

Evaluating the Sensory and Nutritional Properties of Wild Rice (*Zizania* Spp.)

Grown and Processed using three Different Methods

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Discussion

Recap:

- This study found significant differences in volatile composition, antioxidant capacity, and sensory properties for one or more wild rice samples across the three production systems.
- Overall, traditionally-processed, lake-grown rice exhibited the most distinctive set of characteristics.
- Commercially processed samples, whether paddy- or lake-grown tended to be more similar, though some chemical differences persisted.

Industry Relevance:

- Traditionally processed, lake-grown wild rice may offer nutritional and sensory advantages over commercially processed alternatives, including paddy-grown rice, which could potentially support a distinct market niche.
- Incorporating elements of traditional processing into commercial operations could potentially enhance product nutrition, strengthen sensory differentiation, and improve market access.
- Observed chemical differences between lake- and paddy-grown wild rice could provide a basis for geographic indicators or origin-based marketing tools provided validation across larger multi-year datasets.

References

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Introduction

- **North American wild rice (*Zizania* spp.)** is a semi-domesticated cereal traditionally consumed by many Indigenous groups as both a food and medicine.
- It is rich in **antioxidants** and has been linked to **anti-cancer and cardioprotective properties**.¹⁻³
- Wild rice contains more protein, and a more favorable essential amino acid profile compared to common cereals like rice, barley, and corn.⁴
- **Traditional wild rice agriculture** is highly sustainable, occurring in **natural lake ecosystems** with minimal inputs.
- In contrast, most modern wild rice production is intensive, using temporarily flooded paddy fields, fertilizers and pesticides, and is comparatively less sustainable.⁵
- These two production systems are also believed to produce distinct nutritional and sensory properties in the final grain.
- Determining if and how lake-grown rice can be distinguished from paddy-grown rice could help support geographic or production-based claims and protect sustainable wild rice agricultural practices.⁶

Objectives

1. To compare wild rice samples from different production systems in terms of their antioxidant and sensory properties.
2. To develop a volatile and non-volatile wild rice compound database linked to growing and processing conditions.
3. To identify chemical or sensory indicators to distinguish lake- and paddy-grown wild rice.

Methods

➤ Sampling:

Processed wild rice samples were obtained representing a range of production systems:

- Lake-grown, commercially processed (n=8, LC-1 to LC-8)
- Lake-grown, traditionally processed samples (n=2, LT-1 & LT-2).
- Paddy-grown, commercially processed (n=2, PC-1 & PC-2)

Five samples selected for full analysis based on initial

sensory and antioxidant screening, aiming to maximize contrast between samples.

Sensory Properties:

➤ Volatile Organic Compounds (VOCs):

VOC contents were extracted using a Carboxen SPME fiber (**Figure 1.**) (Supelco), then analyzed by GC-MS as previously described Ryland et al., (2024). Compound concentrations were calculated in reference to a 1,3-dichlorobenzene internal standard.

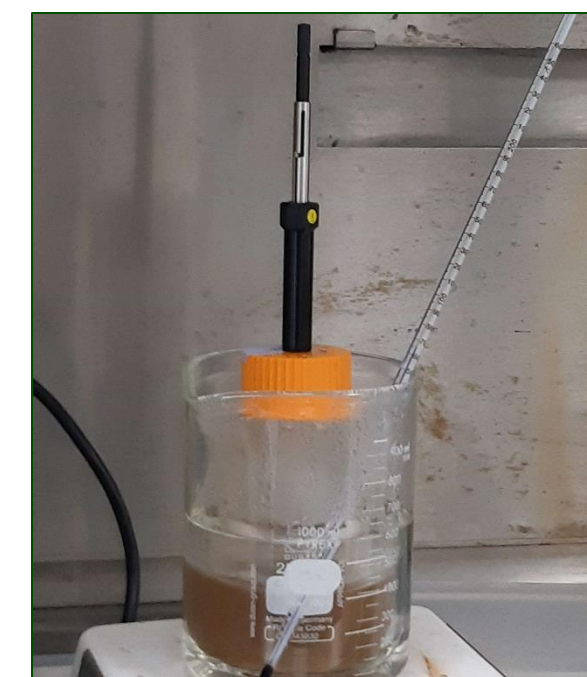


Figure 1. SPME fiber inserted into in heated wild rice sample

➤ Electronic nose (eNose):

eNose measurements were obtained from room temperature samples in headspace vials using an MSEM 160 eNose (Sensigent LLC.). Replicates were analyzed in random order across multiple days to control for sensor drift. Results were analyzed using CDanalysis software (Sensigent LLC) and model accuracy assessed by canonical discriminate analysis (CDA).

➤ Descriptive analysis:

Aroma, flavor and textural characteristics of cooked wild rice samples were developed by a panel consisting of 12-member over 8 group training sessions, followed by evaluation in 3 experimental sessions.

Nutritional properties:

➤ Oxygen radical absorbance capacity (ORAC):

Antioxidant activity was assessed fluorometrically based on Brescia, (2012) using fluorescein as the probe and AAPH as a radical source. Reactions took place on a 96-well microplate and reported as Trolox equivalents.

➤ Total Phenolic Contents (TPC):

Phenolic contents were determined based on Kalpoutzakis et al., (2023). Reactions took place on a 96-well microplate and reported as gallic acid equivalents.

➤ Statistical Analysis:

All analyses were conducted in triplicate or more. One-way analysis of variance (ANOVA) was conducted in Excel (Microsoft Corp.).

Results

Figure 2: eNose responses for wild rice production systems

eNose results:

- CDA model produced modest separation between classes (57.5% accuracy).
- LC samples collectively displayed the most unique eNose ‘fingerprint’.

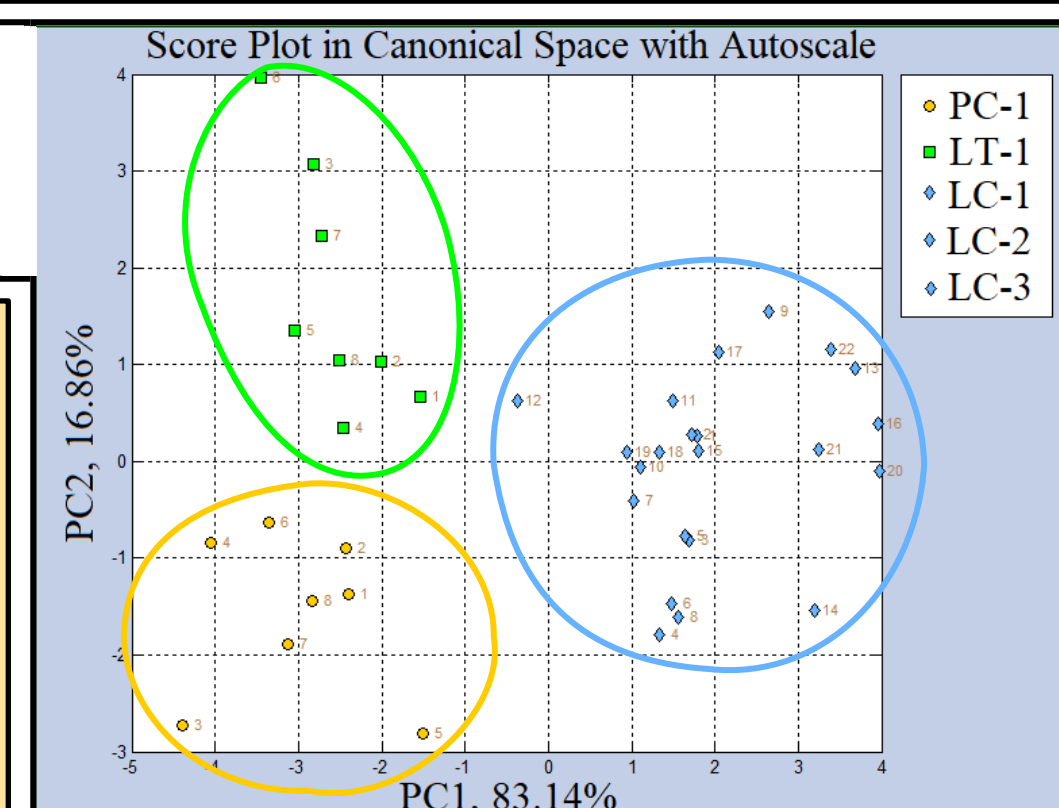
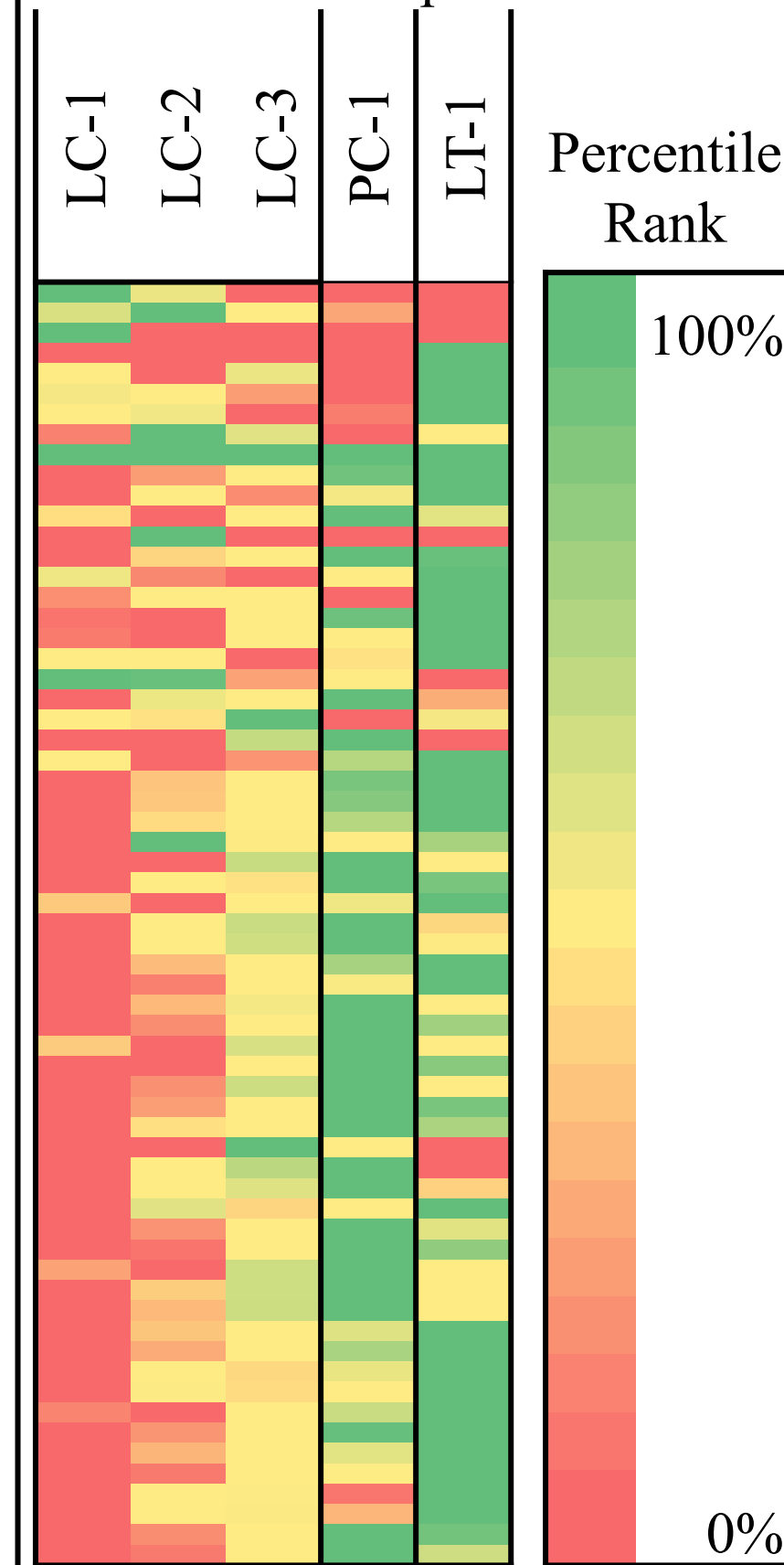


Figure 3: Heatmap of VOC in wild rice samples



VOC results:

- 50 unique VOCs were identified by fragmentation patterns and linear retention indices; 10 additional compounds were not identified.
- 44 compounds showed significant differences between one or more samples (p<0.05).
- Lake-grown, traditionally processed samples possessed the highest total VOC contents, and exhibited particularly high levels of several unidentified compounds.
- Paddy-grown samples had comparatively lower levels of aldehydes.

Descriptive analysis results:

- 13 descriptors showed significant differences between one or more samples (p<0.05).
- Traditionally processed lake rice produced the most unique set of sensory characteristics, particularly for texture.
- Some differences between lake-grown, commercial rice also noted such as LC-1 having particularly strong ‘brown rice-like aroma’, and low ‘sweet aroma’.

Figure 4: Wild rice sensory attributes

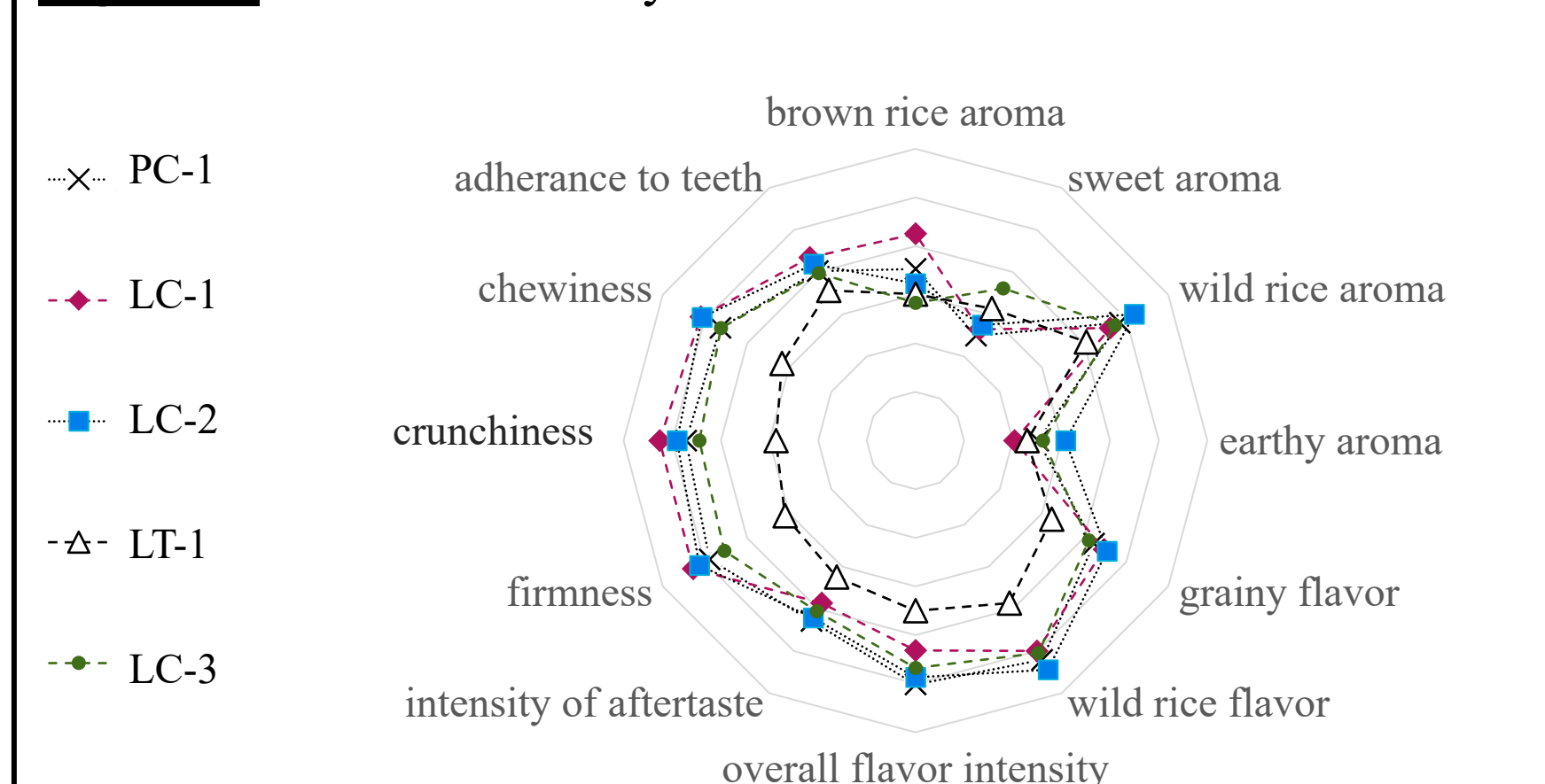


Table 1: Nutritional properties of wild rice samples

Assay	LC-1	LC-2	LC-3	PC-3	LT-1
ORAC (μM Trolox eq.)	12.2 (3.5) ^{ab}	11.7 (2.1) ^{ab}	12.4 (2.6) ^{ab}	9.1 (1.5) ^a	13.8 (4.0) ^{bc}
TPC (mg GAE)	5.2 (0.8) ^a	3.8 (0.6) ^a	4.0 (0.6) ^a	4.5 (0.5) ^a	10.3 (1.0) ^b

Antioxidant results:

- LT-1 rice possessed a greater overall antioxidant quenching capacity and higher phenol contents.
- Commercially processed samples whether paddy or lake-grown were largely indistinguishable from each other.