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The New Life Of Exhausted Bentonite From The Grape Processing Industry: From Waste To Precious Resource To Produce Novel Raw Materials Enriched In POLYPHENOLS

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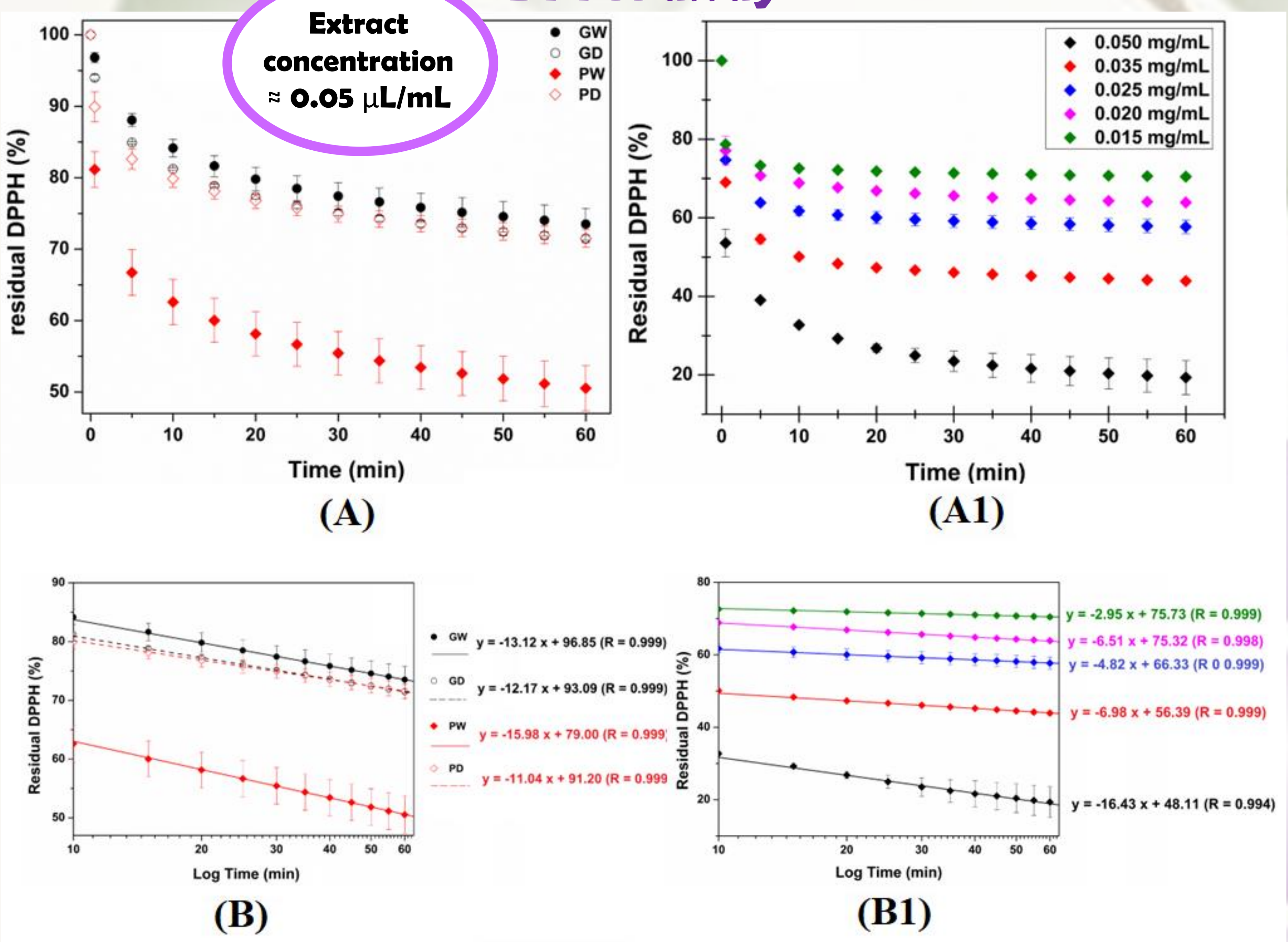
Introduction & Scope

Nowadays, the waste products obtained by the grape processing industries have gained the attention of both companies and researchers. In particular, bentonite is a common additive used to clarify and fine musts and wines. It is great for removing protein haze; however, it can also entrap such interesting molecules as polyphenols. In an ever-growing perspective of circular economy, the development of conscious, sustainable and environmentally-friendly strategies to give new life to the waste products is a key point. The exhausted bentonite could be used as a starting material to produce pharmaceutical/cosmetic excipients enriched in functional polyphenols.

DPPH assay

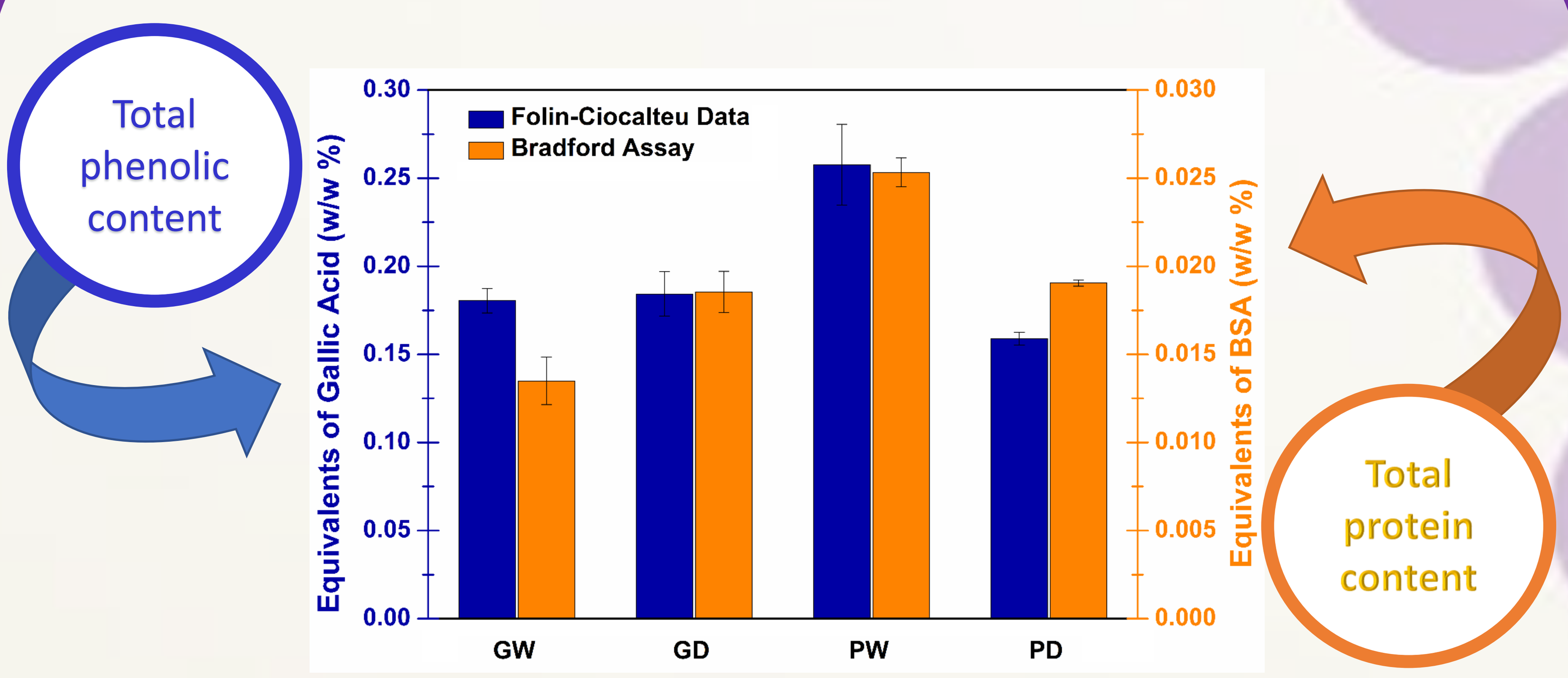


Residual DPPH (%) as a function of incubation time when evaluating the extracts (A) and the standard GA solutions (A1). Detail of the semi-logaritmic curves and linear curve fitting (linearity range: 20-60 min) for the extracts (B) and the standards (B1)

Sample	10 min calibration curve	30 min calibration curve	60 min calibration curve
	y = -1153.55 x + 90.65	y = -1293.95 x + 91.38	y = -1338.35 x + 90.65
GW	5.63 ± 1.08	10.79 ± 1.46	12.80 ± 1.67
GD	8.16 ± 0.14	12.60 ± 0.31	14.34 ± 0.40
PW	24.33 ± 2.73	27.78 ± 2.37	29.98 ± 2.36
PD	9.35 ± 1.02	12.72 ± 0.88	14.31 ± 0.92

Antioxidant power of the extracts reported in equivalent gallic acid concentration (µg/mL) ± SE at 10, 30 and 60 min

Folin-Ciocalteu & Bradford assays



Folin-Ciocalteu data (blue) and Bradford assay results (orange) for all the extracts reported in terms of equivalent percentage amount (w/w %) ± SE of gallic acid and bovine serum albumin used as standards respectively

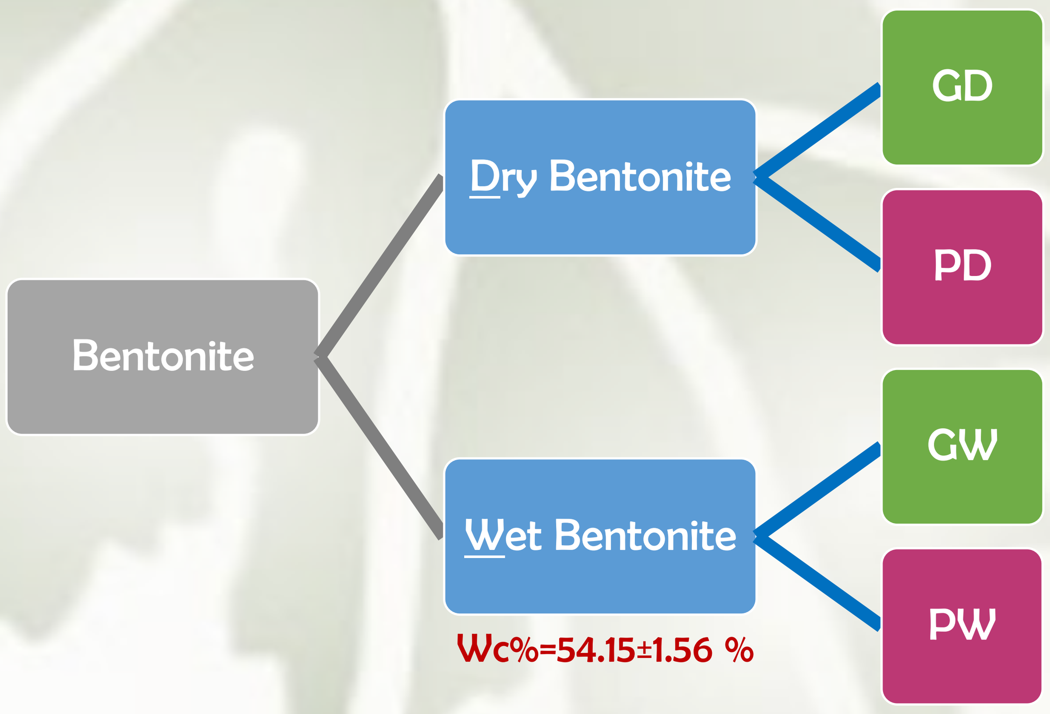
Extracts preparation & characterization

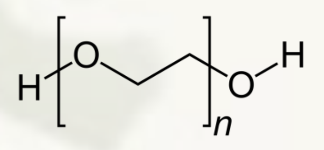
The waste bentonite was supplied by Bono&Ditta s.p.a. (Campobello di Mazzara, Trapani, Italy). 100 kg of bentonite were used to fine 1 hL of wine and then immediately stored at -20°C. Afterward, it was transferred to the laboratory into refrigerated boxes, fractionated in smaller aliquots (≈100 g) and then stored at -80°C.

Three carefully weighted samples were subjected to freeze drying in order to evaluate the water content % (Wc%) based on which the bentonite/extraction solvent ratio was fixed:

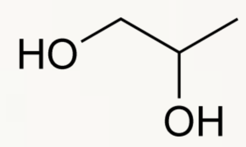
- ❑ Dry bentonite : solvent = 1 : 8
- ❑ Wet bentonite : solvent = 1 : 4

The extraction procedure was carried out at 25.0 ± 0.5°C under vigorous magnetic stirring in the dark. Subsequently, each sample was centrifuged, and the obtained colored supernatant was filtered through a 0.45 µm nylon syringe and stored at 4°C





PEG200 (P)

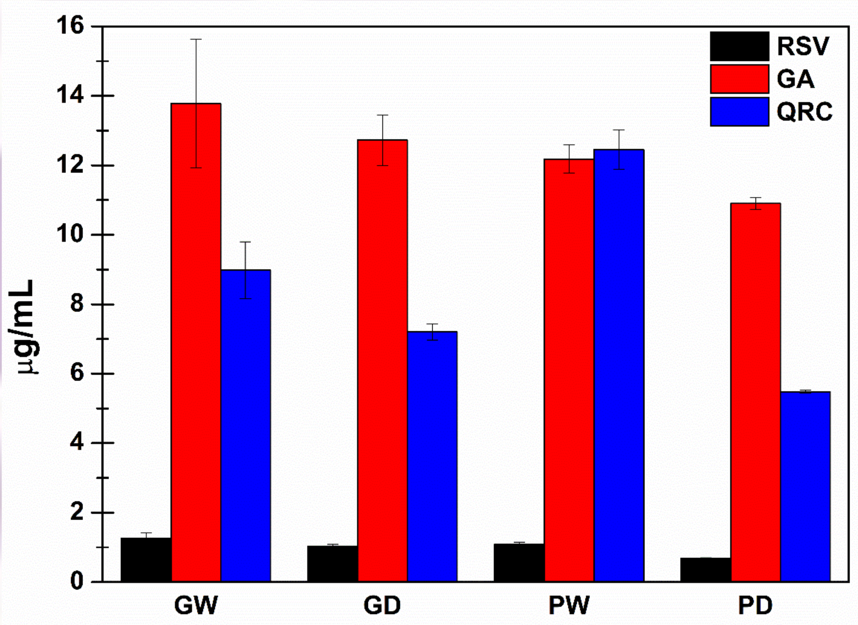


Propylene Glycol (G)

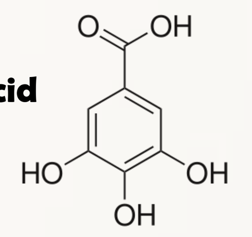
Characteristic of the extracts in terms of yield %, density (g/mL) and pH ± SE

Sample	Yield (%)	Density (g/mL)	pH
Propylene Glycol	-	1.038 ± 0.004	6.665 ± 0.004
GW	82.85 ± 4.88	1.053 ± 0.005	4.265 ± 0.007
GD	61.56 ± 6.69	1.087 ± 0.008	4.320 ± 0.016
PEG200	-	1.115 ± 0.005	6.395 ± 0.012
PW	69.32 ± 6.32	1.134 ± 0.006	4.235 ± 0.005
PD	66.31 ± 2.30	1.180 ± 0.009	4.440 ± 0.008

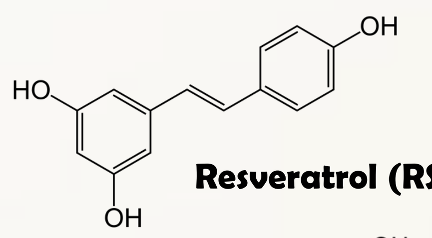
Quantitative HPLC-DAD analysis



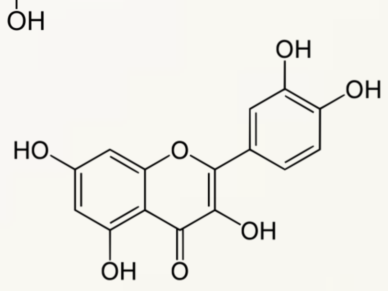
Quantitative results of the HPLC-DAD analysis conducted on the extracts and reported in terms of concentration (µg/mL) ± SE of some representative polyphenols



Gallic Acid (GA)



Resveratrol (RSV)



Quercetin (QRC)

Conclusion & Future Perspectives

Generally, the waste bentonite should represent a valuable source of functional polyphenols and it could be treated with such solvents currently used in the pharmaceutic/cosmetic field to directly obtain novel enriched raw materials useful for several purposes. Among all, the best extract was obtained from wet bentonite treated with PEG200 as it highlighted the highest phenolic content and consequently the strongest antioxidant activity

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