RESPONSE SURFACE METHODOLOGY OPTIMIZATION OF NUT SHELL PHENOLIC COMPOUNDS USING ULTRASOUND-ASSISTED EXTRACTION

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I. INTRODUCTION

The chestnut industry generates large amounts of by-products, particularly the shell, a potential source of phenolic compounds [1]. The main phenolic compounds present in the nut shell are phenolic acids, flavonoids, and tannins [2]. Phenolic compounds have been associated to antimicrobial activity, that might be useful to extend mat shelf life [3]. Response surface methodology (RSM) was applied to optimize the extraction conditions of phenolic compounds from the chestnut shell of two different varieties. The objective of this work was to optimize ultrasonic assisted extraction (UAE) of phenolic compounds from chestnut shell using a response surface methodology design (RSM).

II. MATERIALS AND METHODS

The UAE was performed using an ultrasonic device (Elma, model Elmasonic S 120, Germany), and time and temperature were controlled. The samples were previously dried (40ºC, 60ºC or freeze-dried) and ground. 2g of the powdered sample were extracted with 20mL of solvent (water, water 50% : ethanol 50% or water 70% : ethanol 30%). After extraction, the extracts were centrifuged (Gyrozen, model 1248R, Korea) at 5000x g for 15min and lyophilized. The total phenolic content (TPC) was based on the Folin–Ciocalteu procedure, with minor modifications. The RSM method was used to analyse challenges where the studied responses (dependent variables) were influenced by independent variables. RSM was applied to optimize the conditions under study to select the favourable extraction conditions, maximizing the extraction of phenolic compounds. The data obtained was codified as -1, 0, +1 according to the RSM methodology. The analysed variables were extraction time (30', 45' and 1h), extraction temperature (40°C, 50°C and 60°C), drying procedure (40°C, 60°C and freeze-drying) and solvent (water, water 50% : ethanol 50% and water 70% : ethanol 30%). Two varieties of chestnut shell were studied in separate experiments. The data analysis was performed with Statistica software.

III. RESULTS AND DISCUSSION

From the analysis of the ensemble of results we observed that the drying temperature and extraction time do not influence ($P>0.05$) the extraction rate. Both solvent and drying

procedure influenced the extraction (P<0.05) (Figure 1). Figure 1 illustrates the results obtained through RSM, where the factors under analysis are compared two by two, and a total of six graphs are obtained. The effect of the solvent in the extraction and the drying procedure of the samples, have the most influence on the amount of extracted compounds. The solvent with the best extraction capacity is 70% water : ethanol 30% (0), and the drying procedure with the best results is freeze-drying (-1).

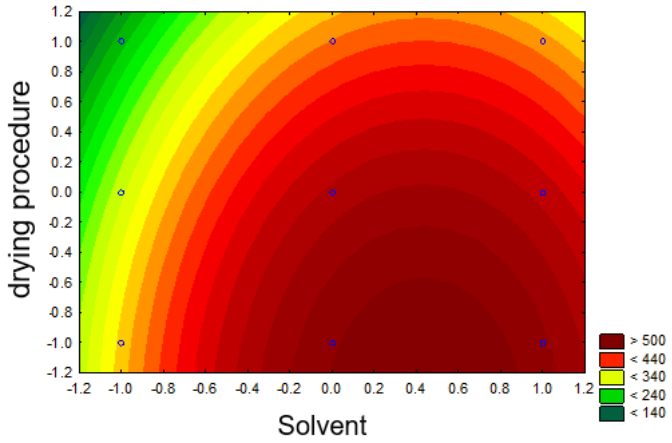

Figure 1- Response surface plots for the interaction effects of drying procedure and solvent. The optimal points were identified on the response surfaces.

IV. CONCLUSION

The extract obtained from the nut shell is a good source of phenolic compounds, having obtained a mean value of 411, 46 mg/L, with a maximum value of 689.33 mg/L and a minimum value of 166.29 mg/L. The factors that most influence the extraction is the solvent and the drying procedure. The factors that most influence extraction are the solvent and the drying procedure, and between them there are not always significant differences.

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