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Optimization of the Anthocyanins extraction process from Aronia berries pomace

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The extraction of anthocyanins from *Aronia melanocarpa* pomace from juice production was studied in the context of waste minimization and biomass valorization. The influence of temperature, solvent concentration and solid to solvent ratio was investigated. The concentration achieved with extraction was quantified by HPLC. The highest concentration of anthocyanin observed was 794.16 mg/l at 50°C, using a concentration of citric acid of 1.5 wt% and a 1:20 solid to solvent ratio.

Keywords: *Anthocyanins*; optimal extraction; bio-waste valorization.

INTRODUCTION

Aronia berries originate from the eastern North America, they are a perennial shrub within the *Rosaceae* family that is indigenous to that region of the world. There are three natural types of Aronia, *Aronia arbutifolia* (Red chokeberry), *Aronia prunifolia* (Purple chokeberry) and *aronia melanocarpa* (black chokeberry), with the latter being the most commonly specie cultivated [1].

Although the Aronia berries are native of North America, they were also cultivated in Europe and then diffused to Russia, Norway, and eastern Europe in the beginning of 20th century. In 1930, the Russian botanist Ivan Mitchurin, discovered the nutritious benefits Aronia, and its resistance to cold climates. The first cases of commercial cultivation of Aronia was registered in the 1980's in Sweden and Poland to produce natural red to replace artificial colorants in foods, juice, jams, wine and herbal tea [1]. Since then the Aronia cultivation increases mainly due to the scientific interest in antioxidants and their benefit for human health [2]. The interest area in Aronia, besides health, also includes the food industries interest in using natural colorants and food preservatives.

Anthocyanins are water-soluble red, blue and purple natural pigments responsible of the color of many fruits and plants such as Aronia [3]. The color of the berries given by anthocyanins serves as way to attract pollinators and seed dispersers and protect photosynthetic tissue from oxidative stress induced by light [4]. Anthocyanins are classified as polyphenols formed by phenylpropanoid metabolism from phenylalanine, and is synthesized by gymnosperms and most angiosperms.

Due to its antioxidative properties, anthocyanins are suited for fruit and vegetables preservatives, to both increase the shelf life and to protect against postharvest pathogens. An enrichment of anthocyanin in tomatoes was able to significantly extend their shelf life suppressing the ripening rate of tomatoes, and other crops [5].

In the optic of biomass valorization and avoiding the competition between food and compound recovery, aronia pomace from juice production was considered as potential source for anthocyanins recovery. This approach allows to valorize wastes that would end their life cycle in a landfill. Extraction temperature, solvent concentration and solid to solvent ratio were considered as fundamental variables to optimize the extraction process.

MATERIALS AND METHODS

The extraction of anthocyanin was performed in a 1000 mL thermo jacketed batch reactor and each experiment was done in triplicates. The solvent considered for the extraction was citric acid monohydrate at the concentration of 0.25, 0,75, 1.5 wt %. The solvent was heated in the reactor at the experiment temperature before starting the extraction. Three temperatures were considered, 30, 50 and 70 ˚C.

After the temperature was stabilized, the aronia pomace was added. The pomace was provided frozen and was thawed overnight in a refrigerator at 5°C. Three amounts of pomace, 12.5, 20 or 50 grams were considered. They are equivalent to the following solid to solvent ratio, 1:80, 1:50 or 1:20. The batch extractions had a runtime of 30-60min, with samples taken at predefined times. Samples

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taken during the extraction process, were filtered through 0.2 μm filters into HPLC vials.

Agilent Technologies 1200 HPLC was used to quantify the anthocyanin. The column used was a Gemini C18 5 μm with the dimensions of 250 mm in length and with a 4.6 mm internal diameter, with a DAD. The mobile phases were water with 0.05 % TFA (A) and acetonitrile with 0.05 % TFA (B). with the following gradients, 0 to 1 min 99 % A, 1 to16 min 82 % A and 16 to 20 min 99 % A, with the injection volume of 20 μl and a flow of 1 mL/min. The detection was carried out at 520 nm.

RESULTS AND DISCUSSIONS

The influence of the different parameters on the extraction performance were reported in Figure 1.

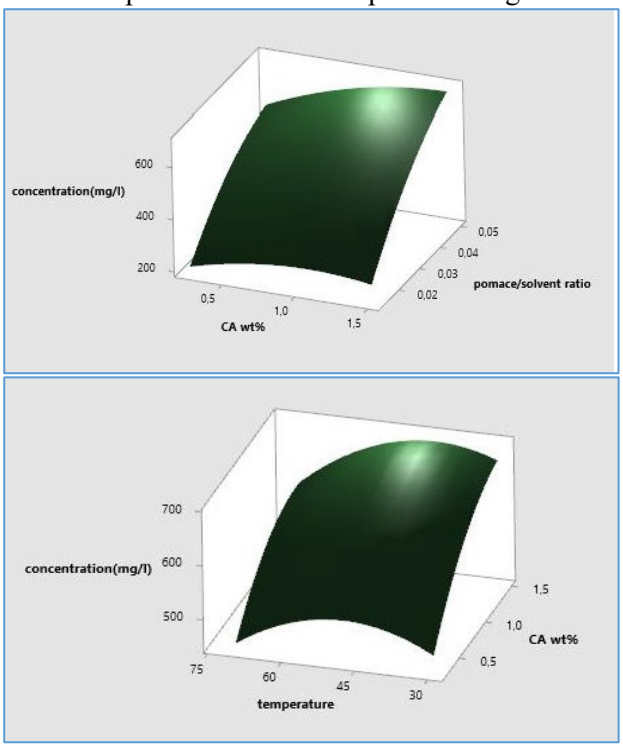

Fig. 1: Influence of citric acid (CA) concentration on anthocyanins concentration (up) temperature influence (down).

As expected, increasing the solvent concentration and the solid to solvent ratio the anthocyanins concentration increases. More interesting the same behavior was not observed for the temperature were a clear maximum in the concentration appears around 45 ˚C. Based on the analysis the maximum concentration was observed at 42 ˚C, a solvent concentration of 0.75 wt % and a solid to solvent ratio of 1:20 and it was equal to 691.77 mg/L.

CONCLUSIONS

The objective of the study was to quantify and optimize the extraction of anthocyanin content from Aronia pomace. Three parameters were examined: temperature, pomace to solvent ratio and the concentration of citric acid in the solvent. All three parameters had a significant influence on the extraction of anthocyanins. The results showed an interesting potential for the valorization of this biowaste opening new potential markets for the Aronia juice producers. However, the optimization of the extraction step alone is not enough to assure the economical convenience of the production. The solvent removal after the extraction is the next challenge to overcome to bring the components to the market.

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