Sweet cherries of second-quality: A sustainable source of high-added value products for the food industry

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INTRODUCTION

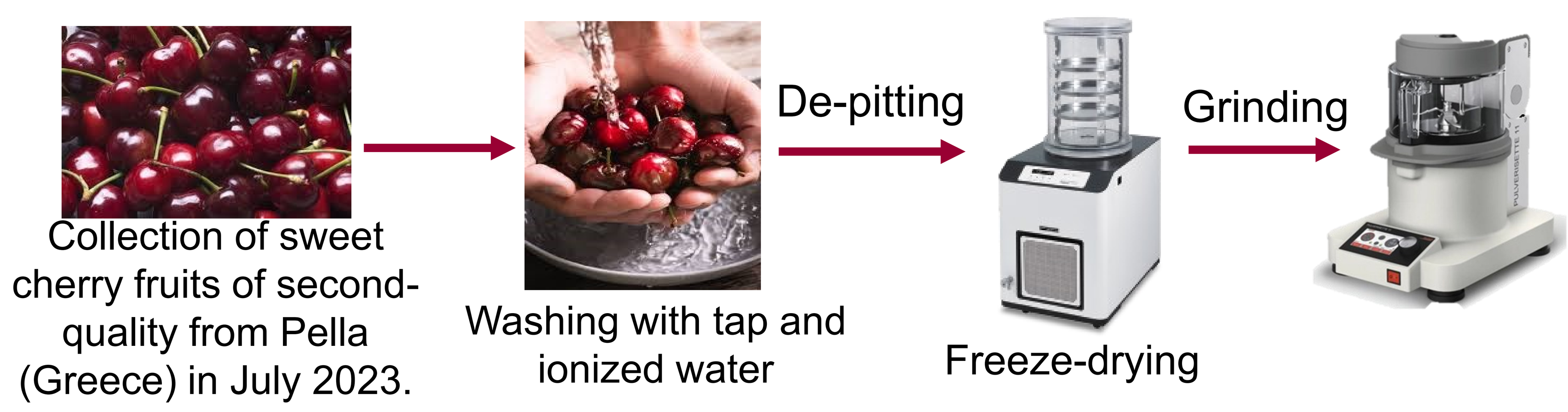
Sweet cherries (*Prunus avium* L.) are stone fruits highly valued for their organoleptic attributes, such as sweet taste and bright red color. They are mainly consumed fresh during late spring to early summer (~60% of the global production) or they can be consumed throughout the year in the form of juices, jams, jellies as well as dried or canned products. Apart from their sensorial characteristics, the consumption of sweet cherries has been associated with various biological actions including the prevention of cardiovascular diseases and the Alzheimer's disease as well as lower blood pressure etc. These beneficial properties are mainly attributed to a variety of bioactive compounds such as anthocyanins (e.g. cyanidin 3-O-glucoside, cyanidin 3-O-rutinoside) and phenolic acids (e.g. cinammic acid, caffeic acid, ferulic acid) [1]. In general, fruit processing results in enormous amounts of wastes worldwide. In the case of sweet cherries, Greece is one of the main producing countries in Europe, after Poland, Italy and Spain, resulting in high amounts of by-products. The main by-products derived from the processing of sweet cherries are stems, pits, pomace as well as **second-quality cherry fruits** [2].

AIM OF THE STUDY

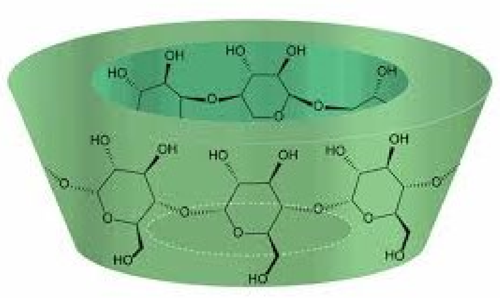
Considering that second-quality cherry fruits are characterized by a lower appearance quality, they cannot be marketed for fresh consumption. In this view, such fruits could be exploited as a sustainable source of a variety of high-added value products for the food industry, including natural colorants and antioxidants.

MATERIALS AND METHODS

Collection and pretreatment of plant material



Experimental design for the selection of optimum conditions to extract bioactive compounds from sweet cherry fruits of second-quality using β-cyclodextrin

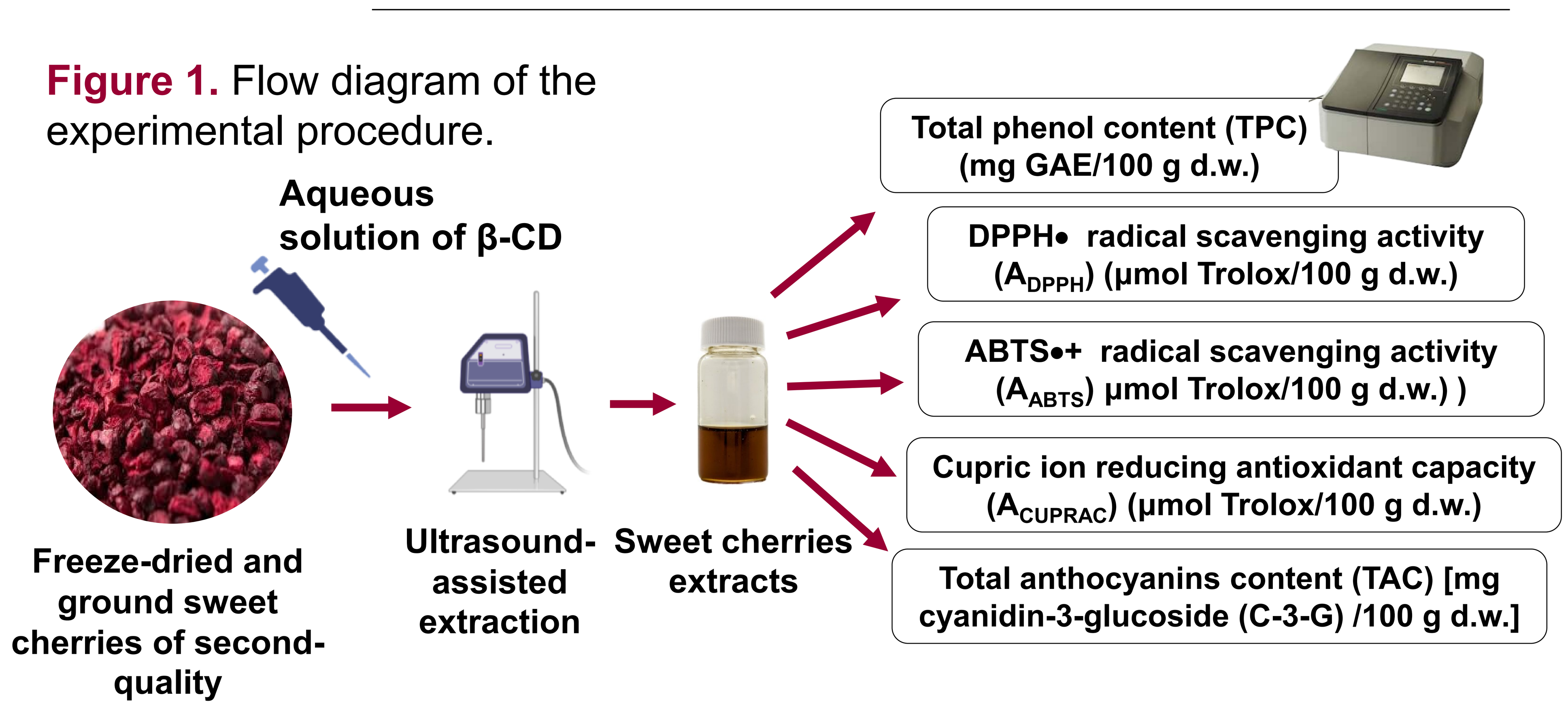


Cyclodextrins are cyclic oligosaccharides that allow molecular inclusion and controlled release of hydrophobic molecules in their hydrophobic cavities. During the last decades, cyclodextrin, such as β-cyclodextrin (β-CD) find applications as extraction enhancers for phenolic compounds through formation of inclusion complexes [3].

Table 1. Levels of independent variables used in the experimental design.

Variable	Levels				
Duration of sonication (min)	5	10	15	20	25
Temperature (°C)	20	30	40	50	60
Solvent:solid ratio (mL/g)	10	20	30	40	50
Concentration of β-CD (mg/mL)	0	4.6	9.3	13.9	18.5

Figure 1. Flow diagram of the experimental procedure.



References: [1] Blando, F., Oomah, B. D. Sweet and Sour Cherries: Origin, Distribution, Nutritional Composition and Health Benefits. Trends Food Sci. Technol. 2019, 86, 517-529. [2] Gençdağ, E., Görgüç, A., Yılmaz, F. M. Valorization of Sweet Cherry (*Prunus avium*) Wastes as a Source of Advanced Bioactive Compounds. In Mediterranean Fruits Bio-wastes: Chemistry, Functionality and Technological Applications, 1st ed.; Ramadan, M.F., Farag, M.A., Ed(s).; Springer International Publishing: Cham, Switzarland, 2022; pp. 559-579.
[3] Mourtzinos, I., Goula, A. Ch. 2 , Polyphenols in Agricultural Byproducts and Food Waste, Editor(s): Ronald Ross Watson, Polyphenols in Plants (Second Edition), Academic Press, 2019, pp. 23-44.

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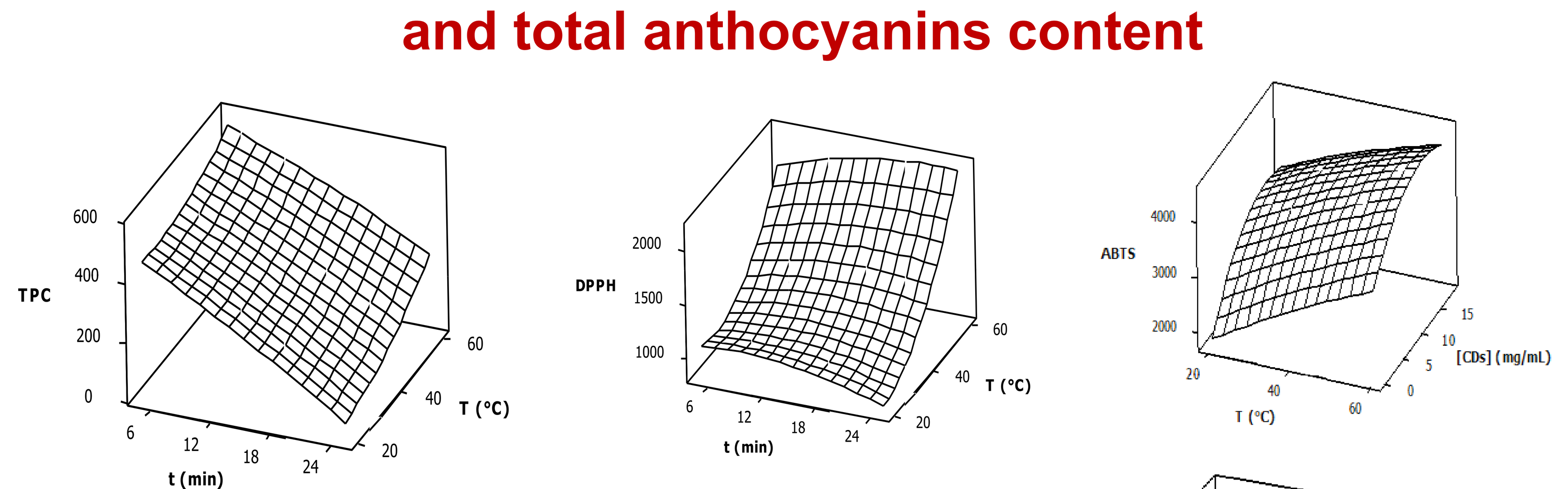
RESULTS AND DISCUSSION

The moisture content of the sweet cherries used in the present study was found to be 80.99%, the total soluble solids were 16.8 °Brix, whereas the color parameters of the peels as well as of the flesh of the fruits were found to be L*= 35.98, a*= 4.14, b*=0.13 and L*= 34.45, a*= 3.04, b*=1.03, respectively.

Main effects of β-cyclodextrin-assisted extraction conditions on total phenol content, antioxidant activity and total anthocyanins content



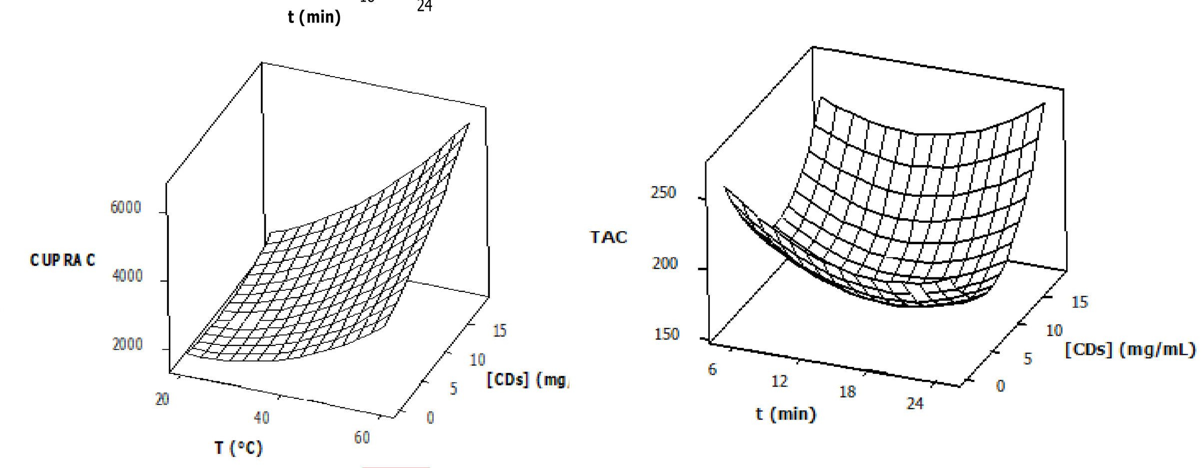


Figure 2. Surface plots for TPC, A_{DPPH}, A_{ABTS}, A_{CUPRAC} and TAC values affected by duration of sonication, temperature, solvent:solid ratio and concentration of β-CD.

TPC, A_{DPPH}, A_{ABTS}, A_{CUPRAC} and TAC reached their highest absolute values upon sonication treatment at increased time along with high temperatures and concentration of β-CD with low solvent:solid ratio.

Multiply response optimization for β-cyclodextrin-assisted extraction conditions

Table 2. Optimum values of the duration of sonication, temperature, solvent:solid ratio and concentration of β-CD as well as predicted and experimental response values.

Factor	Optimum actual values	Predicted values	Mean experimental values
Duration of sonication (min)	25	**TPC (mg GAE/100 g d.w.)**	
		982	986±3.7
Temperature (°C)	60	**A_{DPPH} (μmol Trolox/100 g d.w.)**	
		3737	3843±5.5
		A_{ABTS} (μmol Trolox/100 g d.w.)	
Solvent:solid ratio (mL/g)	29:1	6273	6101±25
		A_{CUPRAC} (μmol Trolox/100 g d.w.)	
		10130	8246±225
Concentration of β-CD (mg/mL)	18.5	**TAC (mg C-3-G/100 g d.w.)**	
		321	384±3.9

CONCLUSION

Findings of the present study are promising towards the valorization of second-quality sweet cherry fruits as sustainable sources of valuable ingredients to produce novel foods and food supplements.