Healthy waste: Potent nutraceutical bioactives from bio-waste for wellbeing

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Abstract

Bio-waste from food processing and other household related sources like flowers/ornamentals are a menace as they surely end up in landfills or dumpsters. Specially, food waste and floral ornamentals from a marriage/party hall are bigger sources for dumpsters. Getting piled up routinely, these biological wastes are degraded by anaerobic microbes resulting in an unpleasant stunk leading to compromised elegance of the surroundings. Interestingly, the plant parts considered waste are in fact rich sources of bioactive principles with greater therapeutic potential for various ailments. The wastes usually include peel, leaves, seeds of vegetables and petals of old flowers. Most of these plant products have been indicated to possess considerable quantities of various phytochemicals with potential biological activities. Owing to the marked rise in the food industry activities, there is an enormous scale of food waste generated globally. Quercetin, gallic acid, ferulic acid, resveratrol are a few popular examples of phytochemicals reported among biological wastes like peels of banana, orange, apple, seeds of guava, avocado, and petals of lilies and roses which are usually generated at home. These bioactives/ nutraceuticals have been indicated to possess significant biological activities ranging from antioxidant to anticancer properties. Numerous secondary metabolites, minerals and vitamins have been extracted from food waste, using various extraction approaches. Shortly, these approaches could provide an innovative approach to increase the production of specific compounds for use as nutraceuticals/functional food. However, there is an urgent need for a meticulous awareness program for processing these wastes at the household and locality levels. There is constant research for exploring the utilization of these bioactive by-products, to prevent pollution and related adversities. Here we review a definite list of plant wastes generated at home and their pharmaceutical propensities.

Introduction

Nutraceutical is established as a nutrient (food) with medicinal (pharmaceutical) property. A nutraceutical product may be defined as a substance, which has physiological benefit or provides protection

against chronic disease. Nutraceuticals can include: minerals, vitamins and other dietary supplements, herbal products, Dietary enzymes/ fibers, hydrolysed proteins/ polysaccharides, phytochemicals,, pre/probiotics etc., Nutraceuticals may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body. Nowadays, nutraceuticals have received considerable interest due to potential nutritional, safety and therapeutic effects. Recent studies have shown promising results for these compounds in various complications. Quercetin, gallic acid, ferulic acid, resveratrol are a few popular examples of phytochemicals reported among biological wastes like peels of banana, orange, apple, seeds of guava, avocado, and petals of lilies and roses which are usually generated at home. These bioactives/ nutraceuticals have been indicated to possess significant biological activities ranging from antioxidant to anticancer properties. The edible parts of the fruits/ vegetables have nutraceuticals for obvious reasons, however, the waste parts from the same, are reported to contain higher quantities of potent nutraceuticals. Hence, we set out to review the possibilities of using food waste or the household bio waste for preparing nutraceuticals while reducing the costs of raw materials. Here, we have thoroughly scrutinized the literature for the bio-wastes for nutraceutical abundance.

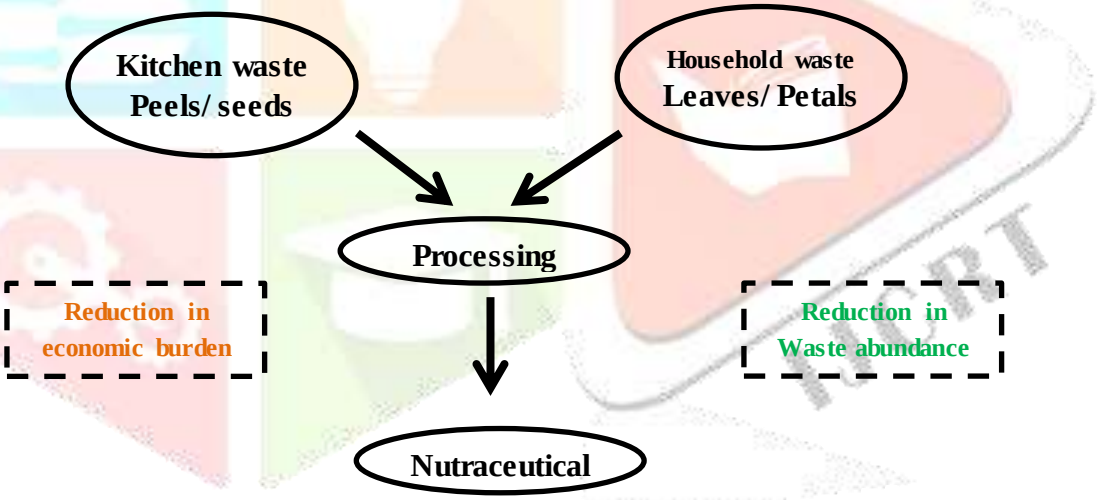

Fig. 1. Schematic representation of major steps involved in nutraceutical isolation from wastes

Tomato seeds and peel

Tomato seeds are reported to be a great source of ferulic and gallic acids. Recently the seed oil is demonstrated to contain higher contents of lycopene and beta carotene. A number of biological properties from antioxidant in vitro to neuroprotection in vivo have been associated with tomato seed preps (Eller). A number of flavonoids like including quercetin, kaempferol, and isorhamnetin derivatives have been reported from tomato seeds (Ferreres). Further, the phenols isolated from tomato seeds have been demonstrated to possess anti-platelet activity (Fuentes). Tomato peel extracts were reported to markedly reduce the peroxide

levels among stored oils as well as scavenge other major reactive species (Elbadrawy). In addition, the peel preparations were demonstrated to protect the nutritive value of the tomatoes while cooking procedures (toor).

Grape seeds

Grape seed is a rich source of resveratrol known for the neuroprotective efficacies (Richard et al. 2011; Bastianetto et al. 2015). Recent demonstrate that grape seed oil is a good source of tocols, and in particular of α-tocopherol, α-tocotrienol and γ-tocotrienol (Ben Mohamed et al. 2016). Burin et al. (2014) compared between the grape varieties and the extraction methods concluding that the concentration of bioactives depends on the varieties.

Avocado seed and peel

After using the pulp of Avocado fruits for salads and guacamole, the usual wastes are peel and the seed (stone). Avocado stones are reported to contain proanthocyanidins and peel are rich in flavonoids (Smitha Grace et al., 2015; 2016). Various bioactives have been demonstrated to possess amylase inhibitory properties as well affirming the quality added product possible from these waste products (Smitha Grace et al., 2016).

Banana Peel

Banana (Musa acuminata) peel extracts are reported to possess high capacity to scavenge 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2′-azino-bis(3-ethylbenzothiazoline)-6-sulfonic acid (ABTS+) free radicals compared to the standard antioxidants. In addition, the banana peel extracts showed significant lipid peroxidation inhibition as well (González-Montelongo et al. 2010). Banana's peel comprises mostly carotenoids, phenolic compounds, and biogenic amines. These bioactives have been suggested strongly for Parkinson’s therapy (Pereira and Maraschin 2015).

Banana flower

The flowers/inflorescence of banana of specific types are used in Malabar coastal cuisine of India, specially among the Indian states of Karnataka and Kerala. Musa (banana) flowers contain potassium, vitamin A, vitamin C, vitamin E, minerals, fatty acid content, flavonoids, saponin, essential and non-essential amino acid, tannins, glycoside and steroid (Salgar and Usman 2015). The flavonoids identified from banana flowers were excellent activators of insulin receptor tyrosine kinase activity owing to indication for diabetes therapy (Ganugapati et al. 2012)**.**

Guava leaves

Guava leaves, one of the medicinal plants used in folk medicine, lack any systematic methodology needed to demonstrate genuine efficacy. However, there have been a number of studies which strongly suggest the presence of flavonoids and phenolics in higher quantities when compared to pulp (Sohafy et al. 2009). Guava leaves mainly contain phenolic compounds, isoflavonoids, gallic acid, catechin, epicathechin, rutin, naringenin, kaempferol. The leaf preparations have been rightly suggested for hepatoprotection, antioxidant, anti-inflammatory, antispasmodic, anti-cancer, antimicrobial, anti-hyperglycemic, analgesic, endothelial progenitor cells, anti-stomachache and anti-diarrhea (Barbalho et al., 2012; Díaz-de-Cerio et al. 2017).

Citrus rinds

Otherwise a routine waste from the dining table, the citrus peels/rinds represent a rich source of phenolic compounds and dietary fibre. In addition the peel oil is an excellent aromatic preparation for both culinary and cosmetic utilities (Khan et al. 2012; Rafiq et al. 2016).

Pomegranate peels

Initial studies conducted by Singh et al. (2002) demonstrated the presence of carotenes and phenolics in pomegranate peels. Further, the antioxidant and anti-pathogenic activity of pomegranate extracts were reported from various model studies (Zhang et al. 2007; Foss et al. 2014; Rosas-Burgos et al. 2017).

Conclusion

The waste parts from the kitchen or general household wastes are reported to contain higher quantities of potent nutraceuticals. Owing to this, we propose to study their neuroprotective and anticarcinogenic properties against suitable study models using mice and drosophila. The findings from our future studies are believed to enhance the use of food waste or the household bio-waste for preparing nutraceuticals while reducing the costs of raw materials as well as reducing the socio economic burden of waste processing.

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