



# Determination of Protected Designation of Origin (PDO) Peruvian Pisco spirits by portable FT-IR, Raman, and UV spectroscopy and multivariate data analysis

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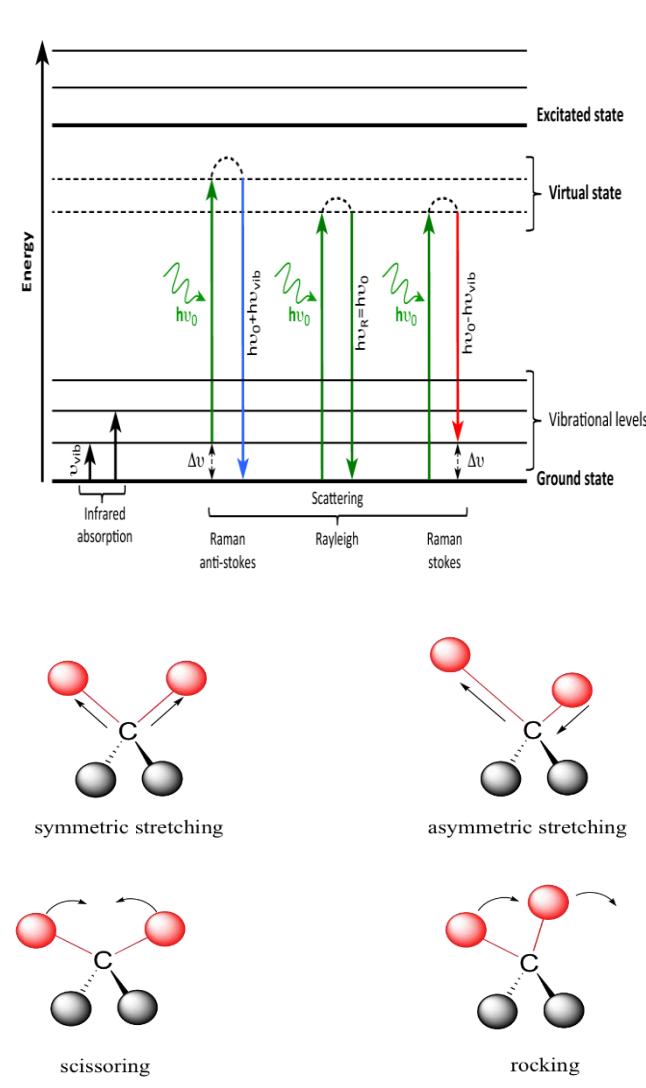
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## Abstract

Pisco is the most consumed distillate drink in Peru obtained by batch distillation from different varieties of Muscat grapes, being considered a high-quality product of economical importance for the region. Pisco is an alcoholic spirits from the distillation of the fermented grape musts. Grape varieties are classified into non-aromatic (Quebranta, Mollar, Negra Criolla, Uvina) and aromatic (Italia, Torontel, Albilla). There is a need for rapid analytical tools for monitoring PDO of Pisco spirits and help to control adulteration. Our aim was to evaluate rapid methodologies based on vibrational (Raman and FTIR) and UV spectroscopy for determination of POD based on grape variety used for Pisco elaboration. Pisco elaborated from pure aromatic (Italia (n=14) and Torontel (n=11)) and non-aromatic Quebranta (n=23) varieties were kindly provided by the Universidad Nacional Agraria (Lima, Perú) and purchased from various Peruvian markets. Aliquots (2 ml) of Pisco samples were either placed in a Quartz cuvette for direct UV transmittance (200-400nm) and Raman spectral measurements or evaporated to dryness under vacuum for FTIR analysis by attenuated total reflectance using a 3-reflection ZnSe crystal. Pattern recognition analysis by Soft Independent Modeling of Class Analogies (SIMCA) was used to classify Pisco samples. Spectra were able to accurately discriminate aromatic from non-aromatic varieties. UV (200-250 nm) and Raman (850-1000 cm<sup>-1</sup>) allowed accurate discrimination based on grape varieties, however, UV provided tighter clustering and superior model performance compared to Raman. Portable FTIR (1200-1550 cm<sup>-1</sup>) also formed distinct clusters allowing the evaluation of aromatic and non-aromatic Pisco varieties, however it resulted in a more time-consuming process. FT-IR and UV-Vis spectroscopy combined with multivariate techniques showed potential as a rapid quality assurance tool for identifying grape variety used in Pisco manufacturing and monitoring adulteration with methanol.

## Introduction

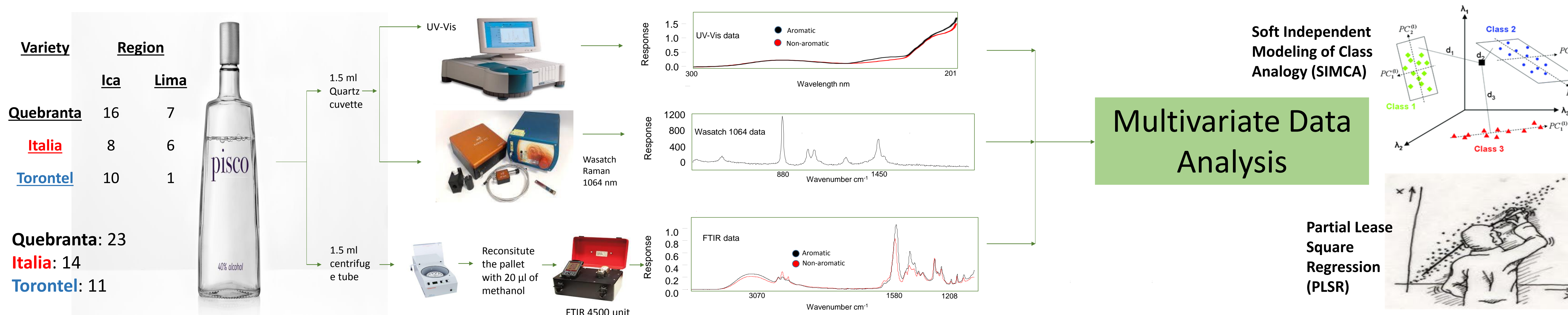


- Pisco is a alcoholic beverage that obtain from fermentation of different grapes grown in Peruvian coasts. Italia and Torontel grape varieties are used to obtain aromatic Pisco, Quebranta as non-aromatic variety is considered as the highest production in Peru. Pisco has economic importance for the region since the exportation is increased significantly in recent years (1).
- Pisco is regulated by Comission de Reglamentos Technocos y Comerciales- INDECOPI. They also regulates the presence of hazardous materials, impurities, and dangarous compunds for the consumers. Besides, Protected Designation of Origin (PDO) defines the grape varieties to obtain Pisco as well as their procedure (2, 3).
- Vibrational spectroscopy are rapid tools to determine authentication of foods, offering a simply, very sensitive and also robust method to detect the adulteration and contaminants based on spectra combination with pattern recognition techniques. Portable FT-IR and Raman spectroscopy are new equipments that help to provide spectra in real-time assessments (4). They have been used for authentication of fruit juices, honey, potato chips, flours, and etc. Moreover, UV-Visible spectroscopy is a tool to determine the adulteration in foods and beverages (5).

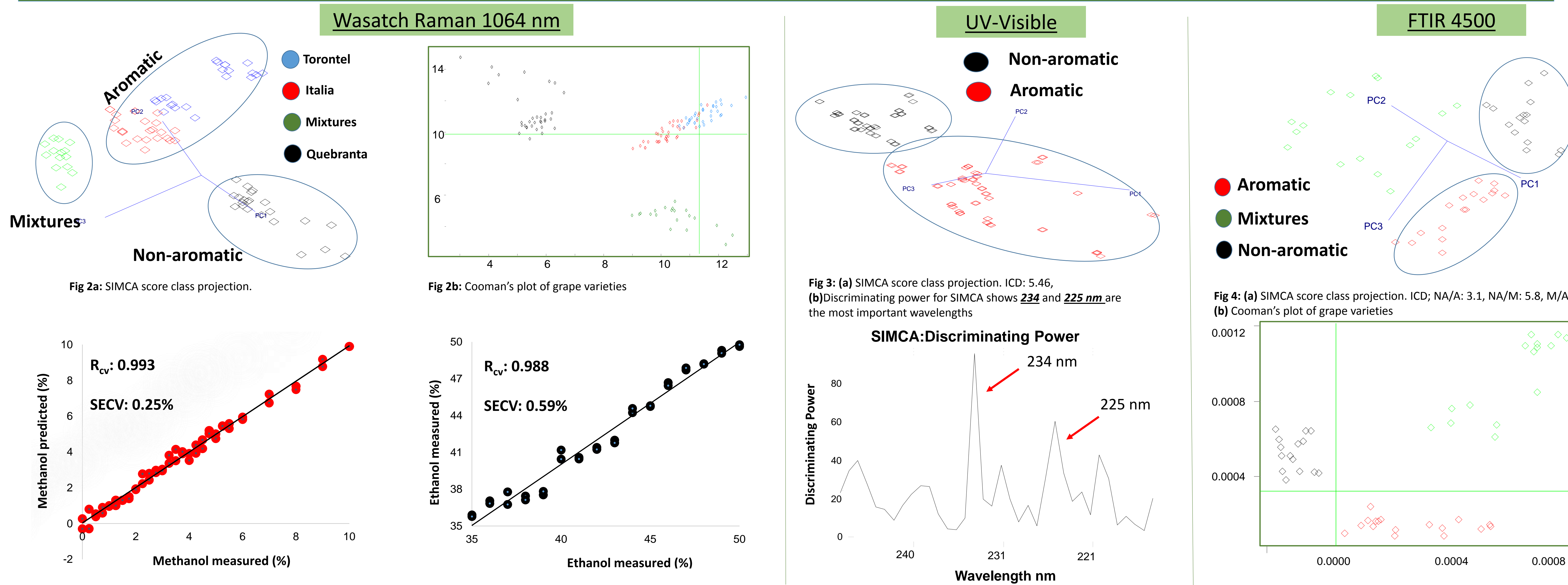
## Objective

- To study the utilization of portable FT-IR, and Raman equipments and UV-Vis as a classification tool for grape variety
- To develop a regression model to predict ethanol and methanol content in Pisco samples

## Materials and methods



## Results



## Conclusions

- Both FTIR and UV-Vis combined with SIMCA allowed to classify aromatic and non-aromatic Pisco varieties.
- UV-Vis spectra provided better cluster with ICD > 3.6, and UV-Vis seems to be more convenient because no sample prep was needed.
- Wasatch Raman 1064 nm spectra combined with PLSR showed very good correlation with methanol and ethanol contents. It also provided the discrimination of aromatic varieties.
- Future studies are required to improve collecting spectra from Wasatch Raman 1064 and FTIR 4500. Surface enhanced raman spectroscopy (SERS) may allow to improve spectra quality.

## Acknowledgments

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## References

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