28th Workshop on the Developments in the Italian Ph.D research on Food Science, Technology and Biotechnology

Catania, 18-20 September 2024

Studying the effectiveness of modified atmosphere to improve the shelf life of table grapes using innovative taylor made IoT nanosensors

Elisabetta Poeta – elisabetta.poeta@unimore.it
Department of Life Sciences, University of Modena and Reggio Emilia, Via J.F. Kennedy, 17/i, 42124 Reggio Emilia, RE, Italy.
Tutor: Dr. **Veronica Sberveglieri**, Prof. **Andrea Pulvirenti**

Collaborations: **CNR-IBBR**, Institute of Biosciences and Bioresources / **CNR-ISPA**, Institute of Food Science and Production
NaNo Sensor Systems S.r.l – Spin-off of the University of Brescia (www.nasys.it)

1 Abstract

This work was partially supported by the Project "ON Foods—Research and Innovation Network on Food and Nutrition Sustainability, Safety, and Security—Working ON Foods" (Project code PE00000003). The study aims to investigate the optimal post-harvest storage conditions to preserve the freshness, quality, and nutritional value of table grapes, seeking an appropriate balance between CO_2 and O_2 concentrations.

2 Introduction

When it comes to organic table grapes maintaining quality during post-harvest handling can be quite challenging [1].
One of the most effective ways to extend their post-harvest life is through low-temperature storage, in particular with sulphur dioxide fumigation, however there are some drawbacks. Alternative techniques have been studied, focusing on modifying the concentrations of carbon dioxide and oxygen in the storage environment [2].

3 Methods

The study examined three storage atmospheres: **CA-1** (3% O_2, 10% CO_2), **CA-2** (3% O_2, 30% CO_2), and **CTRL** (20% O_2, 0% CO_2), with storage durations ranging from 10 to 40 days. **Fresh** samples were used as optimal reference points. The volatilome was analyzed using Gas Ghromatography-Mass Spectrometry (GC-MS) and a device equipped with metal oxide gas sensors (S3+) to analyze the volatile fingerprint (**Fig. 1**).

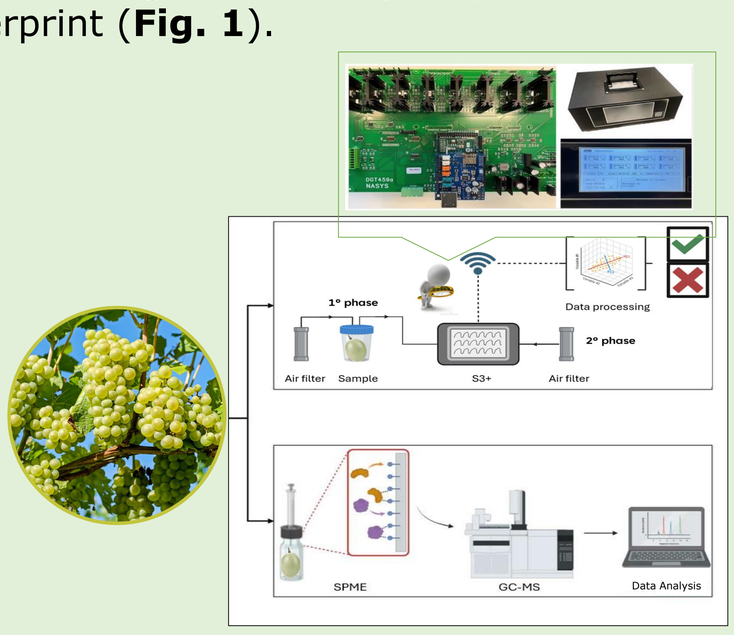
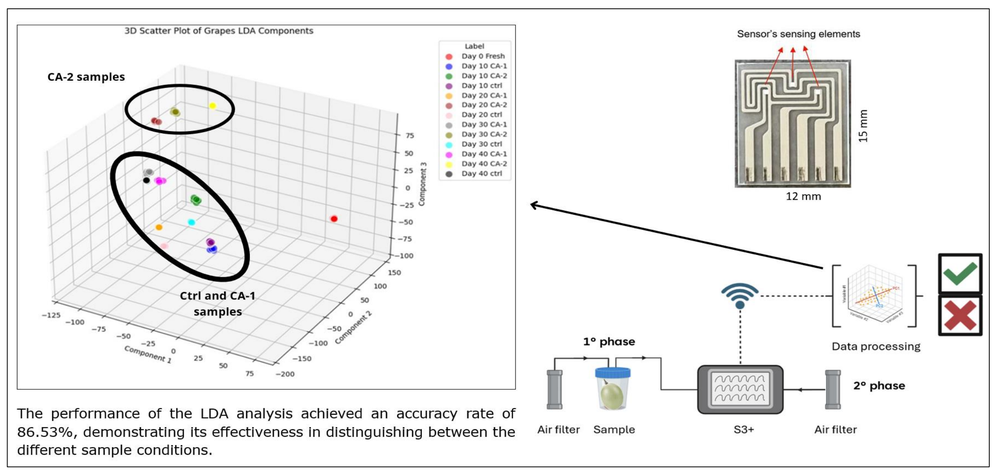


Fig. 1. Graphical representation of the techniques used.

4.1. Sensor results

The S3+ results enabled Linear Discriminant Analysis (LDA), revealing clear clustering based on volatile properties. CA-2 samples are separated in the upper left, while CTRL and CA-1 samples cluster centrally, showing similar yet distinct profiles. The red cluster represents distinctly separated fresh samples (**Fig. 2**).



The performance of the LDA analysis achieved an accuracy rate of 86.53%, demonstrating its effectiveness in distinguishing between the different sample conditions.

Fig. 2. 3D LDA graph carried out on table grapes samples stored under different atmospheres.

4.2. GC-MS results

- PCA aims to extract new components that explain as much variance as possible of the starting 18 variable (**Fig. 3**).
- 5 components have been extracted, accounting for **86.7921%** of the variability in the original data.

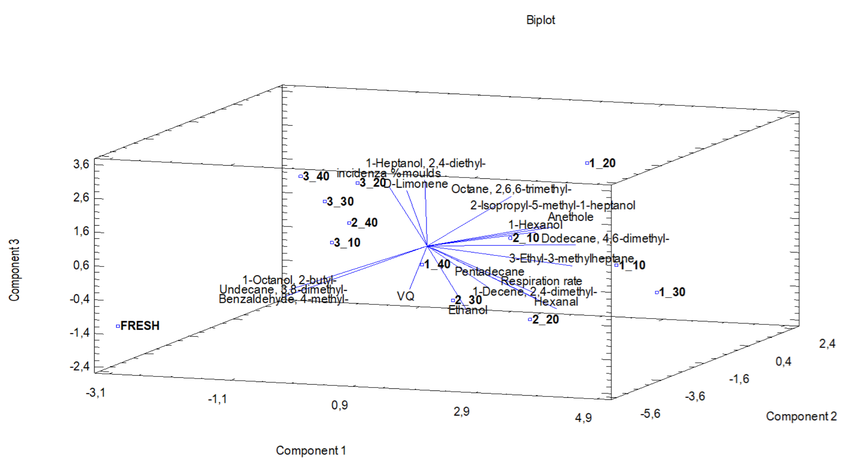


Fig. 3. 3D PCA graph carried out on table grapes samples stored under different atmospheres.

5 Conclusion

- High carbon dioxide levels (30%) induced fermentation leading to grape senescence.
- Lower carbon dioxide levels (10%) helped preserve positive aromatic compounds.
- CA-2 was the most stressful for the grapes, followed by the control and CA-1 conditions.

6 References

1)Zenoni, S.; Savoi, S.; Busatto, N.; Tornielli, G.B.; Costa, F. Molecular Regulation of Apple and Grape Ripening: Exploring Common and Distinct Transcriptional Aspects of Representative Climacteric and Non-Climacteric Fruits. J. Exp. Bot. 2023, 74, 6207–6223. DOI: 10.1093/jxb/erad123.
2)De Chiara, M.L.V.; Cefola, M.; Pace, B.; Palumbo, M.; Amodio, M.L.; Colelli, G. Ready-to-Use Broccoli Raab (Brassica rapa L. subsp. sylvestris) Quality and Volatilome as Affected by Packaging. Postharvest Biol. Technol. 2024, 213, 112961. DOI: 10.1016/j.postharvbio.2023.112961.