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Physicochemical characterization and valorization potential of grape seed oils obtained from winemaking by-products of Chilean Vitis vinifera varieties.

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Introduction

Winemaking generates large amounts of pomace, including skins and seeds, which represent about 20-25% of processed grape mass. Seeds are especially relevant because they contain oils rich in unsaturated fatty acids and minor bioactive compounds with technological and biological value.

Despite the importance of the Chilean wine sector, local comparative data on grape seed oils derived directly from pomace remain limited. This study addresses that gap by comparing eight cultivated varieties and integrating compositional, oxidative, and antioxidant descriptors into one dataset.



Winemaking pomace is a promising raw material for oil recovery and circular valorization.

Objective

Compare oil yield, quality indices, fatty acid composition, thermal behavior, UV–Vis spectral profile and antioxidant-related variables among cultivars.

Methodology

Seed recovery
Pomace from 2025 harvest; 8 grape varieties from 3 wineries

Drying & milling
50 °C, 48 h; particle size <0.6 mm.

Soxhlet extraction
n-hexane, 70 °C ± 2 °C, 4 h.

Characterization
Acid value, peroxide value, density, GC-FID, TGA, UV-Vis, Folin, FRAP and DPPH.

Statistics: triplicate analysis; ANOVA/Tukey after normality and variance tests; Pearson correlation for antioxidant relationships.

Table 1. Physicochemical quality parameters of grape seed oils obtained from different *Vitis vinifera* varieties.

Variety	Peroxide value (mEq/kg)	Acid value (mg KOH/g)	Density values (g mL^{-1})
Torontel (Tor)	14,56±0,21	1,33±0,09	0,9473
Merlot (Mer)	16,22±0,77	1,87±0,16	0,9363
Cabernet Sauvignon (CS)	23,01±0,80	1,47±0,08	0,9339
Petit Verdot (PV)	18,27±0,74	1,77±0,13	0,9322
Carménère (Car)	19,61±0,53	1,44±0,21	0,9244
Pedro Ximénez (PX)	18,15±0,61	1,94±0,24	0,9334
Alicante Bouschet (AB)	17,01±0,64	1,10±0,26	0,9577
País	15,13±0,73	2,02±0,11	0,9458

Chart 1. Fatty acid of Grape seed oils (% of total FAMEs). SFA: saturated fatty acids (C14:0, C15:0, C16:0, C17:0, C18:0, C20:0, C22:0). MUFA: monounsaturated fatty acids (C16:1, C18:1, C20:1). PUFA: polyunsaturated fatty acids (C18:2).

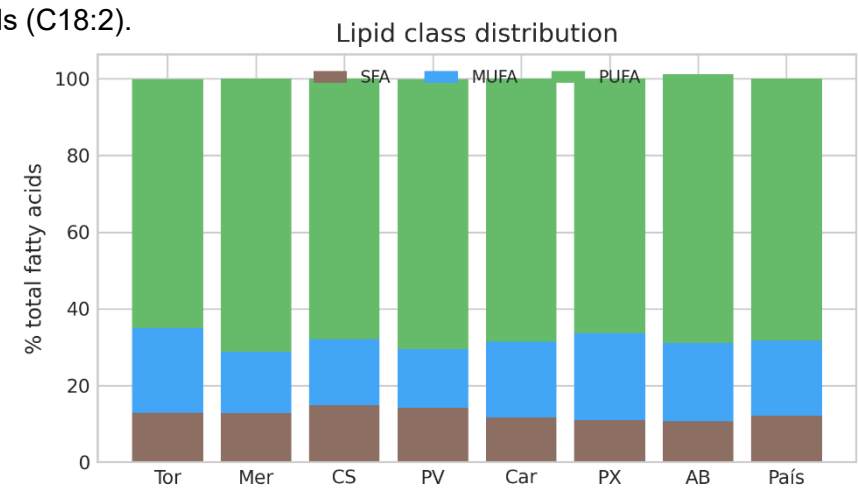


Table 2. Phenolics and antioxidant capacity

Variety	PT (mg GAE·kg^{-1})	FRAP (mg TE·kg^{-1})	DPPH (mg TE·kg^{-1})
Torontel	53,18 ± 3,03^{a}	915,40 ± 12,33^{a}	1162,41 ± 5,80^{ab}
Merlot	49,89 ± 3,23^{ab}	731,55 ± 30,83^{b}	1098,18 ± 3,80^{bc}
Cabernet Sauvignon	45,64 ± 3,83^{ab}	650,87 ± 7,73^{cd}	1117,36 ± 10,90^{bc}
Petit Verdot	44,03 ± 2,27^{ab}	452,32 ± 2,62^{e}	1128,58 ± 10,90^{ab}
Carménère	46,98 ± 3,12^{ab}	709,63 ± 39,19^{bc}	1015,71 ± 5,80^{cd}
Pedro Ximénez	43,17 ± 3,17^{b}	411,77 ± 15,49^{e}	955,65 ± 7,90^{d}
Alicante Bouschet	51,15 ± 4,08^{ab}	720,21 ± 7,73^{b}	1107,25 ± 4,40^{bc}
País	47,89 ± 1,99^{ab}	643,11 ± 32,42^{d}	1233,67± 3,80^{a}
commercial sample	51,51 ± 4,41^{ab}	879,54 ± 2,62^{a}	1130,02 ± 5,80^{ab}

Results and Discussion

Main results

- Oil yield ranged from 9.82% (Torontel) to 32.05% (País).
- Acid value remained low (1.10–2.02 mg KOH/g), indicating limited hydrolysis.
- Peroxide value ranged from 14–23 meq O_2/kg, compatible with crude oils.
- Oils were rich in linoleic acid (65–71%), with PUFA/SFA ratios of 4.57–6.56.
- TGA showed the main degradation event above 400 °C.
- Total phenolics correlated strongly with FRAP (r = 0.93), but weakly with DPPH

Conclusions

Grape seed oils recovered from Chilean winery by-products showed relevant extraction yields, low acid values, moderate primary oxidation, strong dominance of unsaturated C18 fatty acids, and consistent thermal stability above 400 °C.

These results support the conversion of pomace-derived seeds into value-added oils and provide comparative evidence for selecting cultivars in future scale-up, stabilization, and application studies.

Best overall candidates: País for yield, Torontel for phenols/FRAP, and Alicante Bouschet or Pedro Ximénez for high PUFA/SFA ratios.

References and Acknowledgements

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