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Valorification of fruit waste to obtain bioactive compounds

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Abstract:
The demand for fruits and vegetables has increased significantly due to the growing population. They are either consumed raw, minimally processed, or processed and generate significant losses and waste in the fresh. The waste is composed of peels, pomace, seeds, stalks, leaves and pods and these often end up in landfills or being dumped in rivers causing environmental hazards. Fruit waste provides an enormous opportunity for the industry to utilize it as a source of 'naturally' derived: citric acid, pectin, polyphenols, fatty acids, tocopherols, carotenoids, dietary fiber, enzyme, organic acids. In this article were determined the content of total polyphenols and the antioxidant activity of bananas peels and also of oranges peels resulted from human consumption.

Keywords: waste, polypfenols, antioxidant activity

1. INTRODUCTION

There is a range of physical, chemical, and biological techniques currently at our disposal for treating wastewater released by different industrial sectors. Among these methods, Fenton reactions have established themselves as a verified and economically viable process for the eradication of dyes in wastewater [1]. Methylorange, an azo dye employed in the printing, paper production, textile, pharmaceutical, and food sectors, gives rise to various health issues [2].

The fruit production and processing sectors produce tremendous amounts of by-products and waste that cause significant economic losses and an undesirable impact on the environment. These by-products contain a variety of bioactive compounds, such as dietary fiber, flavonoids, phenolic compounds, antioxidants, polysaccharides, and several other health-promoting nutrients and phytochemicals. The bioactive components extracted can be used in developing nutraceutical products, functional foods, or food additives[1]. These fruit wastes can pose major environmental challenges, such as water and soil pollution, the greenhouse effect, eutrophication, global warming, and other health problems if not effectively handled due to their high biodegradability and fermentability. Therefore, waste recycling and resource recovery are essential for the effective valorization of fruit waste [2]. A schematic diagram of fruit waste utilization is shown in Figure 1 [3].

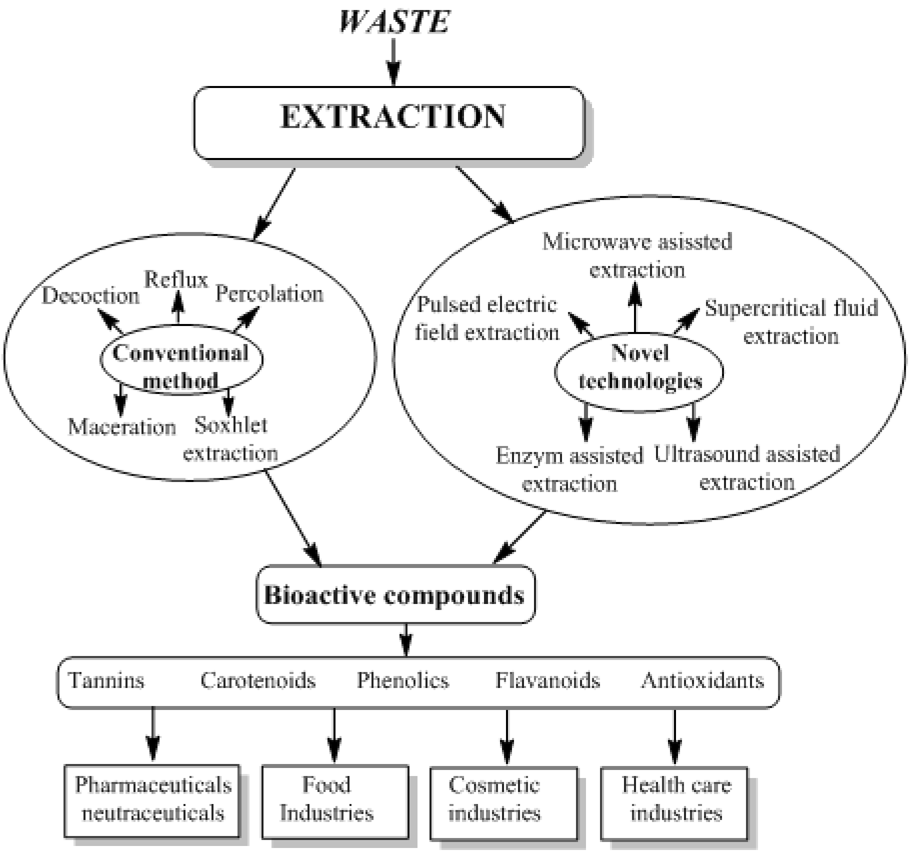

Figure 1. A schematic representation of waste valorisation.

Fruit waste provides an enormous opportunity for the industry to utilise it as a source of 'naturally' derived: citric acid, pectin, polyphenols (ellagic acid, quercitin, gallic acid, epicatechin, procyandin B, flavonols, flavan 3-ols, cafeic acid, anthocyanins, chlorogenic acid), fatty acids, tocopherols, carotenoids, ellagic acid [4; 5], dietary fiber, enzyme, organic acids, flavour, essential oils,biogas, biohydrogen, bioethanol [6].

Currently, waste utilisation for valorisation is limited; to overcome that, strategies need to be developed.

2. MATERIALS AND METHODS

2.1. Materials

Were used in determinations bananas and also oranges peels resulted from human consumption.

Reagents:

Folin-Ciocâlteu reagent, ethanol were purchased from Merck Germany, gallic acid, 2,2-diphenyl-1-picryl-hydrazine, sodium carbonate, quercitin were purchased from Sigma-Aldrich.

2.2. Analysis methods

Extraction of polyphenols from bananas and also from oranges peels

The bananas and also oranges peels were cut into small pieces and dried at 60 °C for 12 h using hot air oven. The dried samples were crushed into the powder by using a blender Biovita Top-Blend and kept in a vacuum aluminum bag under refrigeration (4 °C) until further use.

To extract total phenolic compounds, 10 g of orange and banana peel powder was placed in an Erlenmeyer flask containing 500 mL of 90% ethanol. The extraction was performed for 1 h by stirring at 250 rpm at 50 °C. The mixture was further centrifuged at 5000×g for 10 min, and the supernatant was stored at 4 °C until further use.

The total polyphenol content was measured using the Folin Ciocâlteu colorimetric method. To 800 μL of deionised water, 50 μL of Folin Ciocâlteu reagent and a volume of sample ranging from 10 to 50 μL were added and accurately mixed. After 1 min, 100 μL of 20 % sodium carbonate solution was added and mixed. Deionised water was then added up to a volume of 1 mL.

The solution was carefully mixed and total phenol content was spectrophotometrically estimated at 765 nm after 2 h incubation. The results were expressed as mg (GAE)/g using the following equation y = 0.0135x - 0.074, R2 = 0.9987 based on the calibration curve, Figure 2 [7].

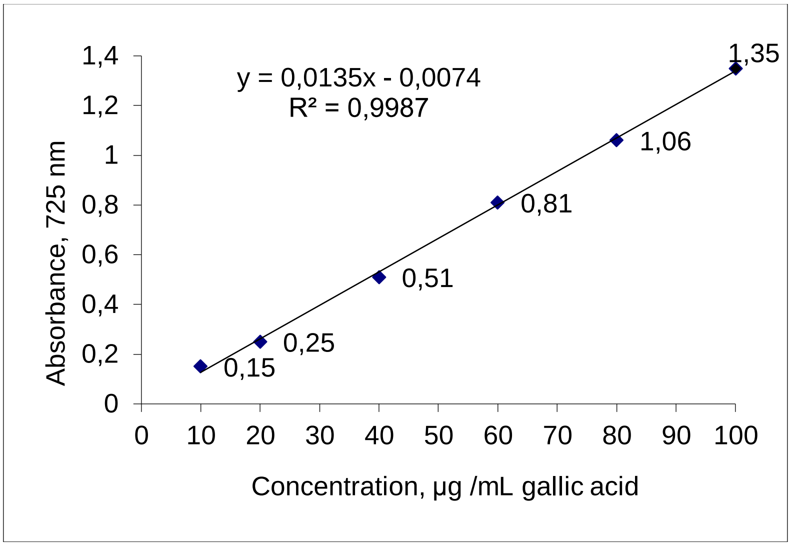

Figure 2. Calibration curve of gallic acid.

Antioxidant activity by DPPH method was analysed using the method as described previously by Dumitru and Ganescu, 2017, Dumitru, 2024. The DPPH solution (oxidized form) was prepared in absolute ethanol to obtain a final absorbance of 0.8 - 1.0. Next, 100 µL of sample was added to 900 µL of DPPH radical solution. After vigorous shaking, the blend was incubated for 30 min in the dark at room temperature. The radical neutralizing capacity was determined by spectrophotometric measurement of the absorbance at 517 nm wavelength The inhibition percentage of the samples was calculated using the equation % inhibition = [(Abs control – Abs sample) / Abs control] × 100 where: Abs control is the absorbance of DPPH radical + methanol; Abs sample is the absorbance of DPPH radical + sample extract.

3. RESULTS AND DISCUSSION

The set-up of innovative and sustainable extraction systems of natural products is currently a hot research topic involving different areas.

The recovery of food by-products is a way to re-use the waste of the agri-food production chain, recovering their precious compounds [8].

The total polyphenol content of the extract from the orange by product was 34.8 mg GAE/g and 29.7 mg GAE/g for bananas by product and antioxidant activity 32% orange and 24% for banana.

The data obtained in this work are difficult to compare to those found in literature for different reasons. There are huge differences in vegetables polyphenol quantification depending different cultivar the cultivation site soil and pest-control [9].

4. CONCLUSIONS

Agricultural residues could be considered valuable resources after recycling and reprocessing. The recovery of food by-products is a way to re-use the waste of the agri-food production chain, recovering their precious compounds.

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