
Katerina Kyriakidou 1, Ioannis Mourtzinos 2, Costas G. Biliaderis 2 and Dimitris P. Makris 1,*

1 School of Environment, University of the Aegean, Mitr. Ioakim Street, Myrina 81400, Lemnos, Greece; fns10045@fns.aegean.gr
2 Faculty of Agriculture, Forestry & Natural Environment, Aristotle University of Thessaloniki, P.O. Box 235, Thessaloniki 54124, Greece; mourtzinos@agro.auth.gr (I.M.); biliader@agro.auth.gr (C.G.B.)
* Correspondence: dmakris@aegean.gr; Tel.: +30-225-408-3114

Academic Editor: Yu-Pin Lin
Received: 2 December 2015; Accepted: 22 January 2016; Published: 2 February 2016

Abstract: Aqueous mixtures of glycerol and 2-hydroxypropyl-β-cyclodextrin (CD), two non-toxic eco-friendly substances, were used as a means of extracting antioxidant polyphenols from oak acorn (*Quercus robur*) husks. The process was optimized by implementing a central composite (Box-Behnken) experimental design and response surface methodology, taking into consideration the critical parameters (independent variables) of glycerol concentration (*C* _gly_), CD concentration (*C* _CD_) and temperature (*T*). The assessment of the extraction model was based on three responses: the total polyphenol yield (*Y*_ _TP_), the antiradical activity (*A*_ _AR_), and the reducing power (*P*_ _R_). The model illustrated that *Y*_ _TP_ depended significantly on *C* _gly_ and *C* _CD_, but not on *T*, whereas both antioxidant properties considered (*A*_ _AR_ and *P*_ _R_) were temperature-dependent. The maximum predicted *Y*_ _TP_ was 122.19 mg GAE per g dry husk weight, while the extract obtained under optimized conditions displayed strong antioxidant activity.

Keywords: antioxidants; hydroxypropyl-β-cyclodextrin; inclusion formation; glycerol; oak acorns; polyphenols