioxidant activity as evaluated by the DPPH scavenging activity and ferric reduction tests. Crude extracts and purified fractions from pomegranate peels could provide health benefits to humans and may be employed in food preservation and pharmaceutical purposes (Mutahar *et al.,* 2012).

b) Sweet lime peel- The citrus production is estimated at 80 million tones per year (Moure et al., 2001). The main byproducts of citrus processing are the peel, pulp, and seeds, which account for 40–60% of the weight of the raw material (Licandro & Odio, 2002).The citrus wastes are rich in nutrients and contain many phytochemicals that can be efficiently used as components in pharmaceutical drugs or as food supplements (Middleton et al., 2000). The main waste of the citrus fruits after processing is the citrus peel. Food industry uses citrus peel as a source of molasses, pectin, oil and limonene (Braddock 1995), and has been studied because it contains several bioactive compounds, such as flavanones, polymethoxylated flavones, flavonols and phenolic acids; these compounds have a lot of uses as a natural antioxidants for pharmaceutical, biotechnological and food industries (Bocco *et al.* 1998). Moreover, it is a good source of total polyphenols and has good antioxidant properties which will make it a useful ingredient in the preparation of various food product (Younis et al., 2015). Mosambi peels are rich in pectin which is known to possess blood sugar-lowering and cholesterol-lowering properties (Baker, 1994). Mosambi peel can be incorporated in jam as a source of pectin. It is a good source of total polyphenols and has good antioxidant properties which will make it a useful ingredient in the preparation of various food products. Overall, the results suggested that mosambi waste could be used as a raw material for many products. From industrial point of view, mosambi peel which is the residues from processing industry could be further processed for value addition of various food products (Younis et al., 2015).

c) Banana peel- Banana constitutes about 30 percent peel of fresh banana weight. Banana peel is the major flavonoid source, banana peel are a potential source of bioactive compounds with high antioxidant capacity (Hernandez-Carranz , 2016). Banana peel, an underutilized source of phenolic compounds is considered as a good source of antioxidants for foods and functional foods against cancer and heart disease (Someya et al.,2002).Furthermore, bananas are one of the most popular fruits; peel is the main by-product, which represents approximately 30% of the whole fruit (González-Montelongo *et al.* 2010). Ripe banana peels contain 4.8 percent total phenolics (Bakshi and Wadhwa, 2013). Banana peel is rich in phytochemical compounds, with high antioxidant capacity such as phenolic compounds (gallocatechin), anthocyanin (delphinidin and cyanidin), carotenoids (βcarotenoids, α-carotenoid and xanthophylls), catecholamines, sterols and triterpenes (Seymour 1993, Kanazawa and Sakakibara 2000, Someya *et al*. 2002).

IV. VEGETABLES PEELS

Cucurbitaceae family is a major source of medicinal agents since ancient times. Various plants parts including fruit and peels of this family have been established for their antioxidant properties. For example the nutritional compositional analysis of pumpkin wastes indicate that both peel and pulp are good source of dietary fibre and minerals like phosphorus and iron and exhibited almost similar antioxidant activity which could be due to the presence of polyphenol compounds. Work on the incorporation of pumpkin peel and pulp in expanded snacks and bakery products have been reported. Thus, these wastes of the pumpkin could be utilized as a source of supplement or further exploited for value addition as they are rich in nutrients and antioxidant components (Mala and Kurian , 2016). In the

present study it review the peel of most commonly used vegetables which have a great burden of waste as a peel for their antioxidant property. Peels of **Cucumber peel, Bottle guard peel** and **Sponge guard peel** are as sources of natural antioxidants.

a) Cucumber peel - Cucumber (*Cucumis sativus L.*) peel is considered as a cheap source of flavanoid and can be used as a potential source of antioxidant for industrial applications (Agarwal et al., 2012). Zeyeda et al. (2008) studied the phenolic content of some selected vegetable wastes and reported the phenolic compound them in descending order as olive leaves > tomato peel > cucumber peel > watermelon peel > potato peel. The major phenolic compounds in cucumber peel were identified as chlorophyll, pheophytin, phellandrene and caryophyllene. Cucumber peel powder even at higher concentration (800 ppm) had lower antioxidant activity than that produced by 200 ppm additives of TBHQ (Sonia et al.,2016) . The pharmacological properties of *Cucumis sativus* L. fruit and seed have been extensively studied, but comparatively very few studies have been reported on the therapeutic potential of *Cucumis sativus* L. peel.

b) Bottle guard peel - The peels of bottle gourd have been shown as good sources of minerals and antioxidants. Various workers have reported the composition of bottle gourd peels (Parle & Kaur, 2011). Dixit *et al*. 2008, studied antioxidant potential of fruit peel extract in carbon tetrachloride and hydrogen peroxide induced lipid peroxidation in liver tissues in mice. They revealed that bottle guard peel extract also regulate the lipid peroxidation. In another experiment, *in vivo* study was performed to evaluate three different concentrations of bottle guard peel extract to select the most effective safe dose for regulation of hepatic, thyroid function, and glucose metabolism.

c) Sponge guard: *Luffa cylindrica,* commonly known as sponge gourd, has been found to be a unique gourd vegetable belonging to the family of Cucurbitaceae. It is a subtropical vegetable and widely cultivated in India, There have been many studies on the phytochemicals and their antioxidant potential in *L. cylindrica.* The phytochemical constituents including alkaloids, flavonoids, saponins, and steroids possessing antioxidant activity have been reported in *L. cylindrica* **(**Irshad et al., 2010**).** Azeez et al., 2013 reported the total phenol content in various extracts of pulp and peel of sponge gourd in the range of 0.94–14 mg GAE/g.

V. CONCLUSION

Lipid oxidation is the most important problem that occurs during processing and storage of fat containing food products. That cause the loss in flavour, texture, colour and nutritional value of food product as well as injurious to the health of consumers. So new approach based on the addition of new bioactive compounds (i.e., antioxidants of plant origin) have come to the practices, which may act as a safeguard of food product and have no adverse effect to health. Plant extracts having antioxidant properties have been proposed for inhibiting rancidity in many food products. The natural extracts acts as a substitute for synthetic antioxidants because of its harmful effects on consumers and could find practical application in many industrial branches. However, the use of natural antioxidants in foods needs a lot of research and development.

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