

New methodologies to prevent fraud in the determination of geographical origin of hazelnuts

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Food fraud concerning the geographical origin of hazelnuts intended for consumption is a problem that damages the agri-food sector and

generates economic losses and consumer distrust.

With a world production of around 590,000 metric tons per year, prices vary greatly according to [origin](#), and fraud is particularly detrimental to local products with a protected designation or geographical indication (PDO and PGI).

There is still no official analytical methodology to authenticate the origin of hazelnuts, and official controls—based on documentary traceability—are insufficient to prevent fraud.

Now research carried out as part of the TRACENUTS project led by Professor Stefania Vichi, from the Faculty of Pharmacy and Food Sciences and the Institute for Research in Nutrition and Food Safety of the University of Barcelona (INSA), reveals new methodologies to guarantee the origin of hazelnuts and thus avoid commercial fraud and food safety problems arising from the lack of traceability of the food.

In a [paper](#) published in the journal *Food Chemistry*, they present the promising results of a methodology based on the use of multiple isotopic markers.

This study pioneered the application of isotopic analysis—one of the most recognized tools for verifying the geographical origin of foods—to authenticate the geographical origin of hazelnuts.

In a [previous study](#), also published in *Food Chemistry*, from the same project, the team had also developed omics methods based on the evaluation of metabolic profiles to authenticate, with high efficiency, both the origin and the variety of hazelnuts.

Multidisciplinary teams from the Faculty of Pharmacy and Food Sciences, the Torribera Food Campus, INSA, the Faculty of Earth

Sciences, the UB Institute of Water Research (IdRA), and the Institute of Food Research and Technology (IRTA) are involved in this research.

Isotopic markers to determine the geographical origin of hazelnuts

The isotopic composition of food is highly influenced by geographical factors such as the geology of the ground, hydrology and the agricultural practices applied on the growing soil. However, analyzing a single isotopic marker may be insufficient to authenticate the geographical origin of an agri-food product.

"The main difficulty in geographical authentication is the complexity of agri-food systems and the factors that can influence the composition of the food, in addition to environmental factors.

"The advantage of certain isotopic markers, unlike other methodologies, is that they can be directly related to environmental and geological factors, without being influenced by other factors such as variety or storage conditions," says Professor Mònica Rosell, from the TECNIO MAiMA—Stable Isotopes and Mineralogy research group at the UB's Faculty of Earth Sciences and the IdRA.

Apart from the high resolution, one of the other milestones of the multi-isotopic approach presented by the study is the great ability to explore the potential of several isotopic markers—and identify the most promising ones—to authenticate the geographical origin of hazelnuts.

"This allows complementary information to be obtained, when identifying the most suitable isotopic markers to authenticate the origin of hazelnuts, which can be applied and tested on large sets of samples to maximize the efficiency of the analysis.

"The new method discards markers that do not help to better distinguish, which saves unnecessary costs eventually and improves the prediction results and the efficiency of the authentication method," explains pre-doctoral researcher Berta Torres, first author of the study and member of the Faculty of Pharmacy and Food Sciences and INSA.

This simple methodology with minimal sample treatment would be easily transferable and applicable to control and routine laboratories. Thus, it could be evaluated as a tool to support control bodies in facilitating more controls by means of a robust and reliable analytical method.

Metabolic profiling to determine the origin and variety of the product

In the earlier study in *Food Chemistry* the research is based on a set of [hazelnut](#) secondary lipid metabolites contained in the named unsaponifiable fraction. "With a single analysis, the technique makes it possible to authenticate both the origin and the variety of the samples.

"So far, there is no study that proposes a methodology to authenticate both factors in a single analysis. This methodology has been developed in a challenging scenario in which it is possible to discriminate both the origin between samples of the same botanical variety and the variety between samples of the same origin," stresses Professor Alba Tres, from the Faculty of Pharmacy and Food Sciences and INSA.

In the study, more than 170 samples from three different origins, covering two crop years and several cultivars, were used. The findings reveal that the model is able to provide an efficient response despite the natural variability of the product.

"This positions our analytical strategy as a suitable option to verify

doubtful samples and to support rapid screening tools," concludes Professor Vichi.

Both methodologies described in these scientific publications are compatible and complementary, and could be used together to improve sample identification. On the one hand, the multi-isotopic approach evaluated in this study is an easily transferable method, as it is based on the analysis of specific and internationally standardized isotopic markers and can be reproducibly applied in routine controls and analyses in other laboratories.

At the same time, fingerprinting of the unsaponifiable fraction has a higher classification efficiency, making it a suitable method to verify challenging or doubtful samples and to support rapid screening tools.

In this line of research, and in the framework of the TRACENUTS project, the team will promote new lines of research on the methodologies presented in these two articles, to apply them to larger sample sets and with more natural variability, as well as for hazelnuts belonging to specific PDOs.

Furthermore, the stability of the markers in the authentication of processed hazelnuts is being evaluated, which allows determining the suitability of these methods for the authentication not only of raw hazelnuts, but also for a wide range of derived products.

In addition, the results also open the door to exploring similar strategies for other types of nuts.

More information: B. Torres-Cobos et al, Investigating isotopic markers for hazelnut geographical authentication: Promising variables and potential applications, *Food Chemistry* (2024). [DOI: 10.1016/j.foodchem.2024.139083](https://doi.org/10.1016/j.foodchem.2024.139083)

B. Torres-Cobos et al, Prospective exploration of hazelnut's unsaponifiable fraction for geographical and varietal authentication: A comparative study of advanced fingerprinting and untargeted profiling techniques, *Food Chemistry* (2024). DOI: [10.1016/j.foodchem.2023.138294](https://doi.org/10.1016/j.foodchem.2023.138294)

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