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From Carrot By-Products to Carrot Flour: Production Process and Flour Characterization

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This work was performed in a framework of a PhD project that aims to develop new breakfast cereal products rich in rich by application of fruit and vegetable by-products flours. Among food industry wastes, fruits and vegetables incur higher levels of losses due to their highly perishable nature. More than 20% of the fruits and vegetables produced worldwide are lost from post-harvest up to, but excluding, the retail level (FAO, 2019). Nevertheless, the scientific community have been found that these by-products may be transformed into flours that are rich in fibre and bioactive compounds, thus bringing value to several food industries. The goal of this work was to produce and analyse flours from carrot by-products. By-products were dried at 55 °C and ground to powder. The resulting carrot flour had a moisture content of 8.4±0.1%; low-fat content (1.89±0.01%) and high total carbohydrates content (74.4±0.1%), of which total dietary fibre (DF) content of 51.6±0.0%; 36.4±0.3% of insoluble DF and 15.1±0.3%soluble DF. Carrot flour presented three simple sugars molecules: sucrose, glucose and fructose, and total sugar content of 302.23±19.12mg sugars/g of flour. Antioxidant activity was measured using ABTS and DPPH methods and showed higher antioxidant activity for the carrot flour than for the fresh carrot by-products(dry basis). Total phenolic content(measured by Folin–Ciocalteu assay) followed a similar behaviour: higher in carrot flour (0.91±0.01 mg GAE/g of DW) than in fresh carrot by-products (0.70±0.07mg GAE/gof DW) and in carrot pomace (0.43±0.04 mg GAE/g of DW). Tocopherols and carotenoids were quantified by HPLC analysis after saponification of samples and hexane extraction. Carrot flour presented two vitamin E isomers, α-and β-tocopherols, by 5.77±0.14 and 3.64±0.06 µg/g of flour, respectively. As well as several carotenoids, namelyα-carotene (345.92±19.56 µg/g of flour),lutein (12.16±1.49 µg/g of flour), β-cryptoxanthin(2.53±0.25 µg/g of flour)and β-carotene (1.52±0.09 µg/g of flour).This work showed that carrot by-products' transformation into flour is an effective way to create added-value ingredients that are rich in fibre and, thus can be applied in the development of the intended breakfast cereal products.

Keywords: by-products valorisation; by-products flour; carrot by-products; bioactive compounds; bioactivity