# METABOLOMICS OF SPONTANEOUSLY FERMENTED BEERS: INSIGHTS FROM NMR AND LC-MS

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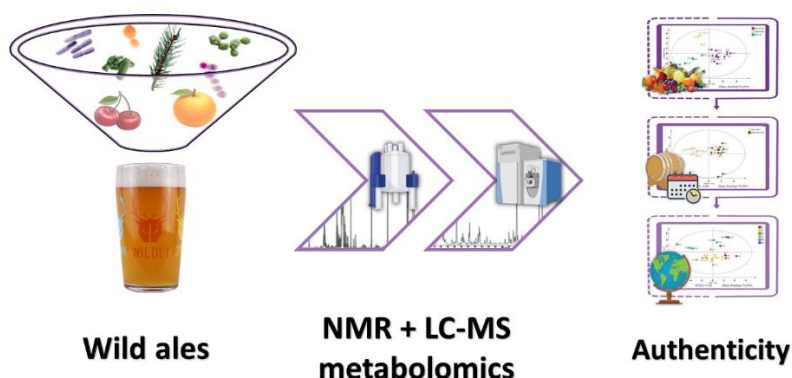
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Wild ales are spontaneously fermented beers characterized by their diverse ingredients and complex microbial activity. In this study, we used NMR spectroscopy, LC-MS, and spectrophotometric assays to analyze the molecular composition and antioxidant potential of wild ales from six different countries. NMR proved to be a robust platform for quantifying key metabolites, including organic acids, amino acids, alcohols, nucleosides, nucleobases, saccharides, and phenolic compounds. LC-MS analysis extended the molecular coverage, partially overlapping with the NMR results and captured a broader range of specialized metabolites, including flavonoids, hydroxybenzoic and hydroxycinnamic acids, flavan-3-ols, procyanidins, bitter acids, and prenylated phenols. Multivariate analysis revealed that the addition of different fruits and the duration of aging significantly influenced the beers' chemical profiles and antioxidant activity. Correlations between specific metabolites and antioxidant assays identified compositional markers relevant to beer functionality. These results demonstrate the usefulness of NMR-based metabolomics for characterizing complex fermented beverages and linking composition to processing variables.

**Wild ales**     **NMR + LC-MS metabolomics**     **Authenticity**