Potential valorisation of vinification by-products

Santos, A.F.[1,2], Ferraro, V.[1,2], Cruz, I.B.[1,2], Ferreira Jorge, R.[2], Carvalho, A.P.[1], Castro, P.M.L.[1] and Pintado, M.E.[1]

[1]CBQF/Escola Superior de Biotecnologia,
Universidade Católica Portuguesa,
Rua Dr. António Bernardino de Almeida,
4200-Porto, Portugal

[2]WeDoTech – Companhia de Ideias e Tecnologias Lda.,
CiDEB - Edif. da Escola Superior de Biotecnologia,
Universidade Católica Portuguesa,
Rua Dr. António Bernardino de Almeida, 4200-Porto, Portugal

Introduction

Management and disposal of large amounts of waste produced by food-processing industry is a serious environmental problem. New processes for a controlled disposal of waste are currently being sought, aiming at waste valorisation into added-value bio-products. Portuguese wine industry produces up to 65,000 ton/year of grape (*Vitis vinifera*) pomace, composed of grape seeds, skins and stems. These by-products, currently used in distillation processes, can present an alternative source of natural antioxidants with potential applications in agro-food, pharmaceutics and cosmetics.

Objective

The aim of this work was to characterise the whole grape pomace and their constituents, namely skin and seeds in terms of antioxidant activity, total phenolic compounds and fatty acid profile of seed oil present in three Portuguese Douro red wine cultivars, during harvest.

Materials and Methods

- For each sample of grape pomace (total, seeds and skin) the antioxidant activity was evaluated by ABTS method, and the total phenolic compounds by the Folin-Ciocalteu method.
- Grape seeds oil was extracted by Soxhlet method and fatty acid composition was analysed by GC-FID.

Extraction procedure

Grape pomace → separation → seeds, skin, grape pomace → rising, drying → grounded seeds, skin and grape pomace → extraction of compounds (4,5 g sample with 25 mL of MeOH/acetone/water (6:3:1) with 0,1 % HCl, 30 min in dark)

Filtration and centrifugation (10 min, 3500 rpm) → analysis → **ABTS method**, **Folin-Ciocalteu method** (Gião et al., 2007)

Extraction of grape seed oil

Seeds (A, B or C) → rising, drying → **grounded seeds** → oil extraction (10 g sample with 150 mL n-hexane in Soxhlet apparatus, 70 °C for 8 h or for 16 h)

concentration (40 °C, 10 min, 180 mbar)

derivatization and analysis → **GC-FID analysis** (Carvalho et al., 2005), **ABTS method (TEAC)** (sample dissolved in 50:50 toluene/ethanol)

Results and Discussion

Aqueous extracts of grape seeds showed a higher antioxidant activity (1.462 g l^{-1} ascorbic acid equivalent) than skin (0.760 g l^{-1} ascorbic acid equivalent); additionally, they exhibited a greater content of total phenolic compounds (1.531 g l^{-1} gallic acid equivalent) compared with skin (0.882 g l^{-1} gallic acid equivalent). For the different types of grape seeds the total content of oil ranged between 5-10 %.

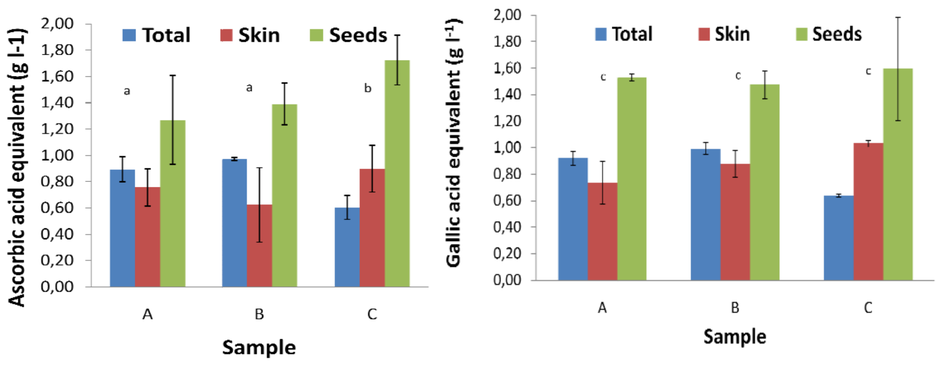

Figure 1. Antioxidant activity and total phenolic compounds in various aquoeous grape extracts.
abc groups of bars with same letters, are not significantly different (*P*>5).

Table 1. Oil content in different samples.

Sample	Content of oil %	
	8 h	16 h
A	4,9	4,6
B	6,1	5,7
C	10,0	10,3

The ANOVA on equivalents of ascorbic acid and of gallic acid, found differences between extracts of total grape pomace and seeds as well as seeds and skin (*P*<0,05), however extract of mixture and total grape pomace were not statistically different (*P*>0,05) in both tests (antioxidant activity and total phenolic compounds).
The different oil extracts revealed that sample C showed the highest concentration ranging between 10-10.3 %. No differences were observed amongst the different extraction times for all the studied samples.

Table 2. Fatty acids profile in diferent seed oil samples.

Fatty acid [%]	Sample A		Sample B		Sample C	
	8 h	16 h	8 h	16 h	8 h	16 h
caproic, 6:0	0,08	0,01	0,04	0,00	0,00	0,00
caprylic, 8:0	0,01	0,01	0,01	0,01	0,00	0,00
decanoic, 10:0	0,01	0,02	0,02	0,01	0,00	0,00
capric, 12:0	0,02	0,03	0,02	0,02	0,01	0,01
myristic, 14:0	0,08	0,10	0,08	0,10	0,06	0,06
pentadecanoic, 15:0	0,02	0,02	0,02	0,02	0,01	0,02
palmitic, 16:0	8,25	8,64	8,05	8,69	7,60	7,93
stearic, 18:0	4,72	4,76	4,65	4,73	4,82	5,07
arachidic, 20:0	0,20	0,21	0,18	0,21	0,20	0,21
heneicosanoic, 21:0	0,01	-	-	-	-	0,02
behenic, 22:0	0,07	0,07	0,06	0,07	0,04	0,05
tricosanoic, 23:0	0,01	0,01	0,01	0,02	0,01	0,01
lignoceric, 24:0	0,31	0,05	0,03	0,04	0,02	0,03
palmitoleic, 16:1 (n-7)	0,13	0,14	0,10	0,14	0,10	0,10
oleic, 18:1 (n-9)	21,82	22,30	21,56	22,92	20,26	20,48
11-eicosenoic, 20:1 (n-9)	0,16	0,16	0,10	0,17	0,16	0,16
docosenoic, 22:1 (n-9)	0,01	0,02	-	0,02	-	0,02
linoleic, 18:2 (n-6)	63,64	63,03	64,65	62,40	66,31	65,45
eicosadienoic, 20:2 (n-6)	0,03	0,03	0,03	0,02	0,03	0,03
γ-linolenic, 18:3 (n-6)	0,02	-	-	-	-	-
linolenic, 18:3 (n-3)	0,39	0,41	0,40	0,41	0,37	0,36

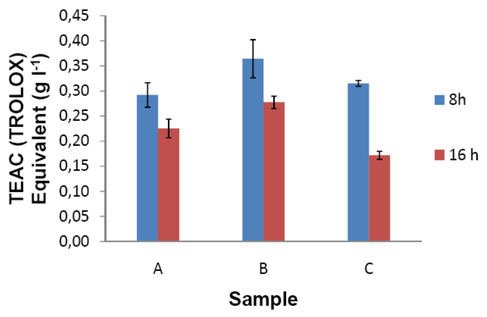

Figure 2. Antioxidant activity in the different samples of seed oil.

The main occurrence on fatty acids, among the analysed samples were linoleic acid (63-65 %), oleic acid (20-23 %), palmitic acid (7-9 %) and stearic acid (4-5 %) (see Table 2).
The ANOVA on antioxidant activity of oils extracts in respect to extraction time, did not show statistical differences between 8 and 16 h of extraction.

Conclusions

It can be concluded that grape seeds have the highest antioxidant capacity as well as total polyphenolic content for all the samples analysed.
The total occurred extraction of grape seed oil was after 8 h under tested conditions.
These results suggest that in the future these by-products can be used as ingredients in functional foods, thus originating high-value products and lowering the overall environmental impact.

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Acknowledgments

V. Ferraro thanks Marie Curie Actions for the Grant ref. FP6 InSolEx RTN;
WeDoTech, Lda. thanks SOGEVINUS Portugal, for support and samples;
I.B. Cruz thanks the Ministry of Science and Higher Education Foundation for Science and Technology grant ref: SFRH/BPD/20653/2004.
A.P. Carvalho thanks the Ministry of Science and Higher Education (Foundation for Science and Technology grant ref: SFRH/BPD/26424/2006;