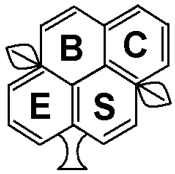

Journal

IN GREEN CHEMISTRY VALUABLE NATURAL ANTIOXIDANT PRODUCTION SERVES THE GREEN CHEMISTRY SCIENCE. (REVIEW ARTICLE)

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ABSTRACT

Green chemistry the new born chemistry environmental science, has been recently known in advanced universities and research world centers. As has been published in a book by the author, green chemistry involves in many scientific fields. The industries in a general generate huge amounts of wastes, which need efforts and money to get off that rubbish. One of these human industries is food industry, which polluted the environment by many vegetarian parts as by-products. The research trials convert the by-products and plant residues into important antioxidant materials. That may tend the science toward producing valuable products from the waste by-products. Especially, synthetic antioxidants are known to have toxic and carcinogenic effects on human health.

INTRODUCTION

Many organic sources have been produced as by-products in plant and vegetation industries. That includes soap stock from oil refining, bran and germ from grains milling, brewer's yeast and distiller grains from ethanol fermentation and cereal food fines from cereal processing. Also other wastes such as glycerol from biodiesel production, grape seed oil from winemaking process, molasses from sugar refining, citrus oils from processed peel fruits, pectin from remains of processed fruits and soybean meal from soybean processing. The article will discuss the valuable products produced and their economic availability and scientific importance through research all over the world.

Green chemistry the new born science is defined as the use of chemistry for pollution prevention. More specifically, green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. The "*Green Chemistry Centre*" will have roles for education and research in clean chemical technology. The groups have excellent links with many organizations around the world. There are several research groups at *York* for example, are interested in aspects of Green Chemistry including catalysis, supported reagents, alternative solvents, environmental fate and sustainable development. Green Chemistry Centre for Industry provides as well links with many chemical and other companies.

The idea discussed in this article will be focus on the right use of plant by-products through overcoming polluted the environment by many sources of these remaining plant parts in food industry processes, and more over using these wastes as natural food antioxidants instead of the harmful synthetics.

Text

The aim of this article is emphasis the vital role of by-product components or organic wastes against reactive oxygen species such as superoxide radicals, hydroxyl radicals and hydrogen peroxide. Radicals' primary targets are major intracellular and extracellular components, proteins, lipids and nucleic acids (Ramarathnam *et al*., 1995). Oxidative stress leads to damage of the biological systems in the body, promoting the development of various diseases and accelerating the aging process.

Beside many of antioxidants as vitamin C, vitamin E and carotenoids as dietary constituents, many researches have focused on strong antioxidant compounds found in citrus, olives, garlic, onions, beans, fruits and vegetables.

As some synthetic antioxidants may exhibit toxicity and require high manufacturing costs but show lower efficiency than natural antioxidants, there is a need to identify natural and possibly more economic and effective antioxidants with potential to be incorporated into foods.

The antioxidative activity of these compounds as phenolic compounds is due to their ability to scavenge free radicals, donate

atoms or electron, or chelate metal cations (Amarowicz *et al.*, 2004). In phenolic acids, the activity depends on the numbers and positions of hydroxyl groups in relation to the carboxyl group (Rice-Evans *et al.*, 1996). In flavonoids is generally more complicated than that of phenolic compounds.

Wastes from fruits and vegetables

Substantial quantities of waste/by-products are generating from fruits and vegetable processing. Fruit and vegetable waste and by-products are disposed of often at a cost to the manufacturer. Therefore, use of the waste as a source of polyphenols may be of considerable economic benefit to food processors. Waste and by-products can range from pomace (leftovers after pressing) to cabbage cut-offs and whole fruits and vegetables.

Fruits and vegetables are the major dietary source of polyphenols the bioactive compounds in the human diet. The possible health benefits of polyphenol consumption have been suggested to drive from their antioxidant and anti-inflammatory properties. Their role in the prevention of degenerative diseases is clear in cancer and cardiovascular diseases.

Moure *et al*. (2001) demands that natural extracts high in antioxidant activity can be added to food products to preserve their colour and flavour and improve their shelflife. The thing that we want to take care of in this area of study is using food safe solvents and methods to optimize and obey the green chemistry principles.

Wijngaard *et al*. (2009) mentioned that kiwifruit, apple and pink grapefruit peel wastes have the highest antioxidant activity, with the lettuce core. They found that the most available polyphenols in these wastes are hydroxy cinnamic acid, flavonolglycosides, flavanols and flavanones. Shaker (2006) evaluated red grape seed and peel as valuable antioxidants with high phenolic content. Sunflower oil had high protection levels with using the different red grape waste extracts.

Peels as waste products have been discharged, causing a severe problem in the community as they gradually ferment and release off odours. In general, peel and seed fractions of some fruits have higher antioxidant activity than the pulp fractions (Jayaprakasha *et al*., 2001). Pomegranate peel has a higher antioxidative activity than its pulp (Li *et al*., 2006), and grape seed is higher as well than its pulp for the

proanthocyanidin (Guo *et al*., 2003). On the other hand, Helmy *et al.* (2006) found that banana peel extract has higher antioxidative activity than banana pulp, for the phenolic content. El-Morsi *et al.* (2000) declared the importance of the potato peels which has phenolic compounds and antioxidant content.

Many phytonutrients of fruits and vegetables may be beneficial in protecting the human body against damage by reactive oxygen and nitrogen species (Diplock et al., 1998). Specially, fruit seeds have a remarked antioxidative activity and phenoilc content (Soong and Barlow, 2004).

We can't ignore tomato peel waste, where it showed as industrial waste high quality in carotene and lycopene more than the tomato puree. Benakmoum *et al.* (2008) sited oil enrichment with tomato carotenoids and lycopene in particular low quality oils like refined olive oils. They considered that an approach to elaborate new function foods.

Wastes from edible plants

One of the plant wastes which contains phenolics and control oxidation in the body and decrease the risk of developing illness are the leaves of edible plants such as *M. japonicas* (Tabata *et al*., 2008). Leaf extract showed stronger antioxidative activity than that for green tea extract. The bark as well has been used to treat stomach disorders and gastric ulcers, and leaves to reduce swelling.

In diabetic biological experiment, Sabry *et al.* (2005) examined papaya leaves as potent antidiabetic agents for alloxane-induced diabetic rats. That may due to reducing power and antioxidant activity for papaya leaves.

Citrus wastes

There is a strong need for effective antioxidants from natural sources as alternatives to prevent deterioration of fats and oils. Extract of oat (Emmons and Peterson, 1999) showed antioxidant activity in cooking oils, and olive leaf (Benavente *et al*., 2000) in prolonging the storage life of fat and oil. Citrus peels are waste material, obtained after extraction of juice from citrus fruit. Rehman (2006) recommended citrus peel extract as a natural antioxidant to suppress development of rancidity in oils and fats.

Antioxidant compounds have been identified as well in the seeds of citrus (Alessandra *et al*., 1998). Shaker (2004) studied the

antioxidative activity for grapefruit, Valencia orange, sour orange, lemon seeds and mandarin, orange leaves. Fruit seeds have not received much attention as antioxidant sources for their lack of popularity and lack of commercial applications.

Other waste sources for antioxidants

Hulls contain compounds with antioxidant activity as hulls from peanut (Xing and White, 1997), mung bean (Duh *et al*., 1997) and buckwheat (Watanabe *et al*., 1997). Bran fraction has been reported to have more antioxidant activity than other fractions as observed for durum wheat (Onyeneho and Hettiarachchy, 1992).

Moreover, Klinke *et al*. (1998) recovered monomeric and oligomeric hemicellulosic sugars, sugar dehydration products, organic acids, extractive and phenolic compounds from lignin fraction. Lignin degradation products are simple phenols derived from guaiacyl, syringyl or *p*-hydroxyphenyl groups depending on raw material. Larsson *et al*. (1999) identified phenolic and cinnamic acids, aldehydes, alcohols and ketones in hydrolysates from mild acid hydrolysis of hardwoods or agricultural residues. The benefit of these hydrolysates leads to crude fractions with antioxidative activity and radical scavenging agents (Gonzalez et al., 2004).

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فى الكيمياء الخضراء:
أنتاج مضادات أكسدة طبيعية فى أطار علم الكيمياء الخضراء

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بدأت المعرفة بعلم الكيمياء الخضراء هذا العلم المولود الحديث من علوم البيئة فى الجامعات المتقدمة ومراكز الأبحاث العالمية. وكما ورد من أساسيات هذا العلم فى كتاب الكيمياء الخضراء للمؤلف فأن هذا العلم يرتبط بالعديد من المجالات والعلوم المختلفة. وأحد المشاكل البيئية التى يرتبط حلها بهذا العلم الأخضر هو أنتاج كميات هائلة من الفواقد الصناعية، التى تحتاج للموارد المالية للتخلص منها. وصناعة الأغذية تنتج على سبيل المثال كميات من الفواقد النباتية من بذور وأوراق وقشور تلوث البيئة. المحاولات البحثية الحديثة تحول هذه البقايا النباتية إلى مواد مهمة لما تحتويه من فينولات و فلافونيدات تمتلك الأهمية كمضادات أكسدة. خاصة بعد أن دارت الشكوك حول مضادات الأكسدة الصناعية التى ظهر دورها كمواد سامة ومسرطنة تضر الصحة العامة.