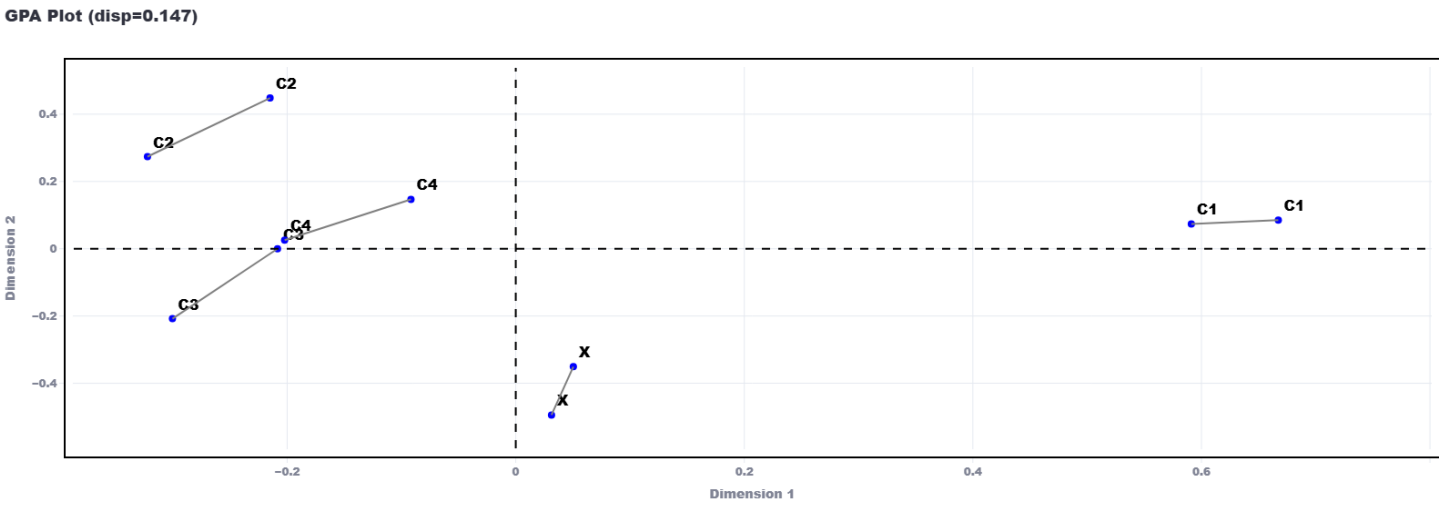


Figure 1. Supplementary Materials. Generalized Procrustes Analysis (GPA) plot comparing PCA configurations derived from volatile compound data (chemical space) and sensory descriptor matrices (sensory space). Blue circles represent beer sample positions from chemical PCA, while corresponding blue points connected by gray lines represent their projected positions from sensory PCA. Shorter connecting lines indicate stronger structural agreement between chemical and sensory profiles.

The GPA analysis revealed a Procrustes disparity of 0.147, indicating a moderate-to-strong overall agreement between the spatial configurations based on volatile composition and sensory descriptors. Sample C4, for instance, exhibited very similar coordinates in both the chemical and sensory spaces, suggesting that its distinctive aroma profile is well-explained by its volatile composition. Similarly, sample X showed close alignment between its chemical and sensory representations, reinforcing its potential as a sample with a consistent chemical-sensory identity. Conversely, samples such as C2 and C3 displayed a greater separation between their chemical and sensory coordinates, suggesting that additional factors—such as matrix effects, compound interactions, or sub-threshold volatiles—may influence their perceived aroma. These mismatches highlight the multifactorial nature of flavor perception and indicate that some compounds may modulate perception indirectly or in synergy with others. Taken together, these results support the existence of a structured relationship between the physicochemical composition of beer and its aromatic perception, as visualized through multivariate alignment. However, the presence of sample-specific discrepancies underscores the need for further exploration, particularly focusing on non-volatile matrix interactions, sensory panel variability, and perceptual thresholds. These aspects will be the focus of future studies aiming to better define the chemical basis of aroma perception in beer.