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Utilization of Fruit Industry Waste for Antioxidant Extraction

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Abstract—*Fruit based industry is rising exponentially in India and with the growing industrial use of fruits, waste management is also getting problematic for the industrialists. If the wastes of fruit industries are utilized properly, then that may be very helpful for lowering the pollution problem and may be a substrate for another industry too. The peel of orange, mango, apple, papaya, pomegranate and many other fruits possess various antioxidants in them and after extracting these antioxidants by various chemical methods, their AOA (antioxidant activity) was calculated. It was found that the waste was having very significant amount of antioxidants and antioxidant activity and so can be utilized for various food and pharmaceutical purposes. The shelf life of edible oils may be enhanced by adding waste of fruit industry to a great extent and rancidity may be delayed.*

Fruits and vegetables contain significant levels of biologically active components that impart health benefits beyond basic nutrition. Polyphenols are secondary plant metabolites which were earlier considered as anti-nutrients because some (tannins) were shown to have adverse effects in human metabolism, but recently the recognition of antioxidative properties of these phenolics has evoked a rethinking towards the health benefits of these secondary metabolites. Polyphenols account for the majority of antioxidant activity when compared with ascorbic acid in fruits .The antioxidant properties of phenolics is mainly because of their redox properties, which allow them to act as reducing agents, hydrogen donators and singlet oxygen quenchers.

Pomegranate fruit arils are also very popular due to their taste. The arils are processed to delicately flavoured juice, squash, jelly, jam, wine, anardhana, etc. Due to the rich color, sweet-sour flavor and high antioxidant content, manufacturers tend to add pomegranate to products such as jelly, ice creams, truffles and chewing gum. A huge amount of pomegranate peel waste is thus produced, disposal of which has become an environmental problem. It has been reported that the peel and seed fractions of some fruits have higher bioactivities than the pulp fractions. About 50% of the total fruit weight corresponds to the peel, which is an important source of bioactive compounds such as phenolics, flavonoids, ellagitannins (ETs), and proanthocyanidin compounds, minerals, mainly potassium, nitrogen, calcium, phosphorus, magnesium, and sodium, and complex polysaccharides.

One of the main compounds responsible for most of the functional properties of many foods, among them pomegranate fruit, are phenolic compounds in any of their forms. Natural polyphenols can range from simple molecules (phenolic acids, phenylpropanoids, flavonoids) to highly polymerized compounds (lignins, melanins, tannins), with flavonoids representing the most common and widely distributed subgroup.

Citrus is one of the most important commercial fruit crops grown in all countries of the world. The essential oil obtained from citrus fruits is having excellent antimicrobial properties and is used in cosmetic industry. An antimicrobial is a substance that kills or inhibits the growth of microorganism such as bacteria, fungi or protozoan's. Antimicrobial drugs either kill microbes (microcidal) or prevent the growth of microbes (microstatic). Citrus fruit products are known to potent antimicrobial agents against bacteria and fungus. Citrus fruits are rich source of flavonones and many polymethoxylated flavones which are very rare in other plants. Citrus fruits and juices are an important source of bioactive compounds including antioxidants such as ascorbic acid, flavonoids, phenolic compounds and pectins that are important to human nutrition.

Citrus byproducts also represent a rich source of naturally occurring flavonoids. The peel which represents almost one half of the fruit mass contains the highest concentrations of flavonoids in the Citrus fruit. Papaya (*Carica papaya* L.) is a kind of tropical evergreen fruit tree. Much peel and seeds waste is produced after the processing and consumption of papaya fruits. Some functions of papaya were related to the antioxidant activity of some secondary metabolites in the papaya organs. Early studies on the DPPH, hydroxyl, and superoxide free radical-scavenging activities of some tropical fruits and the water extract fraction from the flesh seed of papaya indicated that it exhibited the strongest activities. This waste, that usually polluted our habitat, could actually be utilized.

The main bio wastes produced when processing mangos (*Mangiferaindica*L.) are the peel and the seed, which represent approximately 35% to 60% of the fruit. Mango peel and seed has very high antioxidant activity, a fact attributed to its high phytochemical content. Therefore, mango byproducts have been studied as a safer natural alternative to synthetic food antioxidants in biscuits, buffalo ghee, vegetable oils, and potato chips.

Direct extraction using solvents is the most common technique employed to obtain extracts with high antioxidant activity from mango peel and seeds. Methanol or ethanol has been used as extraction solvents; however mixtures of methanol, ethanol, and acetone with water (between 50% and 95%) are the most widely used extracting agents for mango bio waste antioxidants. Hulls contain compounds with antioxidant activity. Active compounds were detected in hulls from peanut and buckwheat. During the extraction of oil from oilseeds, the antioxidant compounds present in the hulls could be incorporated in the oil, as reported for peanut oil extracted from the coated seeds, which contained higher oxidative stability than the oil from dehulled seeds. The outer layers usually contain a greater amount of polyphenolic compounds, as expected from their protective function in the plants. Agricultural and industrial residues are attractive sources of natural antioxidants. Potato peel waste, rape of olive, olive mill waters, grape seeds and grape pomace peels have been studied as cheap sources of antioxidants and recently increased antioxidant activity in rat plasma after oral administration of grape seed extracts was reported. Identification of polyphenolic compounds from apple pomace, grape pomace, citrus seeds and peels pulp waste, old tea leaves, cocoa by-products, non-volatile residue from orange essential oil, and soybean molasses has also been reported. Spent ground coffee oil from the residue from the production of instant coffee was used to obtain an antioxidant product useful for food preservation and for aroma stabilization, the antioxidant activity being due to the 5-hydroxytryptamide carboxylic acids (10± 75% dry wt. of the product).

Sources of natural antioxidants are spices, herbs, teas, oils, seeds, cereals, cocoa shell, grains, fruits, vegetables, enzymes, proteins. Researchers concentrate on ascorbic acid, tocopherols and carotenoids as well as on plant extracts containing various individual antioxidants such as flavonoids (quercetin, kaemferol, myricetin), catechins or phenols (carnosol, rosmanol, rosamaridiphenol) and phenolic acids (carnosic acid, rosmarinic acid). Ascorbyl palmitate is regarded as a 'natural' antioxidant because it is hydrolysed in the body to ascorbic and palmitic acids. Among the herbs of the Lamiaceae family, rosemary has been more extensively studied and its extracts are the first marketed natural antioxidants. Oregano, which belongs to the same family, has gained the interest of many research groups as a potent antioxidant in lipid systems. The review concerns the following main topics: stabilization of oil with individual natural antioxidants, interaction of antioxidants with synergists, stabilization of oil with extracts or dry materials from different plant sources (e.g. herbs and spices), stabilization at frying temperatures and in emulsions.

Fruit wastes can be used for the production of extracts possessing antioxidant activity e.g. wastes from wine grape processing. Bioorganic fruits such as oranges also grow under unfavorable conditions compared to those cultivated according to traditional agriculture; therefore, they also contain more phenolics.

Antioxidants are frequently applied to food as a protection against lipid oxidation. The efficiencies of the two types of antioxidants are very difficult to compare, but generally both of them act by similar mechanisms so that their antioxidant activities depend only on their chemical structure and polarity. No factors specific for natural compounds are involved. Synthetic antioxidants have been developed for the stabilization of bulk fats and oils or foods rich in lipids. In these substrates, they are substantially more efficient than a-tocopherol and other natural antioxidants, which are usually less liposoluble. The highest concentration allowed by law (0.02% on the lipid basis) is sufficient in most cases of synthetic antioxidants for the stabilization of real foods, such as lard, perhaps except for extraordinarily long storage or long deep-fat frying.

Natural antioxidants are mostly much more polar than synthetic antioxidants, except for carotenes, tocopherols and their esters, and sesame seed lignans. Therefore, natural phenolic antioxidants are usually not sufficiently soluble in the lipid phase, which limits their efficiency in bulk lipids. They are not pure substances so that the active fraction is usually much lower than the actual addition, while synthetic antioxidants are nearly 100% pure. Generally, it is necessary to add natural antioxidants in higher concentrations, such as 0.1–0.5%, or even more.

Many attempts have been made to prevent the oxidative deterioration of lipids by using natural antioxidants. Some components in natural products such as carotenoids, flavonoids, anthocyanins, and phenolic compounds are known to function as radical scavengers. In particular, the potential antioxidant activity of polyphenolic compounds has been reported for a number of natural plant extracts including grapes and their residues, almond hulls (*Prunusamygdalus*) and pine sawdust (*Pinuspinaster*) , green teas , berries , and murta fruits and leaves .

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