

Overview of Interlaboratory Proficiency Test on Sensory Detection of Wine Defects

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INTRODUCTION

Since ancient times, wine has been valued for its unique sensory qualities. Nowadays, wine quality control is crucial for wine producers that must identify any wine alteration as soon as possible throughout all the winemaking process. Advanced chemical analytical methods are employed to characterize wine and detect the presence of undesirable compounds. To identify organoleptic defects, chemical analyses are generally complemented by sensory tests conducted by trained experts. In recent years, the number of laboratories offering sensory analysis services has steadily increased. However, wine is a complex matrix, and several factors can affect assessors' perception. The same defect can be perceived at different intensities according to experience, training and cultural origins of the panel. Moreover, even if wines with a neutral sensory profile are selected, adding some molecules can alter the sensory equilibrium and highlight also defects which were not the target. Over 8 years, 34 different wines altered with molecules corresponding to a main olfactory, taste or tactile alteration were submitted to laboratories worldwide as part of interlaboratory tests. The perception of the **defects mouldy-earthy, acetic, reduced, oxidized, animal, acid, bitter, and astringency** by different panels was examined, analyzed and interpreted.

DESIGN and IMPLEMENTATION

Spiking & Samples Preparation Protocol	Samples Distribution & Sensory Evaluation	Data & Statistical Analysis
Defect Induction: Wines were spiked with specific defect compounds (see Table I for levels by matrix and attribute). Homogenization: Mixed in a glass vessel with a floating cover. Integration: Allowed 1–3 days contact time for complete compound integration. Storage: Sealed in glass vials with zero headspace and stored at 12–20°C. Homogeneity and stability check: Evaluated according to ISO 13528 Annex B [1]. Spiked concentrations were verified via chemical analysis following the OIV Compendium [2].	Blind Distribution: Prepared samples were distributed blindly without revealing spiking compound identities. Analyses: Laboratories performed chemical analyses per OIV-prescribed methods [3]. Panel Eligibility: Only panels with ≥ 8 trained assessors were included in the statistical analysis. Intensity Rating: Assessors scored perceived defect intensity on a 6-point scale (0 = Not perceived; 5 = Highest intensity).	Panel Scoring: Individual panel ratings were compiled; median intensity scores were calculated per sample and attribute. Data Visualization: The results were subsequently presented graphically in the final statistical report for each sensory attribute. An example of graphical representation of medians of the intensities returned by each panel for a specific alteration is shown in Figure 2. The median of medians of the intensity of perceived defect of laboratories for which the panel was composed by at least 8 assessors is indicated as a line in these graphs.

RESULTS and DISCUSSION

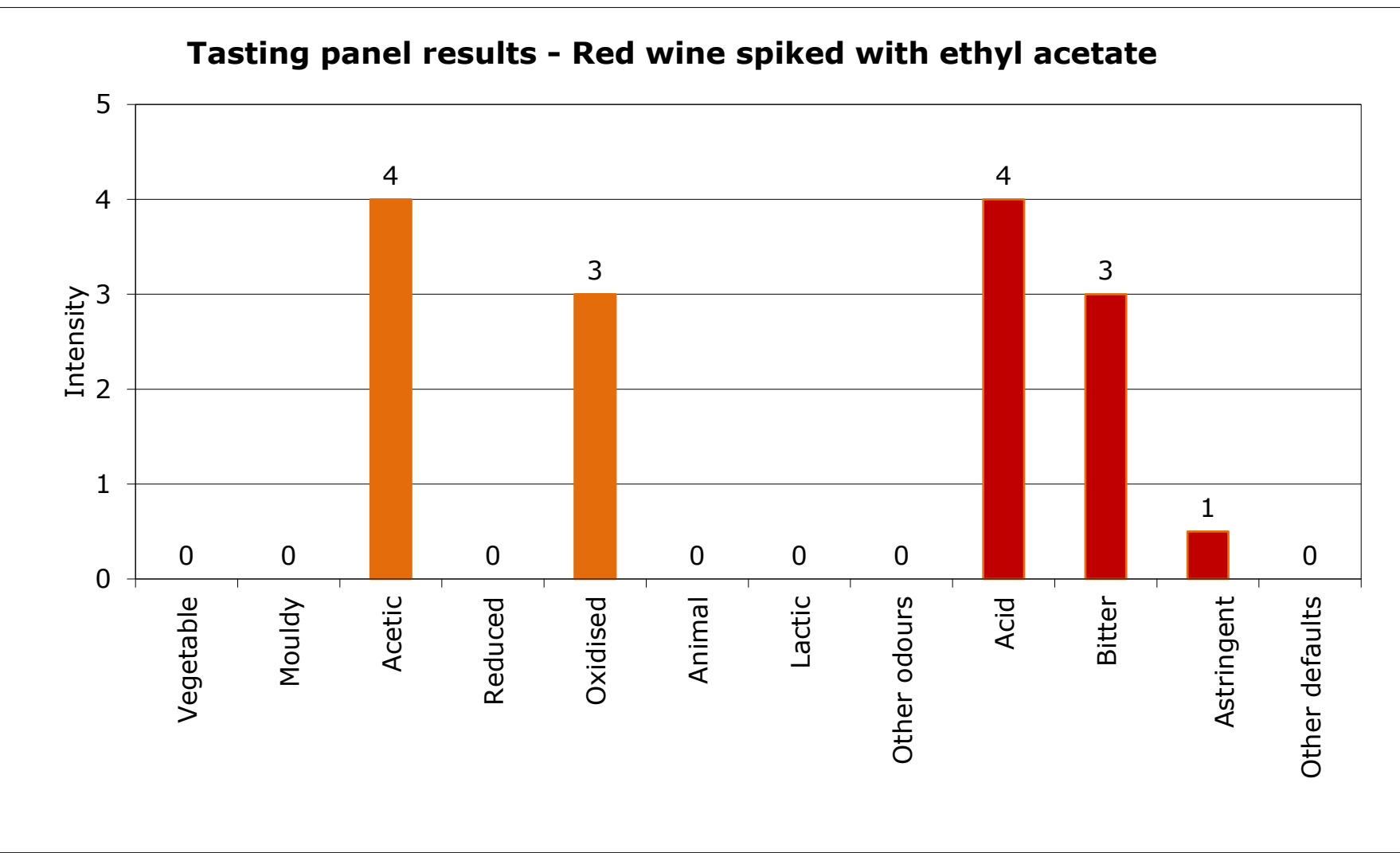


Figure 1. Graphical representation of results obtained by the tasting panel of a laboratory participating in the test on red wine spiked with ethyl acetate (PT of February 2026). Olfactory alterations are indicated in orange, tactile and taste ones in red. The tasting panel of this laboratory detected the main olfactory defect caused by the presence of ethyl acetate (acetic alteration), with an intensity of 4 (high level).

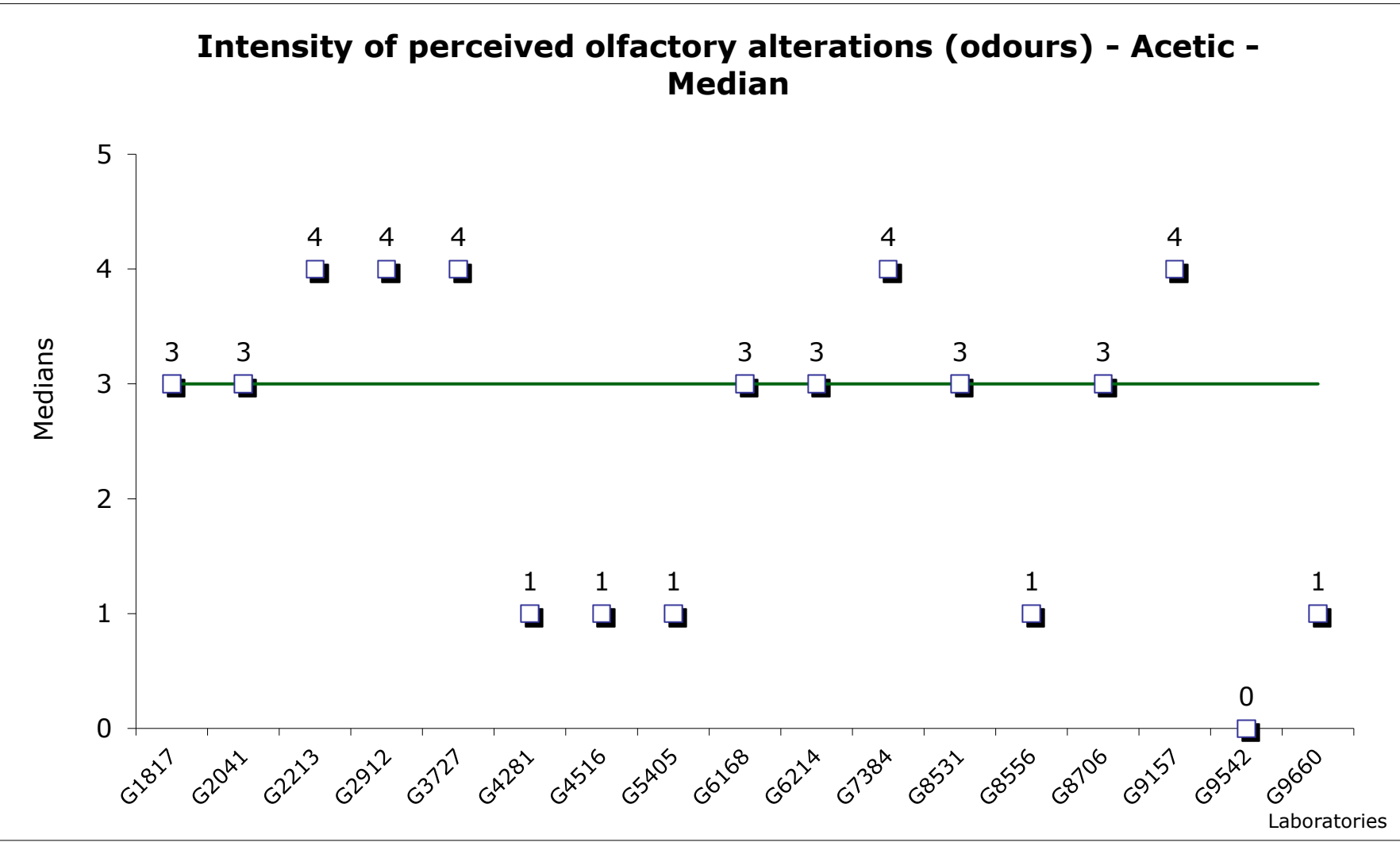


Figure 2. Graphical representation of medians obtained by laboratories on the acetic defect perception for a red wine spiked with ethyl acetate (PT of February 2026). The green line indicates the median of the medians of laboratories which panel consists of at least 8 assessors (selected laboratories).

Alteration molecule / Defect	Trial	Wine	Spiking Concentration	Number of participants	Laboratories identifying the main defect (%)	Intensity of perceived main defect ¹
Trichloroanisole Mouldy-earthy	February 2018	Red	38 ng/L	31	61%	3
	October 2018	Red	29 ng/L	15	83%	4
	February 2023	Red	12 ng/L	19	79%	4
	October 2024	White	15 ng/L	20	83%	4
Geosmin Mouldy-earthy	February 2019	Red	702 ng/L	15	83%	4
	February 2020	Red	451 ng/L	18	100%	4
	February 2025	White	486 ng/L	18	100%	4
Ethanethiol Reduced	October 2019	White	59 ng/L	15	45%	2
	February 2021	Red	81 mg/L	18	60%	3
	February 2025	Red	68 mg/L	18	67%	4
Acetaldehyde Oxidized	February 2021	White	136 mg/L	18	89%	4
	February 2024	White	119 mg/l	18	89%	4
4-Ethylphenol Animal	October 2019	Red	441 mg/L	15	100%	4
	October 2023	Red	354 mg/L	17	38%	4
	October 2025	Red	496 mg/L	14	100%	4
	October 2020	White	28.3 mg/L	15	63%	3
Quinine Sulphate Bitter	February 2022	Red	26.1 mg/L	20	50%	3
	October 2022	White	20.7 mg/L	15	45%	3
	October 2025	White	28.3 mg/L	14	100%	3
	October 2020	Red	1087 mg/L	15	56%	3
Grape tannins Astringency	October 2022	Red	870 mg/L	15	22%	2
	October 2024	Red	1196 mg/L	19	6%	2
2-isobutyl-3-methoxypyrazine Vegetal	October 2021	Red	256 ng/L	17	100%	4
Ethyl acetate Acetic	October 2018	White	160 mg/L	15	20%	1
	February 2020	White	226 mg/L	18	60%	3
	October 2023	White	152 mg/L	17	14%	
	February 2026	Red	189 mg/L	20	70%	3
Acetic acid Acetic/Acid	October 2021	White	1.6 g/L	17	75%/25%	4/4
	February 2024	Red	0.8 g/L	19	40%/13%	3/2
	February 2026	White	1.3 g/L	20	22%/11%	3/3
Tartaric acid Acid	February 2018	White	2.2 g/L	31	16%	4
	February 2019	White	1.1 g/L	15	50%	3
	February 2022	White	3.3 g/L	19	79%	4
	February 2023	White	1.0 g/L	20	75%	4

¹ median of the selected panel

Table 1. Summary of results obtained in interlaboratory tests for identification of wine defects

Overview of Results obtained for Olfactory and Taste Defect
Results are satisfactory: the main laboratories found the defect linked to the presence of the spiking molecule in almost all the proposed samples.
Mouldy-Earthy Trichloroanisole (TCA): Identified by 61% of participants in initial tests (median intensity: 3). Detection rates and median scores improved in subsequent tests, even at lower spiked concentrations. The identification of TCA is affected by matrix interference, panel sensitivity/training variations, and rapid receptor saturation. Geosmin: as TCA, in the first test a smaller population detected the mouldy-earthy alteration. The perceived intensity (median: 4) remains constant across all tests despite the difference in spiking concentration. Reduced (Ethanethiol): 44% of the laboratories detected the reduced defect in white wine, with a median of 2. In this same sample, 33% of laboratories indicated the oxidized defect. More than 60% of the laboratories detected the reduced defect in the following red wines. The higher concentration and the different wine characteristics likely contributed to the improved results of this second test. Oxidized (Acetaldehyde): Good results were achieved with the two wines spiked with acetaldehyde. Animal (4-Ethylphenol): 100% of laboratories detected this alteration in October 2019 and October 2025. In October 2023, only 38% of the laboratories detected this defect: the oxidized defect was found by most of laboratories, certainly present in the red wine before spiking. Bitter (Quinine Sulphate): good improvement in the detection of quinine sulphate over time, considering the spiking concentrations as well. Astringency (Grape Tannins): the presence of grape tannins remains difficult to detect due to regional differences in tasters' familiarity with tannic/astringent wine styles. 56% detected astringency in the first test (median intensity: 3), dropping to 22% in the second test. In October 2024, only 6% identified Astringency while 81% reported Oxidized (highlighting matrix interference). Vegetal (2-Isobutyl-3-Methoxypyrazine): Defect well-detected and consistently recognized by tasters. Acetic Ethyl Acetate: For the trials of October 2018 and October 2023, acetic defect was not indicated as a glaring defect by the laboratories. On the first test, only 20% found this alteration and the predominant negative attributes were acidic for 30% and bitter for 20% of participants. In October 2023, the spiking of ethyl acetate at a concentration of 152 mg/l was probably not sufficient to be detected by the tasters as a flagrant defect: only 1 laboratory detected this acetic defect (43% of the laboratories indicated the acid defect). Higher concentrations and different wine matrices in the trials of October 2020 et 2026 yielded significantly more consistent detection. Acetic Acid: Acetic acid exhibits a vinegar-like odor and acidic taste. Nevertheless, its perception is highly variable among assessors, and the detection of this compound is strongly influenced by the wine matrix. Good results were achieved in October 2021. In February 2026, 33% detected an Oxidized defect and only 22% detected Acid, likely due to premature wine oxidation. Acid (Tartaric Acid): A marked increase in the perception of this alteration was observed: only 16% identified acid as the major defect in the first test (where 68% noted the mouldy-earthy defect with a median intensity of 4), but detection rose to 50% in the second test and surpassed 75% in following tests across various spiking concentrations.

CONCLUSION

Results show that certain defects, such as mouldy-earthy, oxydized and animal notes, are highly recognizable and easily identified by panels. In general, laboratories detect spiked defects more reliably when they have encountered the responsible molecule in prior tests. Indeed, the intensity data of the main defect shows significantly less dispersion in panelists' scores during second-time exposure. Consequently, interlaboratory tests not only foster continuous improvement but also act as effective sensory training, sharpening panel sensitivity and offering valuable data on individual assessor performance.

REFERENCES

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