ARTICHOKE (*CYNARA SCOLYMUS*): ULTRASONIC EXTRACTION AND QUANTIFICATION OF ANTIOXIDANTS

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Introduction

The Artichoke (Cynara scolymus) is an herbaceous plant originally and cultivated mostly in the Mediterranean region of Europe where it has been studied and appreciated for its goodness in health, for which it is known and consumed worldwide.

The main pharmacological actions of the artichoke compounds are related to the processes involved in digestion: choleretic, cholagogue, hepatoprotective and hypocholesterolemic agents; in addition to having an effect on hyperglycemia; in which the cafeilquínicos derivatives seem to intervene, especially the cinarina, the chlorogenic acid and the sesquiterpene lactones like the cinaropicrina; the used doses of artichoke extract vary between 500 mg to 1.5 g, the reported effects are based on evidence from experimental animal studies as well as clinical studies.

An experimental design of the factorial type 2^2 was carried out where the independent variables and their levels were the extraction time (20-50 min) and the pH of the solvent (3-5). The total content of phenols and total flavonoids were selected as response variables.

The ultrasound extraction method (UAE) was used and these results were analyzed through the response surface methodology, through which it was possible to optimize the extraction method and obtain a complete artichoke extract that has a content of Total phenols of: 124±19 mg GAE / g DE, flavonoid content: 80±17 mg CE / g DE, iron reducing capacity: 610±43 µM TE / 1000ppm, the EC50 value for the DPPH of 110±0.4 ppm and the extraction mass yield was 8.33%.

Methodology

The methodology for obtaining the extract is shown in Figure 1. The independent variables and their levels of variation are shown in Picture 1.

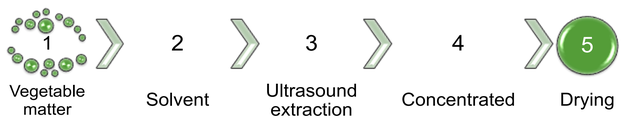


Fig. 1. Extract obtaining diagram

Picture 1. Experimental design of the extraction method

Experiment	Factors		Response	
	Time (min)	pH	Total Phenols (mg GAE /g DE)	Flavonoids (mg CE/g DE)
A	50	3	170.43	110.3
B	20	3	100.17	51.48
C	20	3	84.33	42.39
D	50	5	121.23	68.87
E	50	3	167.13	101.18
F	20	5	105.73	52.17
G	20	5	118.5	65.64
H	50	5	138.83	67.44
I	35	4	127.87	73.22
J	35	4	141.37	90.33
K	35	4	120.1	70.89
L	35	4	142.26	82.46

Constant parameters:
- Solvent: Ethanol
- Acidification: HCl
- Ultrasonic: Intermittent wave Frequency 45 KHz 100% power

Results and discussion

Results of Total Phenols

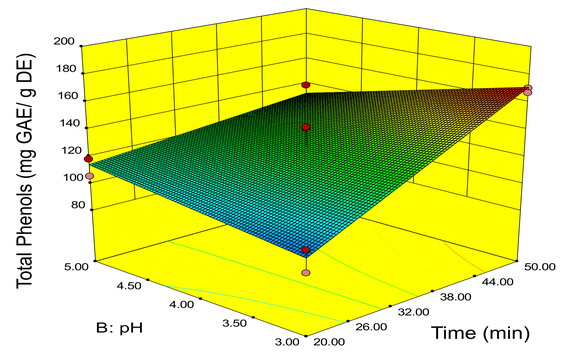


Fig 2. Response surface of Total content of phenols

The data obtained from the different treatments generated equation 1:

Total Phenols = + 128.16 + 23.61 * A - 4.72 * B - 14.65 * AB Eq. (1)

The results indicated that the relationship between the total phenol content and the extraction factors had a significant coefficient of determination (R2 = 0.8820). However, only the variable "time" was highly significant (p <0.001), this is clearly seen in Figure 2.

Results of Flavonoids

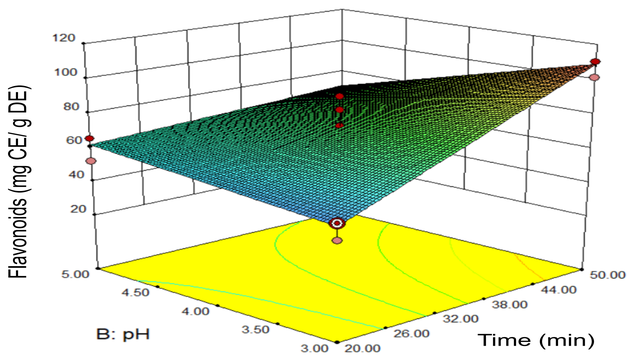


Fig 3. Response surface of Total content of Flavonoids

The data obtained from the different treatments generated equation 2:

Flavonoid content = + 73.03 + 17.01 * A - 6.40 * B - 12.39 * AB Eq. (2)

The results indicated that the relationship between flavonoid content and extraction factors had a significant coefficient of determination (R2 = 0.8574). However, only the variable "time" was highly significant (p <0.001), this is clearly seen in Figure 3.

Results of optimization of the extraction and validation parameters of the model

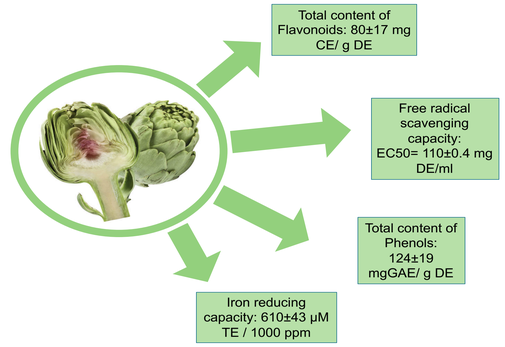


Fig. 4. Validation parameters of the model

Optimal UAE conditions predicted for total phenol content and flavonoid content was at a pH 3 and extraction time 50 minutes, the average of the replicates shows: a total phenol content of 124±19 mg GAE / g DE, 80±17 mg CE / g DE for flavonoid content, 610±43 M TE / 1000ppm for iron reducing capacity, EC50 value for DPPH of 110±0.4 ppm and mass yield it was 8.33%. According to the above, it can be said that in terms of the response surface methodology, the theoretical and experimental results had a good correlation for the optimization of the extraction conditions, obtaining results comparable to those reported in the literature.

Conclusion

The response surface methodology was successfully implemented to optimize the UAE conditions of the artichoke. Optimum pH conditions and extraction time were determined for maximum extraction performance of phenolic compounds.

The study indicated that the EAU of the bioactive compounds with antioxidant activity from Artichoke is an efficient alternative in obtaining phenolic compounds without affecting their antioxidant properties. It is also a simple process and does not require chromatographic techniques or the use of large amounts of organic solvents for the preparation of extracts rich in natural antioxidants.

The response surface through the design of experiments highlighted that the content of phenols and flavonoids was mainly influenced by the extraction time.

There is the potential for the use of Artichoke as a source of bioactive compounds with antioxidant activity in the food industry.

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