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Experiments with Douro Tinto
and
High Extract Staves over 2 Months

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The Analysis

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	Control M1	H Toast M1	Mocha M1	H Vanilla M1	H Spice M1	Control M2	H Toast M2	Mocha M2	H Vanilla M2	H Spice M2
Tannin breakdown compounds										
Gallic Acid	7.26	6.06	6.94	6.82	6.28	6.03	6.61	7.78	7.05	6.7
Ellagic Acid	28.91	17.07	6.15	28.52	22.43	36.87	41.9	7.99	8.43	5.29
Hemicellulose caramelisation										
Furaneol	0.24	0.21	0.12	0.14	0.26	0.28	0.44	0.28	0.45	0.43
5-Hmf	0.03	0.03	0.05	0.08	0.06	0.04	0.06	0.06	0.09	0.12
5-Methyl furfural	0.18	0.23	0.18	0.2	0.15	0.16	0.1	0.19	0.11	0.11
Furfural	0.02	0.23	0.16	0.23	0.31	1.00E-36	0.87	0.77	0.64	0.82
Wine phenolics										
Protcatechuic aci	0.22	0.3	0.33	0.24	0.21	0.18	0.09	0.09	0.09	0.11
Epicatechin	3.34	2.73	3.92	3.81	1.71	3.1	3.52	4.98	4.71	3.98
Chlorogenic acid	0.71	0.84	0.74	0.72	0.75	0.69	0.64	0.35	0.87	0.72
Caffeic acid	21.9	23.19	21.77	20.92	20.13	20.61	20.9	23.74	22.06	21.11
Myricetin	2.68	2.4	2.07	2.26	2.27	1.41	1.41	1.74	1.62	1.49
Quercetin	7.74	7.91	7.08	7.3	6.94	7.11	7.05	8.35	7.62	7.32
Lignin degradation compounds										
Vanillic acid	1.7	1.87	1.97	1.85	1.46	1.24	1.56	1.51	1.62	1.53
Syringic acid	19.76	19.86	20.42	19.67	18.21	17.58	18.71	20.81	19.7	18.43
Vanillin	0.43	0.02	0.16	0.49	0.11	0.43	0.73	0.93	0.95	0.75
Syringaldehyde	0.84	0.42	0.81	1.1	0.51	0.89	1.09	1.67	1.78	1.06
Coniferaldehdye	0	0.05	0.04	0.05	0.01	0.05	0.03	0.03	0.04	0.07
Sinapaldhehyde	0.48	0.42	0.45	0.41	0.42	0.45	0.46	0.56	0.58	0.54
'Smoke' phenolics										
Phenol	4.46	4.49	4.05	3.79	5.24	4.25	3.56	6.25	5.49	4.75
Guaiacol	7.94	7.77	7.29	8.99	7.64	6.39	5.23	9.1	6.18	5.99
m/p Cresol	1E-36	1E-36	0.03	1E-36	0.02	1E-36	1E-36	1E-36	1E-36	1E-36
o-Cresol	1E-36	1E-36	1E-36	1E-36	0.01	1.00E-36	1E-36	1E-36	0.08	1.00E-36
4-Ethyl phenol	0.14	0.01	0.24	0.13	0.15	0.02	0.22	0.29	0.42	0.16
4-Ethyl guaiacol	0.19	0.03	0.03	0.08	0.09	0.04	0.09	0.05	0.09	0.2
Oak Lactones										
trans oak lactone	0.008	0.011	0.007	0.01	0.009	0.006	0.017	0.008	0.013	0.013
cis oak lactone	0.018	0.027	0.02	0.047	0.035	0.02	0.033	0.023	0.068	0.059

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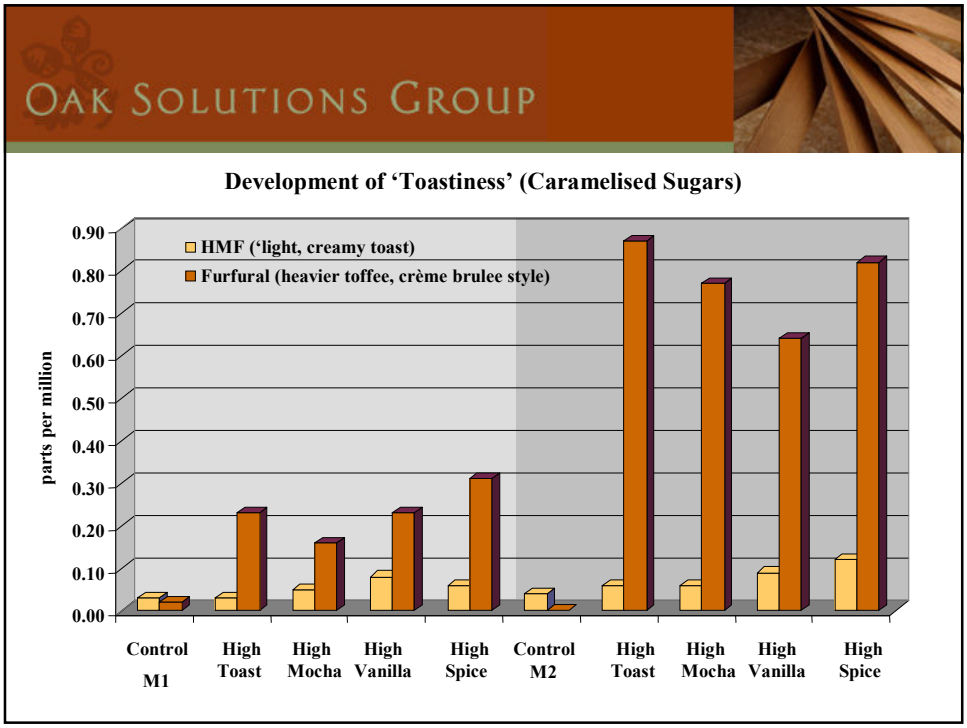

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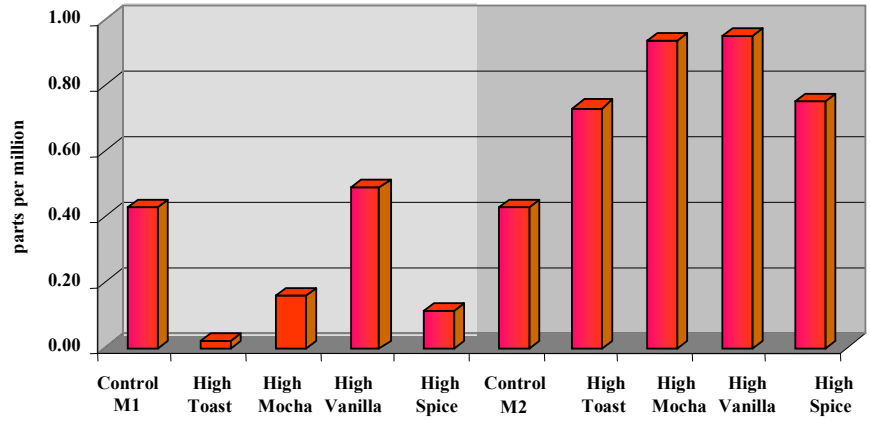
Development of 'Vanillin over 2 months



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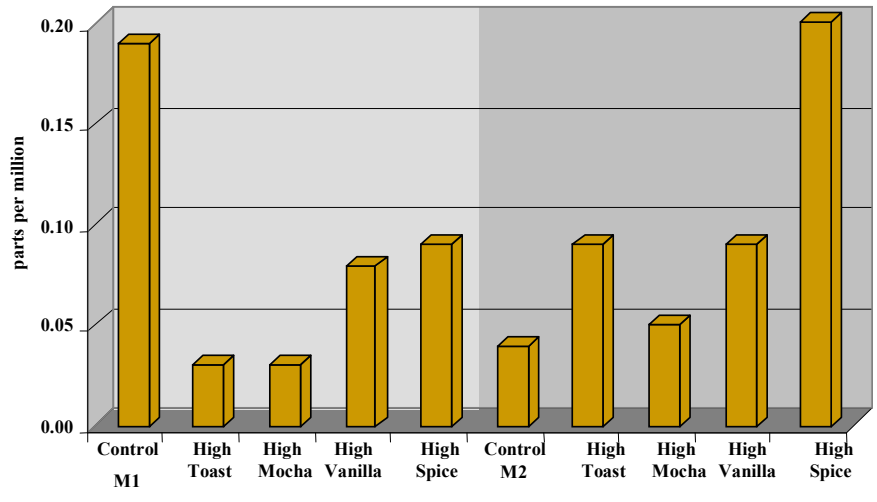
Development of 'Spiciness' over 2 months)



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Experiments
with
Fine Toast, Convection toasted & Infrared toasted
tank staves

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	Control 16/03	Fine T 16/03	Conv 16/03	Infrared 16/03	Control 19/04	Fine T 19/04	Conv 19/04	Infrared 19/04
Tannin breakdown								
Gallic Acid	32.02	30.04	28.94	31.25	30.18	28.55	29.98	30.68
Ellagic Acid	22.02	27.97	31.2	40.88	32.82	36.95	37.48	35.76
Hemicellulose caramelisation								
Furaneol	0.58	0.67	0.55	0.63	0.57	0.59	0.64	0.72
5-Hmf	0.03	0.08	0.04	0.1	0.03	0.13	0.07	0.12
5-Methyl furfural	0.15	0.11	0.13	0.15	0.13	0.19	0.24	0.17
Furfural	0	0.8	1.28	0.92	0	2.03	3.06	1.2
Wine phenolics								
Protcatechuic acid	1.13	1.23	1.37	1.1	1.23	1.38	1.22	1.24
Epicatechin	7.97	6.99	5.96	6.69	7.09	6.52	6.22	6.02
Chlorogenic acid	1.03	1	1.33	1.46	1.44	1.23	1.16	1.27
Caffeic acid	11.85	11.09	11.18	11.86	11.69	10.75	11.41	11.95
Myricetin	10.03	8.97	9.18	10	10.1	9.03	9.09	9.19
Quercetin	13.83	12.83	12.85	13.3	14.07	12.18	12.26	12.49
Lignin degradation compounds								
Vanillic acid	1	0.87	1.03	1.09	1.11	1.1	0.94	0.83
Syringic acid	25.6	24.25	24.22	26.48	26.01	24.38	25.08	25.71
Vanillin	1E-36	0.21	0.22	0,18	1E-36	0.22	0.23	0.18
Syringaldehyde	0.78	0.96	1.11	1.12	1.12	1.01	1.56	0.97
Coniferaldehyde	0.41	0.32	0.35	0.33	0.38	0.33	0.3	0.27
Sinapaldehyde	0.73	0.36	0.59	0.49	0.49	0.5	0.42	0.46
'Smoke phenols								
Phenol	0.11	0.1	0.02	0.02	0.04	0.01	0	0.04
m/p-Cresol	0.11	0.18	0.16	0	0.01	0.09	0.1	0.03
o-Cresol	0.18	0.09	0.13	0.08	0.06	0.07	0.12	0.17
4-Ethyl phenol	0.01	0.06	0.02	0.12	0.03	0.02	1E-36	0.12
4-Ethyl guaiacol	0.39	0.24	0.38	0.41	0.43	0.23	0.43	0.41
Oak Lactones								
trans lactone	0.001	0.032	0.016	0.007	0.007	0.01	0.012	0.012
cis lactone	0.004	0.048	0.032	0.021	0.019	0.028	0.032	0.028

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To "overview" the results we often use statistical techniques based upon Principal Components Analysis (PCA).

These procedures can simplify a large table of data and assist in its interpretation

In the following diagram each type of tank stave is shown (as a barrel!) and the chemical compounds nearest to it are the ones that influence it (and it's flavour) to the greatest extent

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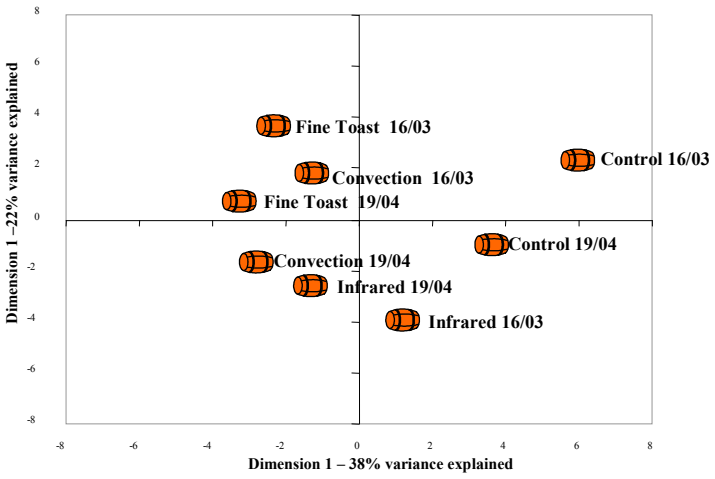
Principal Components Analysis of VDS Tank Stave Experiment



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Looking at the locations of the samples we see that
All have moved to a similar extent from 1 to 2 months
i.e. all except the infrared toast staves…….*why?*

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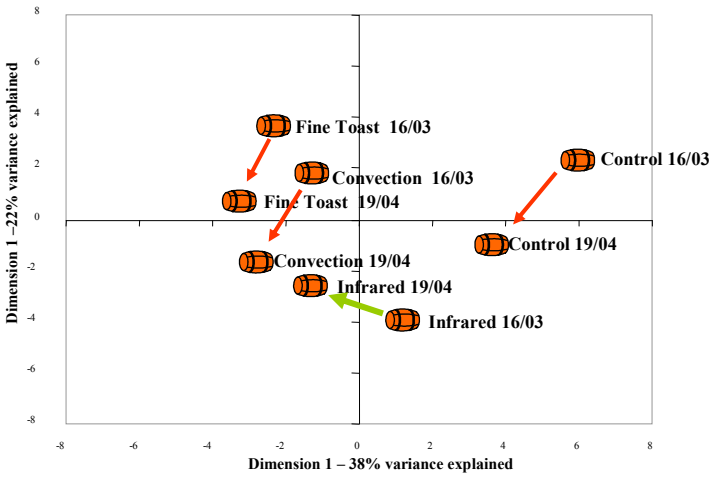
Principal Components Analysis of VDS Tank Stave Experiment



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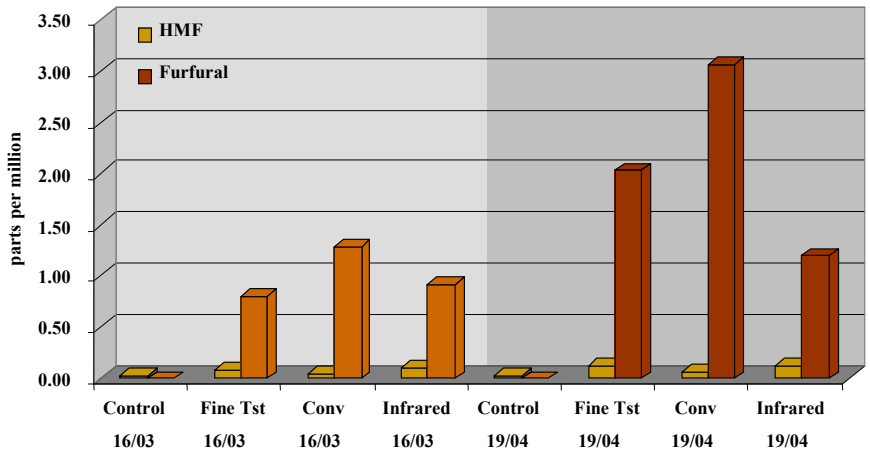

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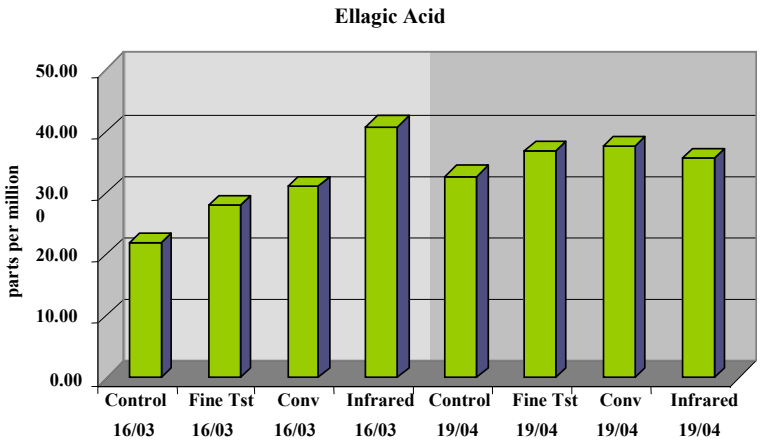
The oak ellagitannin breakdown compound ellagic acid that augments the amount that derives from the wine is behaving differently in the infrared stave



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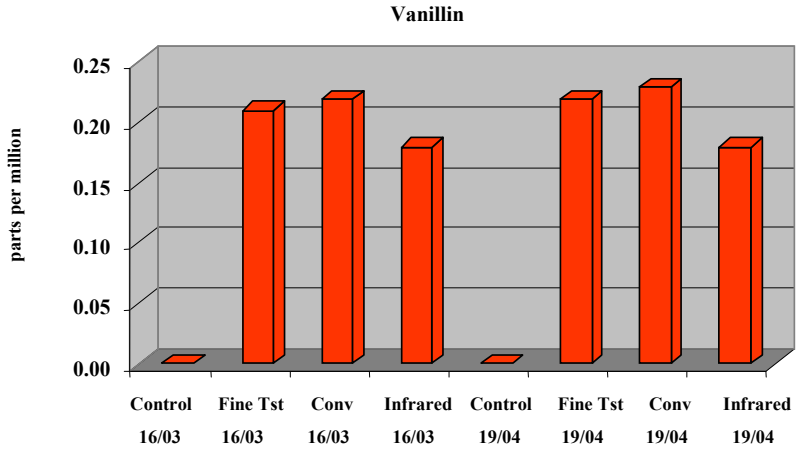
Vanillin extraction also appears to behave differently