

## 浓香型白酒窖池微生物群落结构特征

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## Characteristics of microbial community structure in Luzhou-flavor fermentation pits.

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- 摘要
- 参考文献
- 相关文章

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## 摘要

窖池是中国白酒,尤其是浓香型大曲酒生产颇具特色的固态生物反应器,窖龄与微生物群落结构关系密切且复杂,对产品质量影响非常显著.本研究以微生物细胞膜的特征组分磷脂脂肪酸(PLFA)为指标,研究了不同窖龄(5年、100年和300年)窖池窖泥、糟醅和黄水的微生物群落结构特征.结果表明:窖泥中总PLFA含量最高,糟醅次之,黄水最低.PLFA的组成因窖龄而异,黄水中总PLFA含量随窖池窖龄的增长而减小.窖泥中直链饱和脂肪酸含量最高,为PLFA总量的50.7%~73.9%,其中300年窖池窖泥最高.窖泥中表征革兰氏阳性(G<sup>+</sup>)厌氧细菌的PLFA含量较高,而糟醅和黄水中均以表征革兰氏阴性(G<sup>-</sup>)厌氧菌的PLFA含量较高.100年窖泥中表征G<sup>+</sup>菌、G<sup>-</sup>菌和厌氧菌的PLFA含量高于其他窖龄相应样品.5年窖泥、糟醅和黄水中真菌PLFA含量均高于其他窖龄相应样品.经主成分分析,5年窖和100年窖中主要变异菌群是G<sup>+</sup>菌和真菌,300年窖中主要变异菌群是细菌.描述窖池微生物群落特征的多样性指数可以选用PLFA的频次、Simpson优势度指数和Shannon多样性指数.

关键词: 磷脂脂肪酸 窖池 微生物群落

## Abstract:

Fermentation pit is a kind of solid bioreactors with unique feature for brewing liquor, especially for Luzhou-flavor, which has significant effects on the quality of produced liquor. There exists a close and complicated correlation between pit age (using time) and microbial community. Taking the characteristic component phospholipid fatty acid (PLFA) in microbial cell membrane as an index, this paper studied the characteristics of the microbial community structure in the pit mud, fermented grains, and yellow water of different age (5-year, 100-year, and 300-year) fermentation pits. The results showed that the total PLFA content was the highest in pit mud, followed by in fermented grains, and in yellow water. The composition of PLFA differed with pit age, and the total PLFA content in yellow water decreased with increasing pit age. In pit mud, straight chain saturated fatty acid had the highest content, occupying 50.7-73.3% of total PLFA and being the highest in 300-year pit. As for the microbial community structure, the PLFA content characterizing Gram-positive (G<sup>+</sup>) anaerobic bacteria was higher in pit mud, and that characterizing Gram-negative (G<sup>-</sup>) anaerobic bacteria was higher in fermented grains and yellow water. The PLFA content characterizing G<sup>+</sup> and G<sup>-</sup> bacteria in the pit mud of 100-year pit was higher than that in the pit mud of other ages' pits, while the PLFA content characterizing fungi was higher in the pit mud, fermented grains, and yellow water of 5-year pit, as compared with other ages' pits. Principal component analysis showed that the main varied microbial populations in 5- and 100-year pits were G<sup>-</sup> bacteria and fungi, and the main varied microbial population in 300-year pit was of bacteria. The indices frequency index, Simpson index, and Shannon index could be chosen for characterizing the diversity of microbial community in fermentation pits.

Key words: phospholipid fatty acid fermentation pit microbial community

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