

STAGE I: OBTAINING AND CHARACTERIZING POWDERS AND EXTRACTS FROM FRUIT PROCESSING BY-PRODUCTS

To achieve the project objectives in Stage I, the following studies have been developed:

1. Forced convection drying of by-products resulting from the processing of apples (Starkrimson, Idared and Jonagold varieties) and pears (Santa Maria and Abate varieties) at three drying temperatures 57°C, 63°C and 68°C. To characterize the drying process, drying curves were determined, which describe the variation of the moisture content of the material as a function of the applied temperature and drying time, and the speed of the drying process. The obtained dried pomace powders were analyzed for proximal composition, titratable acidity, water activity (aw), color parameters, rehydration capacity, total phenolic content, DPPH free radical scavenging capacity, phenolic profile and organic acid profile. Studies have shown that forced convection drying is an effective method for the valorization of apple and pear pomace, allowing the obtaining of powders with a high content of bioactive compounds. From the point of view of drying kinetics, no major differences were observed between apple and pear pomace. The process takes place predominantly in an internal diffusion regime, without a constant stage, and empirical drying models can describe the phenomenon very well. A drying temperature of 63°C can be considered optimal because it leads to a reduction in drying time compared to a temperature of 57°C, while preserving the physicochemical, nutritional and functional characteristics of the pomace.

2. Forced convection drying at 57°C of by-products resulting from the processing of blueberries, blackberries and blackcurrants and evaluation of the nutritional and bioactive content of the resulting powders. The color parameters of the powders, proximal composition, fatty acid profile, total content of phenolic compounds, anthocyanins and flavonoids, antioxidant activity and polyphenolic profile were determined. The results showed that berry pomace powders are a source of oils with a unique fatty acid profile, being rich in MUFA and PUFA. Blueberry pomace was the richest in n-3 PUFA, followed by blackcurrant pomace. The berry pomace powders had a high content of anthocyanins, which gives them coloring properties. Due to their lipid profile and richness in antioxidant compounds, berry pomace are good candidates as food ingredients to improve the functionality of food products.

3. Influence of extraction solvent (water, 1% citric acid, 40%, 60% and 80% ethanol) on conventional maceration and ultrasound-assisted extraction (UAE) of phenolic compounds from blueberry, blackcurrant and wild blackberry pomace. The resulting extracts were compared in terms of total phenolic compounds (TPC), anthocyanins (TAC) and DPPH antioxidant activity (AA). TPC was approximately 2.3-3.2 times higher in ethanol extracts compared to aqueous extracts. Extracts

made in 60% ethanol presented the highest values of TPC, TAC and AA, regardless of the extraction method and pomace matrix, while water and 1% citric acid were very little effective in recovering anthocyanins or even phenolic compounds. The highest antioxidant activity and TPC were found in blueberry pomace extracts obtained by both maceration and UAE. Under the conditions of this experiment, the extracts obtained by maceration showed higher TPC values and were more antioxidant than the extracts obtained by UAE.

4. Development of an efficient ultrasonic and enzyme-assisted aqueous extraction method for the recovery of phenolic compounds and water-soluble components from apple pomace. An optimization study was performed using a Box-Behnken factorial design combined with response surface methodology to evaluate the influence of enzyme/substrate ratio (0–10 % v/g), extraction time (1–5 h) and temperature (25–55 °C) on three response variables: total phenolic content (TPC), antioxidant activity (RSA) and soluble substance content (SSC) of the extracts. In addition, the effect of extraction parameters on the individual phenolic content of the extracts was investigated. The optimal extraction conditions to simultaneously obtain the highest content of phenolic compounds, DPPH radical scavenging activity and soluble substances content from the extraction of apple pomace in water were enzyme/substrate ratio = 9.77%, temperature = 43 °C and extraction time = 1 hour. The response values at the optimum were TPC = 270 mg GAE/L, RSA = 0.68 mmol Trolox/L and SSC = 4%.