OPTIMIZATION OF PHENOLIC COMPOUNDS EXTRACTION CONDITIONS FROM ARTICHOKE (*Cynara scolymus* L.), ANTIOXIDANT ACTIVITY AND COMPARISON BETWEEN FOLIN-CIOCALTEU AND UV METHODS FOR TOTAL PHENOLIC CONTENT QUANTIFICATION

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Abstract. Artichoke (*Cynara scolymus* L.) is well known for its various health benefits, most of which are related to the phenolic composition. The present study concerns the optimization of phenolic compounds extraction conditions from edible part of artichoke (*Cynara scolymus* L.), the assessment of antioxidant activity and the comparison of two methods for total phenolic content quantification by sperctrophotometry, Folin Ciocalteu and UV methods. The investigated parameters included methanol concentration, solvent to solid ratio and extraction time. It was found that methanol concentration and solvent to solid ratio are the most significant factor that influences the TPC. The optimal extraction conditions were found to be: 24 hours extraction time, 10 ml for solvent volume and 100 % for methanol concentration. The second variable, the DPPH scavenging capacity was strongly affected by all the studied factors. The best experimental conditions are different from those of TPC. They were found to be 1 hour extraction time, 10 ml for solvent volume and 80 % for methanol concentration. The experimental results obtained revealed a poor correlation between TPC and DPPH scavenging capacity. The last studied response is the TPC based on UV method to TPC based on FC method ratio. We had recorded a significant effect of extraction time and methanol concentration; we had recorded also a positive and significant correlation between the phenolics content determined by using the two different analytical methods. The results suggest that the UV method can be employed as an efficient and fast tool for the determination of total phenolic compounds in artichoke samples.

Keywords: *Cynara scolymus* L.; antioxidant activity; phenolic compounds; Folin-Ciocalteu; UV method.

INTRODUCTION

Phenolic compounds are the most commonly used and important class of natural antioxidants [33, 60]. These compounds are the most widely distributed group of secondary metabolites in the plant kingdom and are ubiquitous in all plant organs. These bioactive substances are usually produced as a response to defend plants against pathogens and stress, and they are responsible in part for the organoleptic properties of plant foods. More than 8000 phenolic structures are currently identified and these ranged from simple molecules such as phenolic acids to highly polymerized substances such as tannins [15].These secondary metabolites have received increasing interest in recent years from consumers and the food industry due to their flavor, color, biological properties and preventive effect against diseases associated with oxidative stress [9, 26]. Extraction of bioactive compounds from plant material is the initial and the most important step in both the analysis and exploitation of phenolic compounds [15, 65]. Several novel extraction techniques have been investigated for the extraction of phenolic compounds from plant material with the aim of improving the efficiency, extract quality, extraction time and solvent consumption [8]. However, conventional methods (maceration, decoction and Soxhlet) are still hugely preferred over newer techniques (ultrasound assisted extraction, microwave assisted extraction and supercritical fluid extraction). Indeed, a total of 889 publications were recorded for phenolics based on conventional methods in comparison to 521 publications recorded for extraction of phenolic with newer technique [27]. Maceration is a traditional method which presents the advantage to be simpler, more suitable and economical in terms of instrumentation [46, 74]. The optimal extraction method should be simple and rapid for analytical and industrial applications [12, 52, 55]. The efficiency of an extraction method is influenced by several parameters, such as the chemical nature of the sample, the solvent used, agitation, extraction time, solute/solvent ratio and temperature [17, 22]. It must be noted, however, that many phenolic compounds are easily hydrolyzed and oxidized. The use of long extraction times and high temperatures increases the chance of oxidation of phenolics and this decreases the yield in the extracts [63]. Therefore, maceration methods must be carefully developed and evaluated.

A number of spectrophotometric methods have been developed for quantification of plant phenolics. These assays are based on different principles and are used to determine different structural groups present in phenolic compounds [48]. The most abundant used method in the assessment of total phenolic content of plant extracts is the Folin-Ciocalteu method (FC method). It's well known for its simplicity, easiness and availability of the chemical reagent [41]. A disadvantage of the FC method is that it is nonspecific and can be affected by other non-phenolic reducing molecules as organic acids (ascorbic, citric and tartric acid), carbohydrates (fructose, glucose, saccharose)