Combining chemistry and flavor to study beer flavor interactions
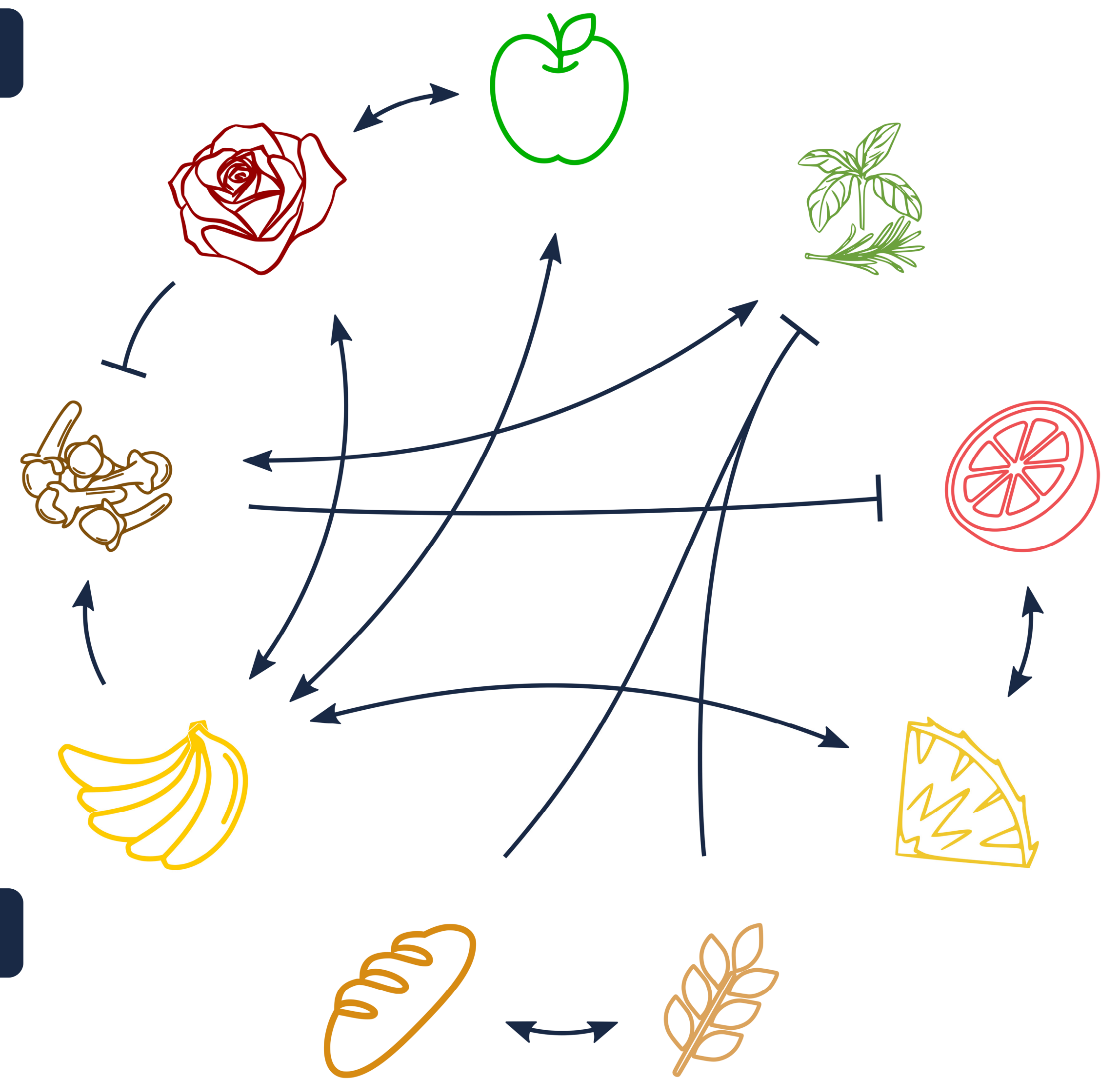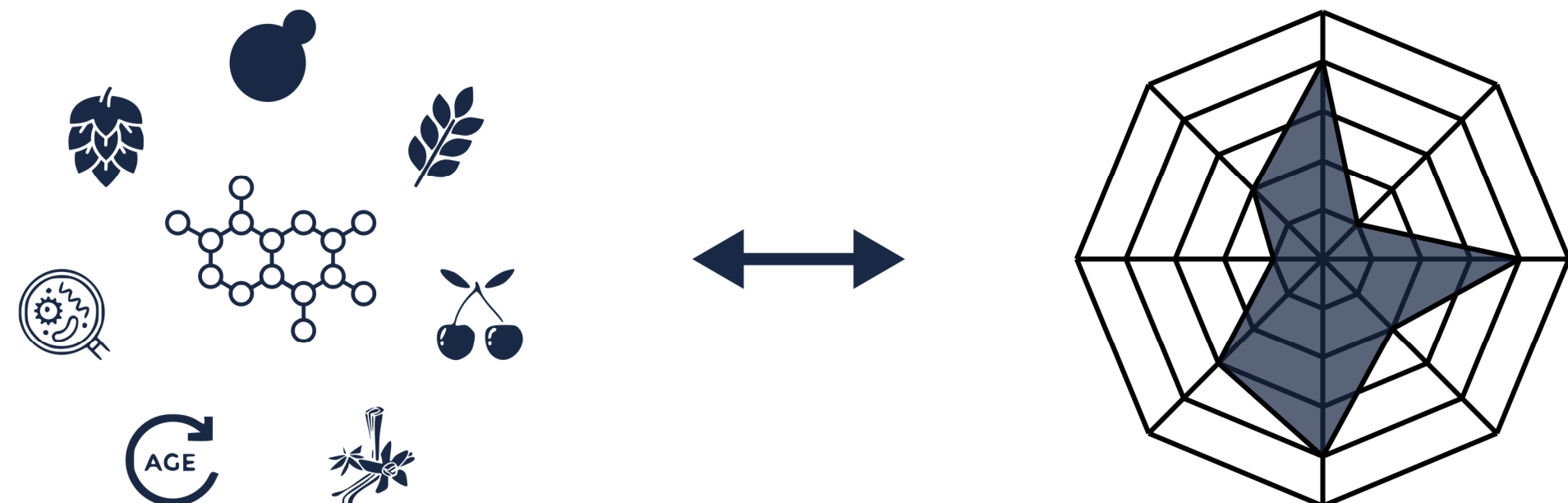
INTRODUCTION

The complex beer matrix contains hundreds of chemical compounds that influence beer flavor through additive, synergistic, antagonistic and masking interactions. Many of these interactions have not yet been described.
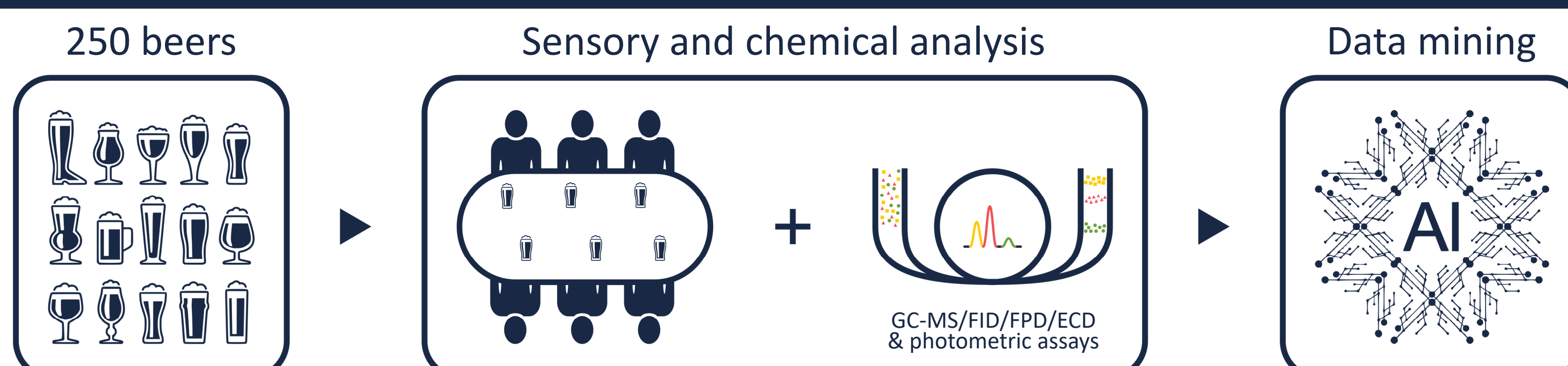
We present an extensive chemical and sensory dataset that allows us to identify potential sensory interactions and the main drivers of beer flavor.
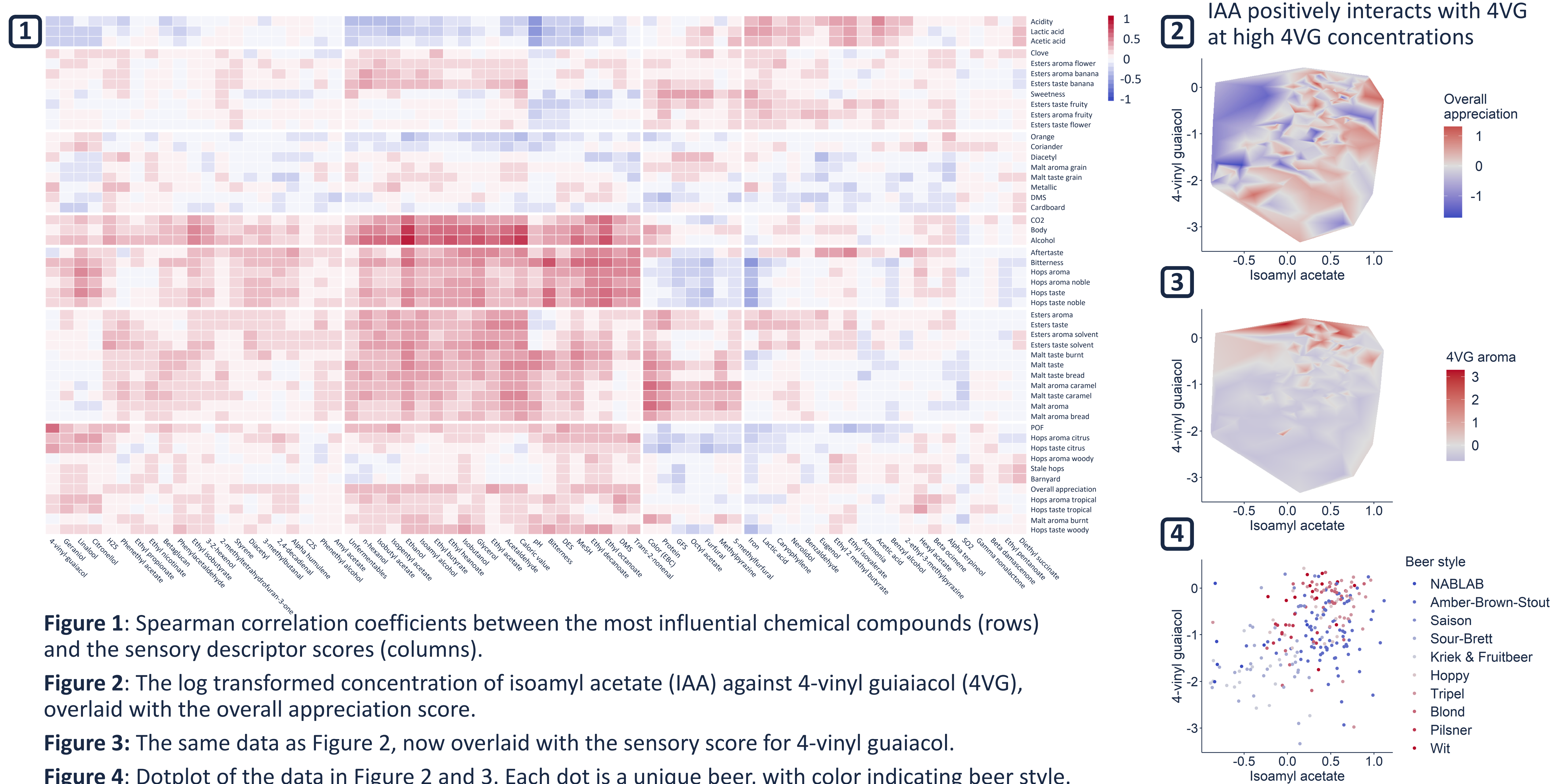
OBJECTIVE

Discovering new links between chemical composition and flavor profile and using these links to steer beer flavor to desirable end products.

MATERIALS AND METHODS

250 beers → Sensory and chemical analysis + GC-MS/FID/FPD/ECD & photometric assays → Data mining (AI)

RESULTS

Figure 1: Spearman correlation coefficients between the most influential chemical compounds (rows) and the sensory descriptor scores (columns).

Figure 2: The log transformed concentration of isoamyl acetate (IAA) against 4-vinyl guiaiacol (4VG), overlaid with the overall appreciation score.

Figure 3: The same data as Figure 2, now overlaid with the sensory score for 4-vinyl guaiacol.

Figure 4: Dotplot of the data in Figure 2 and 3. Each dot is a unique beer, with color indicating beer style.

DISCUSSION

Correlation heatmaps, like Figure 1, hint at possible drivers of beer flavors. For example, beer body seems to be influenced primarily by ethanol, glycerol, higher alcohols and esters. We are currently studying their effects and ability to improve beer in pairwise comparison tasting experiments.

Specific cases, like Figure 2-4, point towards potential flavor interactions. It appears that 4VG aroma is perceived at high 4VG concentrations, but it is only appreciated when esters, like IAA, are abundant as well. This visualizes how the beer flavor profile is determined by sensory interactions, rather than a simple combination of all compounds present above their sensory threshold concentration.

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