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Non-fermentable sweeteners improve Generation Z liking of red wine

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Declining wine consumption among young adults, particularly for red wine, calls for innovation. Non-fermentable sweeteners avoid the risks of re-fermentation and offer nutritional advantages. Three studies using Check-All-That-Apply (CATA) and hedonic evaluations assessed erythritol, rebaudioside-A and xylitol additions to red wine young adult panels. In all cases, sweetened wines were better liked, with sweet, soft and fruity as positive drivers of liking, and bitter, acid and bland as negative drivers.

Context and materials

Wine consumption has declined globally, with red wine sales falling 15 % over the last 15 years[1]. Young adults are a key target for innovation in the wine industry. Adding sweetness is a recognised strategy to improve palatability[2], but standard sugar additions risk in-bottle re-fermentation, which requires additional stabilisers such as sulfites, dimethyl dicarbonate, or potassium sorbate. Sucrose also provides an additional caloric supply of 4 kcal/g, which may be an obstacle for individuals trying to limit their energy intake. Non-fermentable sweeteners offer a promising alternative. Three sensory studies were conducted between 2023 and 2025 with young adult panels (mean age ~22 years) from the Toulouse area, France. In studies 1 and 2, grouped in a recent article[3], a dry red wine made from Seibel 5455 was edulcorated with either erythritol (0, 10, 20, 30 g/L) or rebaudioside-A (0, 20, 40, 60 mg/L). In study 3[4], xylitol (0, 10, 20, 30 g/L) was added to a dry Fer Servadou red wine (vintage 2024). Relative to sucrose (sweetness index = 1), erythritol has a sweetening power of approximately 0.6–0.7, xylitol exhibits a sweetness similar to sucrose (≈1.0), while rebaudioside A is approximately 200–300 times sweeter. In all studies, panellists evaluated wines monadically, completed a 9-attribute CATA questionnaire in the CATA-then-liking order, and rated overall liking on a 1–9 hedonic scale. Note that erythritol, rebaudioside-A and xylitol are not authorised oenological compounds under EU wine regulations based on the OIV International Code of Oenological Practices, and were tested for research purposes only. Although all three are commercially available as food additives authorised in the EU, their use in alcoholised beverages classified as 'wine-based products' is not currently authorised. Data were analysed by correspondence analysis and ANOVA with Tukey's post-hoc tests. Penalty analyses were additionally applied to study 3.

Results about erythritol and rebaudioside-A (studies 1 and 2)

In study 1 (erythritol), correspondence analysis clearly separated the sweetened wines from the control, which was the base dry wine without residual sugars (Figure 1A). Sweetened wines were associated with sweet, soft, and fruity attributes, while the control clustered with bitter, acid, and bland. Three distinct statistical classes of liking scores were identified (Table 1), with the highest erythritol dose (PLUS30: 30 g/L) scoring significantly better than the control. In study 2 (rebaudioside-A), similar attribute associations were observed, with sweet and soft linked to sweetened wines and bitter and acid to the control (Figure 1B). However, no statistically significant differences in liking scores were found between wines (Table 1), even if the same trend was observed: liking scores increased with sweetener dose. In both studies, panellists from comparable profiles (similar age, gender ratio, and wine experience) showed consistent patterns across the attribute space.

Results about xylitol addition and penalty analysis (study 3)

In study 3 (xylitol), correspondence analysis placed wines containing 20 and 30 g/L xylitol (PLUS20 and PLUS30) in close association with sweet, soft and fruity, while the unsweetened control clustered with acidic, bitter and bland (Figure 1C). Confidence ellipses were well separated between PLUS30, PLUS20 and the control, indicating clear sensory differentiation. Liking scores for PLUS20 and PLUS30 were significantly higher than for PLUS10 and CONT, with a plateau effect beginning around 20–30 g/L (Table 1). A penalty analysis was performed[5,6] combining CATA attribute data and liking scores. Figure 2 shows that bland, bitter, and acidic had

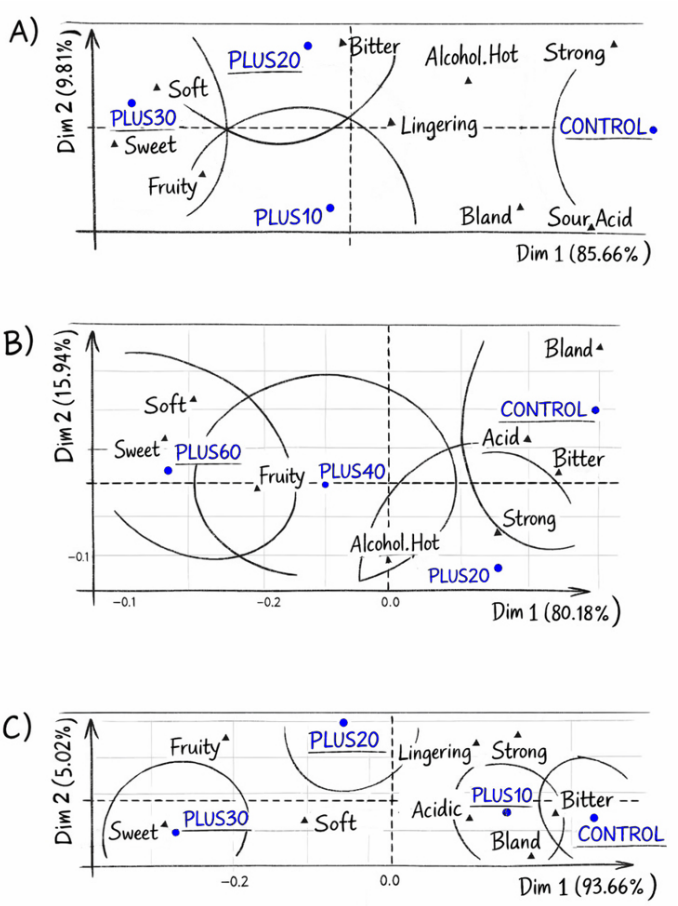


FIGURE 1. Correspondence analyses for study 1 (erythritol, panel A), study 2 (rebaudioside, panel B), study 3 (xylitol, panel C), using Check-All-That-Apply (CATA) analyses. See details of sweetener doses in Table 1 legend. Panels A and B adapted from Geffroy *et al.* (2024)[3] CC BY 4.0; panel C adapted from Chervin *et al.* (2026)[4] CC BY 4.0.

TABLE 1. Liking scores (mean ± SE) for red wines with non-fermentable sweeteners across three studies; different letters indicate significant differences (Tukey's test, $p < 0.05$). Doses 1, 2, and 3 of erythritol were 10, 20, and 30 g/L, respectively. Doses 1, 2, and 3 of rebaudioside-A were 20, 40, and 60 mg/L, respectively. Doses 1, 2, and 3 of xylitol were 10, 20, and 30 g/L, respectively. Controls were all 0 g/L, wines without addition.

	Control	Dose 1	Dose 2	Dose 3	Number of panellists
Study 1 (Erythritol)	$4.2^{c} \pm 0.2$	$4.8^{bc} \pm 0.3$	$5.3^{ab} \pm 0.3$	$6.0^{a} \pm 0.3$	39
Study 2 (Rebaudioside)	$4.5^{a} \pm 0.2$	$4.7^{a} \pm 0.2$	$5.0^{a} \pm 0.3$	$5.3^{a} \pm 0.3$	51
Study 3 (Xylitol)	$4.3^{c} \pm 0.2$	$4.9^{b} \pm 0.2$	$5.6^{a} \pm 0.2$	$6.0^{a} \pm 0.2$	119

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positive penalty values (i.e., their presence lowered liking scores), while fruity, soft, and sweet had negative penalty values, confirming their positive contribution to liking. These observations were expected, but allowed straightforward validation of the penalty analysis approach developed here. Penalty analysis is useful when developing a new product to understand which attributes are impacted by the process and which are linked to consumer liking.

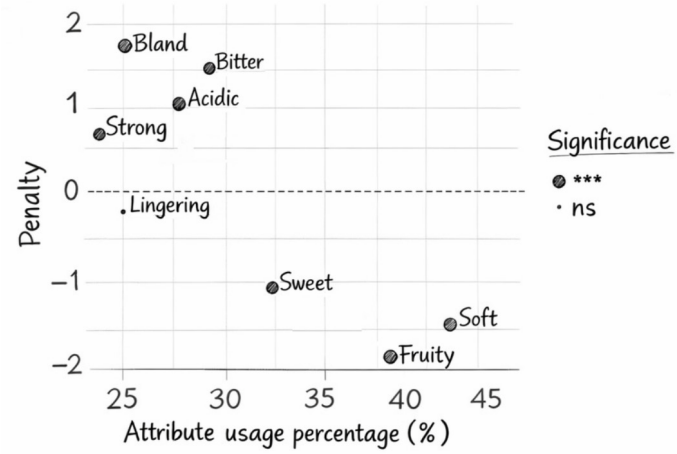


FIGURE 2. Penalty analysis was performed by combining CATA and liking data, as developed in study 3 using the xylitol dataset. "***" denotes adj. $p < 0.001$; "ns" denotes non-significant. The penalty metric is counterintuitive: a negative penalty value indicates that an attribute contributes positively to the liking score. For example, 'Fruity' shows the largest negative penalty, indicating the strongest positive impact on liking score. Adapted from Chervin *et al.* (2026)[4], CC BY 4.0.

Conclusions

Across all three studies and three distinct sweeteners, the same convergent pattern was observed: non-fermentable sweeteners consistently improved young adult liking of red wine and enhanced sweet, soft and fruity perceptions. These results provide the wine industry with actionable insights into the sensory mechanisms by which such additives improve the palatability of dry red wines for younger consumers. Regarding the sweetener doses that give the best results, the industry should note that they are equivalent to approximately 20 g of sucrose per litre. The use of sweeteners in dealcoholized wines could also be valuable for rebalancing mouthfeel and addressing the high propensity of these wines to undergo refermentation when sucrose is added. Studies are under way. These results also raise the question of why such sweeteners are permitted in beer production but not in wine-based beverages. This is not to suggest that all wine-based beverages would benefit from their inclusion, but that market share could be gained in targeted segments. ■

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