



Fingerprinting of unsaponifiable fraction for pistachio geographical authentication

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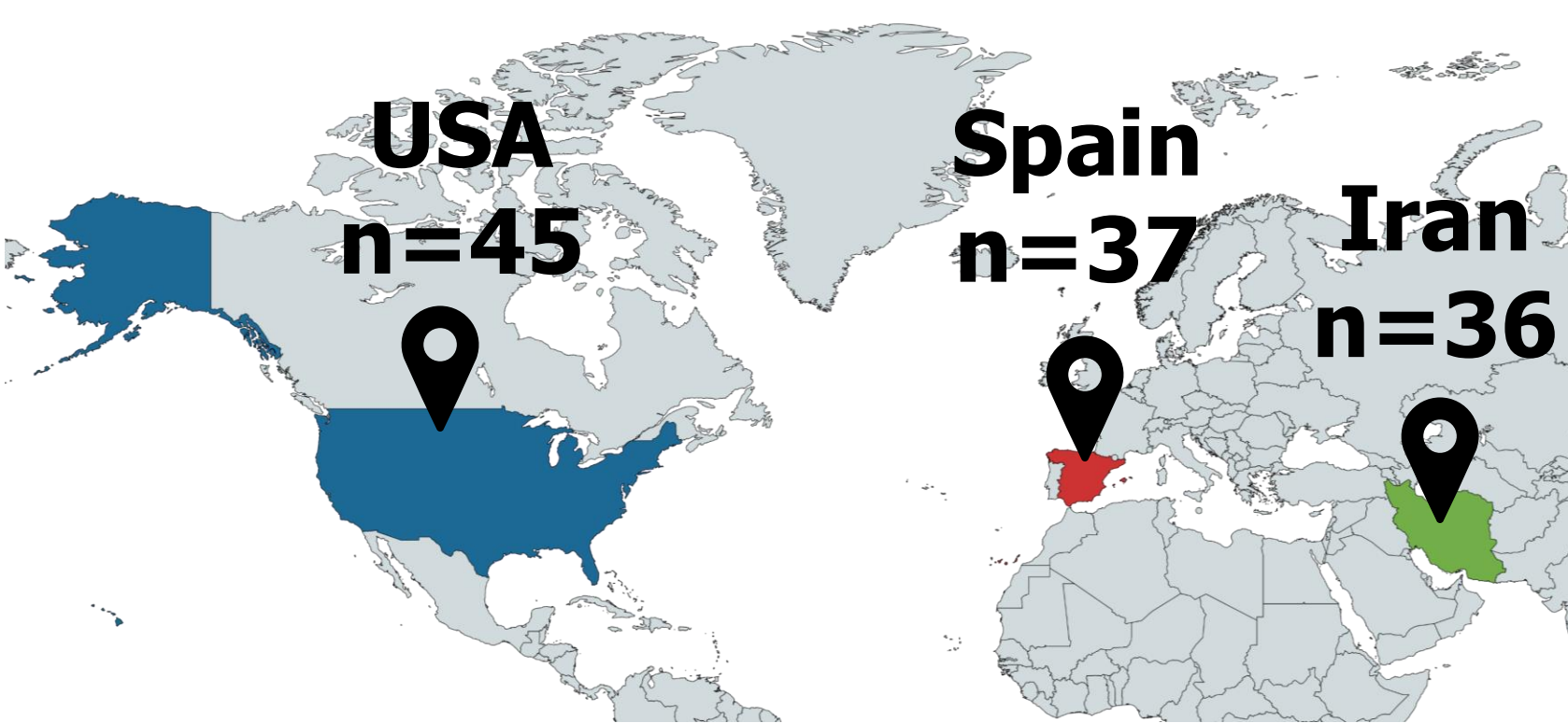
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BACKGROUND

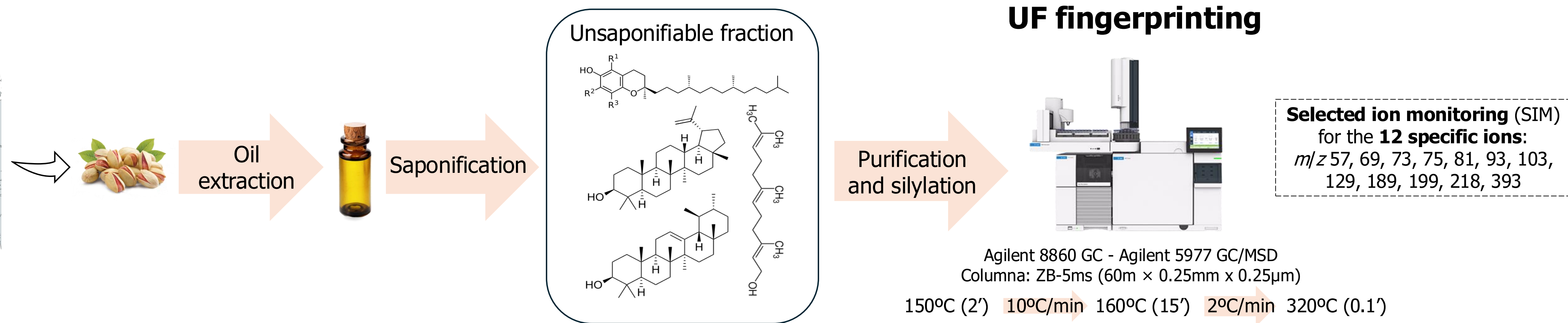
- The genus *Pistacia* (*Anacardiaceae* family) includes several species, but only *Pistacia vera* L. produces edible seeds, pistachios, widely used worldwide in various culinary applications as well as in the food industry.
- Pistachio production has increased** significantly in recent decades, leading to **significant differences** in the quality and price of these nuts **depending on their geographical origin**, increasing the risk of economically motivated **food fraud**¹.
- There is an increasing need to develop robust analytical methodologies for accurately verifying the geographical origin of pistachios.
- Previous literature has demonstrated that **fingerprinting of the unsaponifiable** fraction combined with chemometric techniques is a **reliable methodology** for geographical authentication of other nuts².

The **OBJECTIVE** of this preliminary study is to evaluate whether **fingerprinting** of the **unsaponifiable fraction** combined with **PLS-DA** could serve as an effective tool for verifying the geographical origin of pistachios.

1 SAMPLING



2 ANALYTICAL METHOD



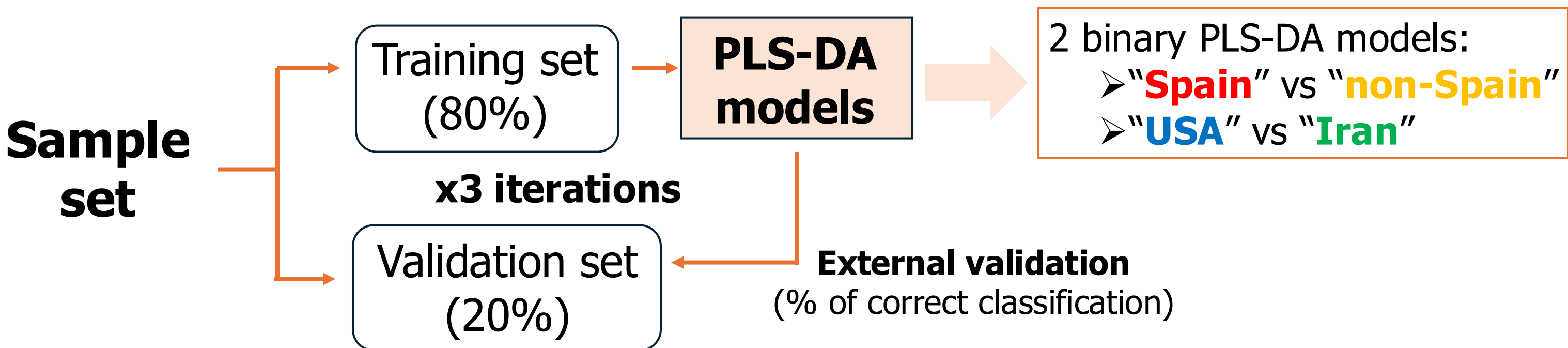
MATERIALS AND METHODS

3 PREPROCESSING

- Extracted Ion Chromatograms (EICs) of each ion were **normalized** and **aligned** among them using the algorithm Correlation Optimized Warping (COW)³ on Matlab®.
- The **twelve** aligned matrices were concatenated conforming a **two-way unfolded matrix**
- The matrix was imported to **SIMCA v13.0**® with **scaling** applied for data **preprocessing**.

4 CHEMOMETRICS

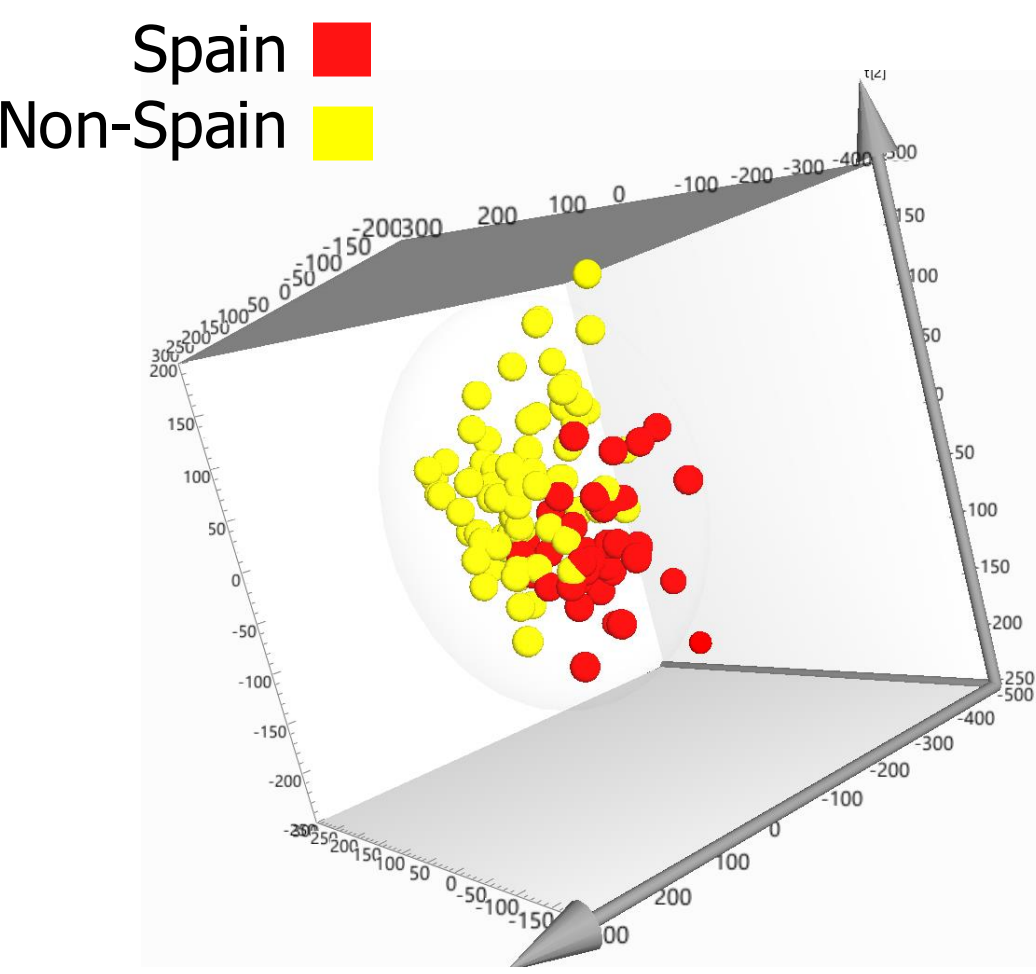
PLS-DA training models were developed and optimized according to the cross-validation (leave 10%-out) results, N° of latent variables (LV), RMSEcv and Q².



The **regression coefficients** of PLS-DA were evaluated in order to **tentatively identify the compounds** that **characterize** each **origin** of pistachios and discriminate it from others.

RESULTS

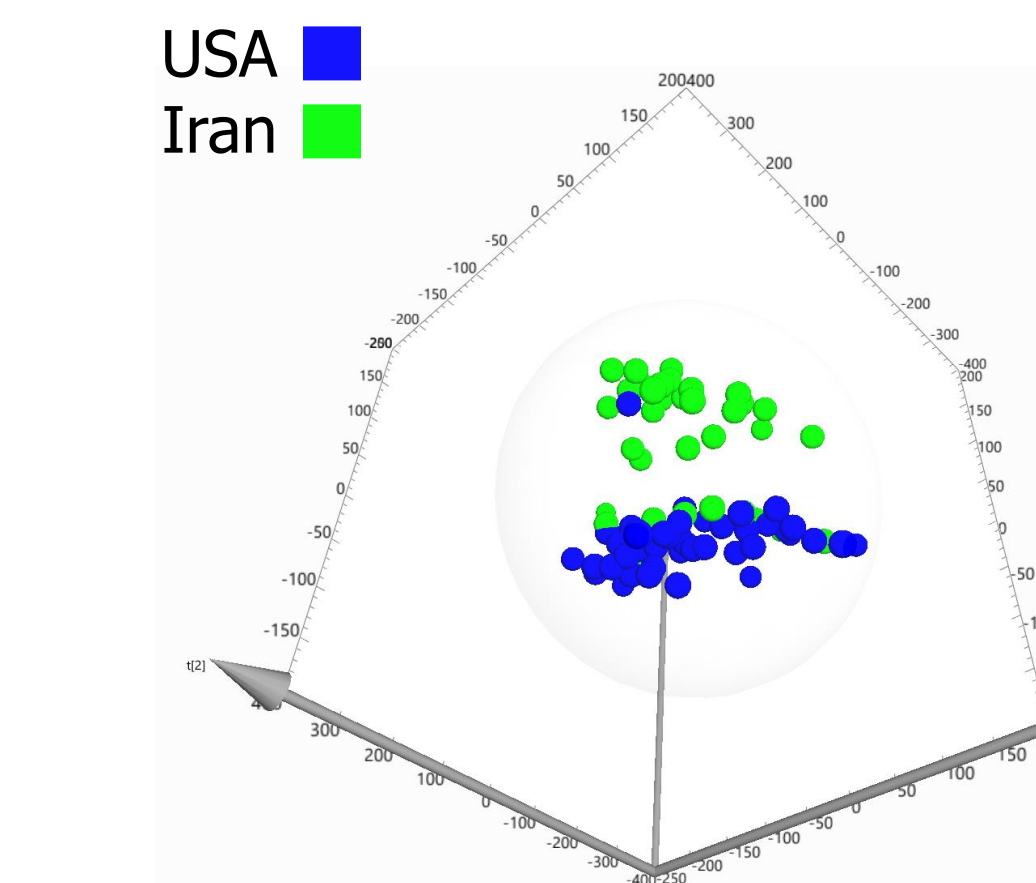
"Spain" vs "non-Spain" model



External validation	n	Correct classification (%)
Spain	7	90.5±4.1
Non-Spain	16	96.9±0.0
Total	23	94.9±1.3

Model parameters: 5 LV, Q²=0.35±0.02, RMSEcv=0.39±0.02

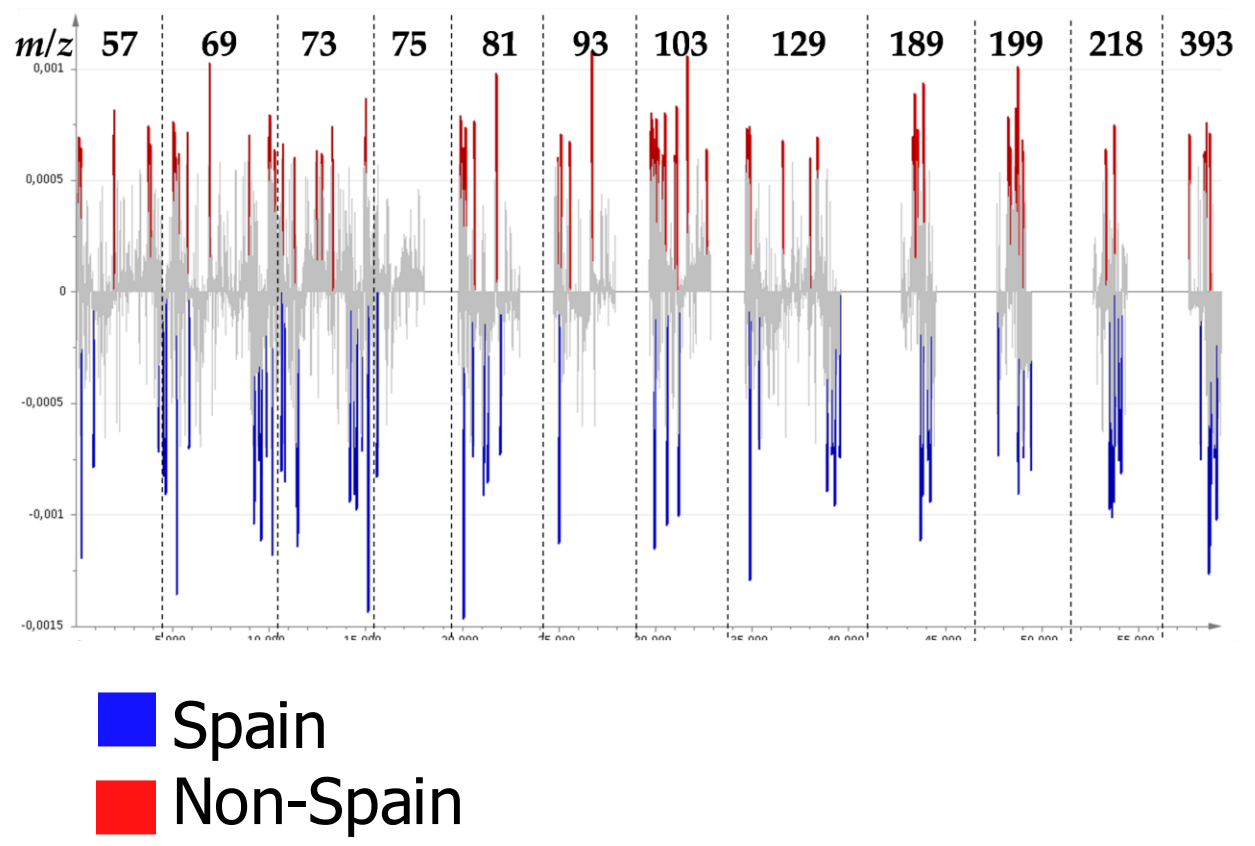
"USA" vs "Iran" model



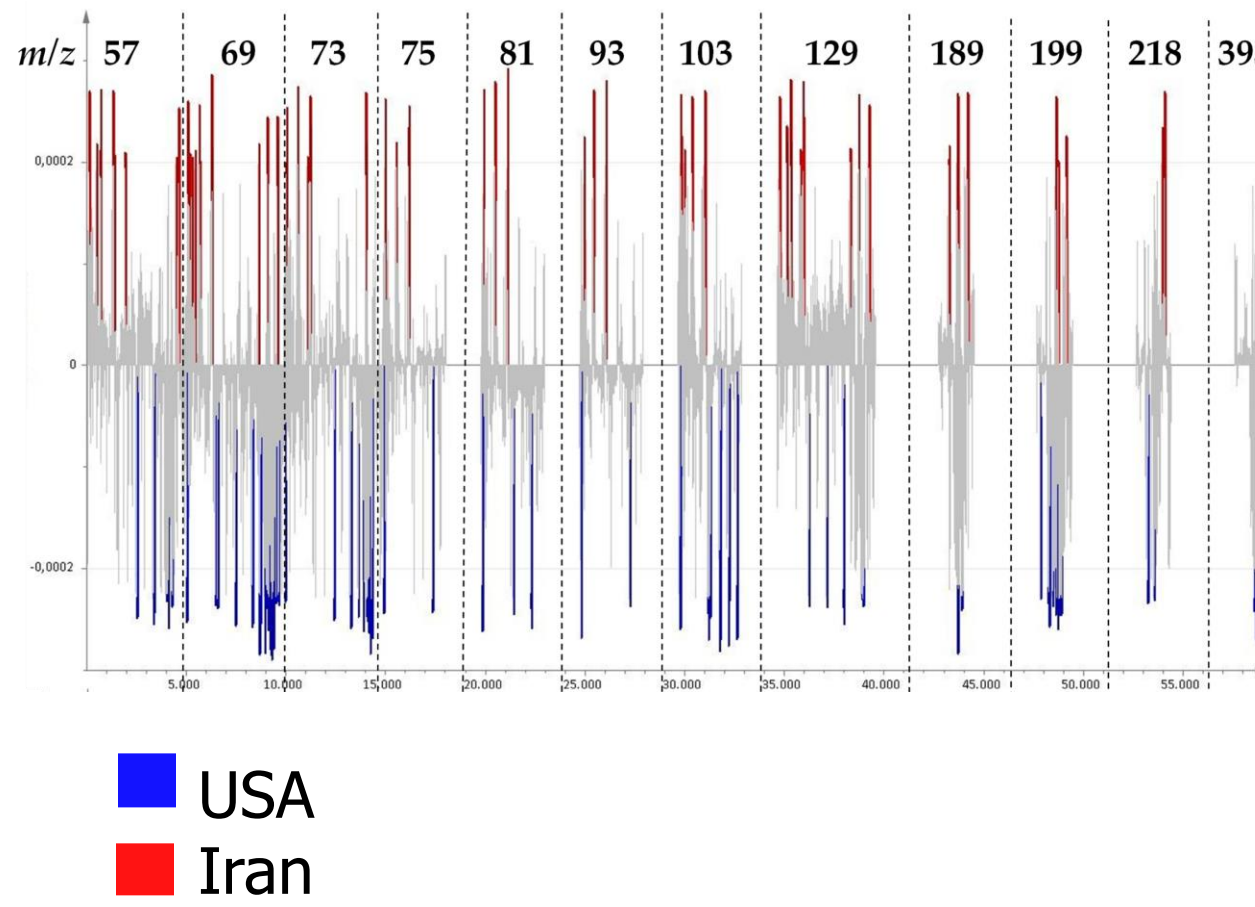
External validation	n	Correct classification (%)
USA	9	97.1±2.9
Iran	7	73.6±2.0
Total	16	86.5±1.8

Model parameters: 3 LV, Q²=0.36±0.02, RMSEcv=0.41±0.01

REGRESSION COEFFICIENTS



- Relevant coefficients were spread across all ions.
- Significant coefficients often matched minor or unresolved compounds.
- Some of the main chemical families were specific of a single class.



- Most discriminant **chemical families**:
- Fatty acids
 - Terpenic alcohols
 - Alkylphenols
 - Linear alcohols
 - Sterols
 - 4-methylsterols
 - 4,4-dimethylsterols

In **CONCLUSION**, the **fingerprinting** of the **unsaponifiable fraction** obtained through GC-MS **proved to be a promising tool for the geographical authentication of pistachio**. The application of the chemometric approach allowed the discrimination among the three different geographical origins.

FUNDING

This work is part of the LOCALPISTACHIO project (CNS2023-145490) funded by MICIU/AEI /10.13039/501100011033 and by the European Union NextGenerationEU/PRTR. The Institut de Recerca en Nutrició i Seguretat Alimentària (INSA-UB) is recognised as a Maria de Maeztu Unit of Excellence (grant CEX2021-001234-M) funded by MICIU/AEI /10.13039/501100011033.

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