Contract no. 651PED/2022
Project code: PN-III-P2-2.1-PED-2021-1095

Wine fingerprint recognition based on spectroscopic methods and Artificial Intelligence (WineRec – AI)

Phase 3 summary: Realization of the final presentation form of the web application. Dissemination and promotion.

Implementation period: 01.01.2024 – 31.08.2024

1. Summary of the activities completed during the implementation period

In this stage, the most effective results obtained through the application of Raman and ^{1}H-NMR spectroscopies in conjunction with machine learning for developing efficient wine origin recognition models were analyzed in detail. In this regard, the significant markers that enabled the construction of robust prediction models, having very high accuracy scores (i.e. between 94% and 100% in cross-validation) were identified for each classification criterion (i.e. geographical origin, grape variety, production year). The spectral points determined to have a high discrimination power for wines were directly associated, in the case of 1H-NMR spectroscopy, with the presence of specific chemical compounds responsible for a certain differentiation, and in the case of Raman spectroscopy, with the characteristic vibrations of molecules present in the studied matrix. Additionally, based on the functionalities implemented in the developed web application, a user manual was drafted for the software solution in order to provide an immediate reference resource for potential users, containing clear and detailed instructions on all available functions. The web application was promoted through the Technological Transfer Center of INCDTIM, with a dedicated web page at: http://ro.itim-cj.ro/servicii/ctt-tehnologii/ctt-tehnologii-winerec-ai-solutie-software-pentru-controlul-autenticitatii-vinurilor/. Last but not least, a patent application (OSIM registration no. A00131/25.03.2024) was written and submitted to OSIM for the procedure underlying the development and use of the prediction models available within the application.

The results obtained in this stage of the project were disseminated as follows:

1. **1 ISI article** published in the *Food Chemistry* journal, which is in the first quartile (Q1) according to Web of Science
2. **1 presentation** at an international conference
3. **1 invited lecture**

2. Progress summary

	Planned Deliverables/Indicators	No.	Achieved Deliverables/Indicators	No.
1.	**Presentation at international conferences**	**1**	**Presentation at international conferences**	**1**
2.	**Web application user manual**	**1**	**Web application user manual**	**1**
3.	**Patent application**	**1**	**Patent application**	**1**
4.	**Published ISI article**	**0**	**Published ISI article**	**1**
5.	**Invited lecture**	**0**	**Invited lecture**	**1**

The dissemination of results is presented in detail as follows:

I. Publication of one article in first quartile journal (Q1 – Web of Science)

1. Hategan, A. R., David, M., Pirnau, A., Cozar, B., Cinta-Pinzaru, S., Guyon, F., & Magdas, D. A. (2024). Fusing ^{1}H NMR and Raman experimental data for the improvement of wine recognition models. *Food Chemistry*, 140245. https://doi.org/10.1016/j.foodchem.2024.140245

II. Participation at an international conference

1. Magdas, D. A., Hategan, A. R., David, M., Pirnau, A. The development of wine authentication tools through a new approach based on ^{1}H-NMR and Raman data fusion and Machine Learning. 12th International Conference Agriculture & Food, 12-15 August 2024, Burgas, Bulgaria.

III. Invited lecture

1. Magdas, D. A., Hategan, A. R., David, M., Berghian-Grosan, C. Green analytical techniques in association with Artificial Intelligence for subtle food frauds detection. International Bio-Inspiration N.I.C.E. Summer Event, 19-21 June 2024, Nice, France. The conference is endorsed by CNRS and IUPAC.

Project Director,
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