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OPTIMIZATION OF SOLID-LIQUID EXTRACTION OF PHENOLIC ANTIOXIDANTS FROM DEFATTED GRAPE SEED CAKE

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Plant objects are considered to be promising sources of antioxidants. Technologies for obtaining additives from vegetable raw materials in the form of extracts are increasingly used in the manufacturing of functional food products with high antioxidant potential, as well as increased biological and nutritional value.

Grape seed is produced in large quantities as a waste of the wine industry and is increasingly used to create food ingredients. This is due to the fact that it is a source of antioxidants of polyphenolic nature, whose antioxidant activity is associated with an action against various types of oncology, pathology of cardiovascular diseases.

The objective of this study was to conduct an assessment of optimal conditions of the total antioxidant capacity (TAC) and the total phenolic content (TPC) of defatted grape seed cake powder (Oleovita™, Orion, Ukraine) by liquid-solid extraction. The extraction was carried out by using water as solvent. The powder was made from fresh grape seeds of unfermented garbage in the process of cold pressing. In the experiment, the seeds of mixture in four varieties of grapes were used in equal proportions by weight, grown in the southern regions of Ukraine and the Republic of Moldova.

A response surface methodology was applied to investigate experimental conditions on TAC and TPC of grape seed cake extracts [1]. The TAC was determined by the coulometric titration with the help of electro generated bromine [2]. The TPC was determined by the Folin-Ciocalteau method [3] with slight modifications. TAC and TPC were expressed as gallic acid equivalents (GAE)/g dry weight (DW) of grape seed cake. Each measurement was repeated three times and data was reported as a mean value. The Box–Behnken (BB) design was used to determine the optimal conditions of liquid-solid extraction of TAC and TPC.

The influence of the three parameters, including extraction temperature T, extraction time t and liquid-to-solid (L/S) ratio were studied by a single experimental scheme to determinate the proper range for each independent variable. These factors are coded at three levels. The complete design consisted of a second order polynomial quadratic model corresponding to BB experimental design, with 17 experimental points including three replications of the center points.

The experimental design, surface and contour plots and response surface regression followed by analysis of variance (ANOVA) to assess full correspondence

and significance of regression coefficients were performed using design Design-Expert version 11 and JMP v.5.1 software.

The results of extraction of defatted grape seed cake in term TAC and TPC which were obtained by BB construction and installed to a second order polynomic equation. The value of these models coefficients was evaluated by the analysis of variance. The coefficient of determination (0,9891 for TAC and 0,9899 for TPC), and its adjusted value (0,9694 for TAC and 0,9688 for TPC) and predicted values confirming that the model fitted to the experimental data and the predicted values were also in reasonable agreement with the adjusted values.

The obtained results indicate that the selected factors, namely the temperature, time and ratio of the powder mass to the solvent mass, have the influence on the extraction with water of antioxidants and polyphenolic substances. The strongest effect is manifested under the influence of temperature. At the same time, we have a practically unchanged curve on the time dependence after 130 minutes. The influence of the solvent / powder ratio leads to flat curves, and an increase in TAC with increasing r and a reverse trend for TPC is typical for them.

The obtained data were used to search the conditions under which the optimal solution corresponds to the best response of the objective function, i.e. the maximization of both separately taken, and a combination of magnitudes of TAC and TPC. The optimization results are given in table 1.

The validation of the obtained model by the prediction of the TAC of the aqueous extract outside the range of the data studied was carried out. The difference in the experimental and calculated values within 5% percent should be considered as a good result.

Table 1 – Optimized extraction conditions

	T, °C	t, min	L/S	TAC, mg GAE/g DW	TPC, mg GAE/g DW	Desirability
TAC	100	148	99	37,63		1,0000
TPC	100	145	65		47,54	1,0000
TAC+TPC	100	147	77	37,29	47,01	0,9876

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