

# **Use of Commercial Dry Yeast Products Rich in Mannoproteins for White and Rosé Sparkling Wine Elaboration**

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**Supplementary Table 1.** Chemical composition of sparkling wines aged on lees for nine months after tirage<sup>a</sup>

Chemical compounds <sup>d</sup>	Godello					Verdejo				
	C <sup>b</sup>	DYA-1	DYA-2	DYA-3	DYA-4	C	DYA-1	DYA-2	DYA-3	DYA-4
Total phenolics	29.94 ± 2.92	25.91 ± 0.97	26.88 ± 1.01	26.71 ± 1.01	27.39 ± 1.03	15.34 ± 0.36	15.38 ± 0.36	15.36 ± 0.36	15.67 ± 0.37	15.31 ± 0.36
Total hydroxycinnamic acids	6.49 ± 0.19	6.38 ± 0.19	6.53 ± 0.19	6.48 ± 0.19	6.50 ± 0.19	11.26 ± 0.32	11.03 ± 0.30	11.16 ± 0.31	11.08 ± 0.31	11.21 ± 0.31
Total flavan-3-ols	19.79 ± 0.99	18.96 ± 0.95	19.79 ± 0.99	19.70 ± 0.99	20.29 ± 1.02	3.44 ± 0.17	3.69 ± 0.19	3.63 ± 0.18	3.94 ± 0.20	3.67 ± 0.19
Total flavonols	0.66 ± 0.02	0.57 ± 0.01	0.56 ± 0.01	0.52 ± 0.01	0.61 ± 0.02	0.64 ± 0.02	0.66 ± 0.02	0.57 ± 0.12	0.65 ± 0.02	0.54 ± 0.02
Total proanthocyanidins	3.00 ± 0.15	n.q. <sup>c</sup>	n.q.	n.q.	n.q.	n.q.	n.q.	n.q.	n.q.	n.q.
Total amino acids	224.46 ± 10.44	243.46 ± 9.18	248.38 ± 6.86	250.09 ± 7.40	238.78 ± 5.98	234.85 ± 36.78	236.29 ± 19.11	202.61 ± 16.40	211.09 ± 2.62	236.68 ± 30.95
Acid amino acids	4.96 ± 0.87	6.58 ± 0.62	5.37 ± 0.47	6.78 ± 0.17	6.82 ± 0.15	1.96 ± 0.29	2.31 ± 0.10	1.62 ± 0.09	1.63 ± 0.02	2.33 ± 0.33
Neutral amino acids	202.12 ± 10.43	218.65 ± 2.16	226.96 ± 6.83	225.38 ± 0.39	213.23 ± 5.98	225.58 ± 36.78	225.55 ± 19.10	194.84 ± 16.39	202.14 ± 2.62	222.64 ± 30.95
Basic amino acids	17.38 ± 0.51	18.23 ± 0.25	16.06 ± 0.61	17.93 ± 0.09	18.73 ± 0.24	7.31 ± 0.48	8.44 ± 0.26	6.15 ± 0.33	7.32 ± 0.15	8.71 ± 0.48
Total biogenic amines	4.02 ± 0.13	4.08 ± 0.05	4.34 ± 0.30	4.01 ± 0.12	4.22 ± 0.11	1.59 ± 0.20	1.70 ± 0.09	1.52 ± 0.15	1.41 ± 0.05	1.51 ± 0.11
	Garnacha					Tempranillo				
	C	DYA-1	DYA-2	DYA-3	DYA-4	C	DYA-1	DYA-2	DYA-3	DYA-4
Total phenolics	116.16 ± 2.96	113.54 ± 4.11	118.34 ± 2.98	113.17 ± 3.05	112.31 ± 3.04	61.22 ± 1.34	64.05 ± 1.42	63.80 ± 1.43	63.30 ± 1.49	64.04 ± 1.42
Total monomeric anthocyanins	6.98 ± 0.19	7.09 ± 0.20	6.90 ± 0.20	7.50 ± 0.22	7.07 ± 0.20	10.90 ± 0.33	10.43 ± 0.32	10.35 ± 0.32	10.50 ± 0.32	10.63 ± 0.33
Non-acylated anthocyanins	5.61 ± 0.29	5.78 ± 0.20	5.68 ± 0.19	6.01 ± 0.22	5.68 ± 0.20	9.18 ± 0.32	8.97 ± 0.32	8.81 ± 0.31	9.10 ± 0.33	9.25 ± 0.33
Acetyl-glucoside anthocyanins	0.68 ± 0.02	0.63 ± 0.02	0.59 ± 0.02	0.57 ± 0.01	0.69 ± 0.02	0.85 ± 0.02	0.81 ± 0.02	0.85 ± 0.03	0.73 ± 0.02	0.72 ± 0.02
Coumaryl-glucoside anthocyanins	0.69 ± 0.02	0.69 ± 0.02	0.64 ± 0.02	0.71 ± 0.02	0.70 ± 0.02	0.70 ± 0.02	0.65 ± 0.02	0.68 ± 0.02	0.66 ± 0.02	0.66 ± 0.02
Total hydroxycinnamic acids	57.29 ± 2.35	55.12 ± 2.28	55.69 ± 2.31	56.21 ± 2.30	55.25 ± 2.28	33.51 ± 1.12	32.98 ± 1.11	33.95 ± 1.12	33.84 ± 1.11	33.32 ± 1.11
Total flavan-3-ols	31.83 ± 1.59	30.70 ± 1.54	29.39 ± 1.37	27.72 ± 1.89	28.65 ± 1.33	13.96 ± 0.65	14.08 ± 0.80	14.82 ± 0.74	15.03 ± 0.75	15.07 ± 0.78
Total flavonols	2.48 ± 0.06	2.63 ± 0.06	2.46 ± 0.06	2.64 ± 0.06	2.39 ± 0.06	1.89 ± 0.04	1.92 ± 0.04	2.06 ± 0.05	1.93 ± 0.04	1.84 ± 0.04
Total proanthocyanidins	18.59 ± 0.80	18.00 ± 3.05	16.90 ± 1.27	19.10 ± 1.78	20.94 ± 1.49	2.20 ± 0.20	2.65 ± 0.20	2.53 ± 0.37	2.20 ± 0.56	2.96 ± 0.26
Total amino acids	220.41 ± 3.80	224.31 ± 1.81	218.91 ± 1.91	219.29 ± 1.31	224.79 ± 0.57	460.66 ± 8.02	480.08 ± 21.54	444.9 ± 10.84	477.45 ± 11.58	467.94 ± 2.13
Acid amino acids	7.75 ± 0.12	8.41 ± 0.60	7.24 ± 0.36	7.32 ± 0.08	7.97 ± 0.09	9.00 ± 0.15	10.29 ± 0.95	8.57 ± 0.42	11.64 ± 0.32	10.27 ± 0.12
Neutral amino acids	193.07 ± 2.77	194.72 ± 1.51	193.13 ± 1.81	189.97 ± 1.29	190.76 ± 1.49	408.23 ± 0.91	434.47 ± 21.45	410.09 ± 10.75	423.78 ± 11.55	426.51 ± 2.09
Basic amino acids	19.59 ± 0.21	20.18 ± 0.79	18.54 ± 0.50	17.00 ± 1.22	20.06 ± 0.28	46.43 ± 1.44	49.33 ± 3.42	46.23 ± 1.32	48.03 ± 0.82	47.16 ± 0.44
Total biogenic amines	4.27 ± 0.07	4.57 ± 0.23	4.58 ± 0.16	4.05 ± 0.02	4.30 ± 0.05	5.60 ± 0.12	5.84 ± 0.34	5.30 ± 0.27	5.51 ± 0.17	5.77 ± 0.14

<sup>a</sup> data in mg/L.<sup>b</sup> C: control wine; DYAs: sparkling wines treated with the different dry yeast autolysates.<sup>c</sup> nq: below the quantification limit.

<sup>d</sup>Total phenolics were calculated as the sum of total anthocyanins, hydroxycinnamic acids, flavonols, catechin and proanthocyanidins. The content of non-acylated anthocyanins was calculated as the sum of delphinidin, cyanidin, petunidin, peonidin and malvidin-3-glucosides; the content of acetyl-glucoside anthocyanins defined as the sum of delphinidin, cyanidin, petunidin and malvidin-3-(6-acetyl)-glucosides; the content of coumaroyl-glucoside anthocyanins included delphinidin, petunidin, and malvidin-3-(6-p-coumaryl)-glucosides. The sum of all anthocyanin forms was referred to as total monomeric anthocyanins. Total hydroxycinnamic acids were calculated as the sum of caffeic, ferulic and coumaric acid, and the hydroxycinnamates cis-caftaric, trans-caftaric, cis-coutaric, trans-coutaric, and trans-fertaric. Total flavonol content was calculated as the sum of myricetin-3-galactoside, myricetin-3-glucuronide, myricetin-3-glucoside, quercetin-3-rutinoside, quercetin-3-galactoside, quercetin-3-glucoside, quercetin-3-glucuronide, kaempferol-3-glucoside, isorhamnetin-3-glucoside, kaempferol-3-glucuronide, myricetin, quercetin, kaempferol and isorhamnetin. Total flavan-3-ol was calculated as (+) catechin. Total proanthocyanidin content was calculated as the sum of all the subunits: extension subunits (phloroglucinol adducts) and terminal subunits (catechin, epicatechin and epicatechin-gallate). Basic amino acids were calculated as the sum of asparagine, glutamine, histidine, arginine, tryptophan, ornithine and lysine. Acid amino acids were calculated as the sum of aspartic acid and glutamic acid. Total amino acids content was calculated as the sum of neutral, basic and acid amino acids. Total biogenic amines were calculated as the sum of histamine, spermidine, tyramine, putrescine, tryptamine, cadaverine, phenylethylamine and isoamylamine. Quantification of non-commercial compounds was made using the calibration curves belonging to the most similar compound: malvidin-3-glucoside for the anthocyanins; quercetin-3-glucoside for myricetin-3-glucoside and quercetin-3-glucuronide; caffeic acid for cis- and trans-caftaric acids (cis- and trans-caffeoyl-tartaric acid); p-coumaric acid for cis- and trans coutaric acids (cis- and trans-p-coumaryl-tartaric acid); ferulic acid for cis- and trans-fertaric acids (cis- and trans-ferulic-tartaric acid). Proanthocyanidin cleavage products were estimated using their response factors relative to (+)-catechin, which was used as the quantitative standard. Each amino acid and biogenic amine was quantified by using its respective commercial standard.

**Supplementary Table 2.** Factor loadings after varimax rotation of the sparkling wines by grape variety.

	Godello		Verdejo		Garnacha		Tempranillo	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Ethyl butyrate	0.396	0.323	<b>0.685</b>			<b>0.856</b>	0.416	0.487
1-propanol	-0.317	<b>0.641</b>	-0.264	-0.575	<b>-0.627</b>			
Ethyl 2-methylbutyrate	<b>0.897</b>				0.432	<b>0.839</b>	<b>-0.828</b>	0.332
Ethyl isovalerate	<b>0.883</b>		-0.334			<b>0.972</b>	<b>-0.792</b>	0.279
Isobutanol	-0.272		0.421				0.309	
Isoamyl acetate	<b>-0.688</b>	0.415	0.584	0.419		<b>0.879</b>	<b>0.937</b>	
Isoamyl alcohols	0.290		-0.299	0.492	0.261	-0.536	<b>-0.644</b>	0.326
Ethyl hexanoate			<b>0.761</b>	0.507		<b>0.860</b>	<b>0.763</b>	
Hexyl acetate	<b>-0.764</b>	0.452	<b>0.839</b>		-0.478	<b>0.710</b>	<b>0.956</b>	
Ethyl lactate	<b>0.773</b>	<b>-0.622</b>	<b>-0.614</b>	<b>0.649</b>	<b>0.768</b>	-0.377	-0.434	<b>0.871</b>
1-Hexanol	<b>0.613</b>	-0.596		<b>0.918</b>	<b>0.883</b>			0.392
trans-3-hexen-1-ol	0.593	<b>-0.709</b>		<b>0.939</b>	<b>0.904</b>			<b>0.913</b>
cis-3-hexen-1-ol	<b>0.876</b>	-0.383		<b>0.848</b>	<b>0.746</b>	-0.405	0.304	<b>0.901</b>
Ethyl octanoate	0.513	-0.454	<b>0.836</b>			<b>0.920</b>	<b>0.933</b>	
Linalool		<b>0.953</b>	<b>0.644</b>	-0.420	<b>-0.791</b>		<b>0.909</b>	
$\gamma$ -Butyrolactone		<b>-0.734</b>	<b>-0.784</b>			-0.293	-0.278	<b>0.887</b>
Ethyl decanoate			<b>0.906</b>				<b>0.619</b>	
Isovaleric acid	0.434	<b>-0.609</b>		<b>0.796</b>			-0.300	<b>0.909</b>
$\alpha$ -Terpineol	<b>0.830</b>		<b>-0.740</b>		0.511	-0.496	-0.334	<b>0.724</b>
Citronellol		<b>0.820</b>	<b>0.802</b>	-0.302			<b>0.953</b>	
2-Phenylethyl acetate	-0.359	<b>0.759</b>	<b>0.776</b>		-0.417		<b>0.955</b>	
Hexanoic acid		<b>-0.616</b>	-0.299	<b>0.808</b>	<b>0.689</b>	0.310	-0.360	<b>0.613</b>
Benzyl alcohol	<b>0.863</b>		-0.306	<b>0.613</b>	0.355	<b>-0.835</b>		<b>0.956</b>
2-Phenylethanol	<b>0.842</b>	-0.374	-0.306	<b>0.797</b>	<b>0.804</b>	-0.441		<b>0.817</b>
$\gamma$ -Nonalactone		<b>0.857</b>						
Octanoic acid	<b>0.601</b>	-0.487	0.341		<b>0.933</b>		<b>0.838</b>	
4-vinylguaiaicol	-0.323	<b>0.863</b>	0.523	-0.378	<b>-0.635</b>			<b>0.737</b>
Decanoic acid			<b>0.606</b>			0.342	<b>0.721</b>	
Methyl vanillate		<b>0.742</b>	-0.275		-0.477		<b>-0.783</b>	-0.306
Acetovanillone	<b>-0.672</b>	0.376	<b>-0.826</b>		-0.503		<b>-0.707</b>	<b>0.664</b>

Loadings lower than absolute values of 0.250 are not shown

Values in bold indicate the highest weight of each compound in each factor