Stage II/2019

Objective: Investigation of voltammetric “electronic tongue” (ET) sensor devices coupled with multivariate analysis as innovative screening strategy for the rapid fingerprinting and classification of authentic wines based on their tasting fingerprints

Activiteis:
2. Exploring the capabilities of polypyrrole modified electrochemical sensors in combination with multivariate statistical analysis for wine authentication purpose
   - Development of voltammetric sensors based on carbon screen printed electrodes modified with polypyrrole doped with different doping agents (polypirrole, potassium hexacyanoferrate (III), FCN; sulfuric acid, sodium decansulphonate, DSA)
   - rapid imprinting and classification of white and red wines according to the grape variety and the year of production.
   - Development of an "electronic language" type device made of screen-printed electrodes (SPE) modified with different electroactive materials (in particular, carbon nanotubes: SWCNT and MWCNT) commercially available.
   - Voltammetric signals represent the input variables for the multivariate statistical analysis based on which differentiation of white wines was made according to variety and their age
   - The proposed systems for "electronic language" were used individually for the analysis of white wines, of different ages.
4. Evaluation of total phenolic compounds in white and red wines using a multicomponent enzyme sensor based on carbon scree printed electrodes (SPCE) modified with cobalt phthalocyanine (II) as electron mediator and tyrosinase as biocatalyst
   - Biosenzor development
   - Measurement of total polyphenols in red and white wines using the proposed biosensor
   - Correlation between the electrochemical and spectrophotometric determinations for the estimation of total polyphenols in wines.
5. Addressing wine authenticity using biochemical properties and chemometrics
   - Determination of red and white wines bioactive properties (total polyphenolic content – TP, total flavonoids content – TF and antioxidant capacity – AC) by quantitative UV-Vis spectrophotometric methods
   - Correlation between red and white wines bioactive properties
   - Discrimination between different red and white wines by varieties and harvest year
6. UHPLC-MSMS fingerprinting of wine characteristic compounds profiles combined with multivariate analysis for wine authentication approaches

- UHPLC-MS and UHPLC-MS/MS fingerprint of different white and red wines
- Exploring the capabilities of screening UHPLC-MS in combination with multivariate statistical analysis for the discrimination of different red and white wines.
- Target UHPLC-MS/MS analysis of phenolic compounds coupled with multivariate statistical analysis for wine authentication.

Conclusions:

- Cyclic voltammetry applied to screen-printed sensors modified with different materials (poly-pyrrole doped with DSA, SWCNT, MWCNT) and statistical analysis of data (PCA, LDA) represent promising methodologies for the rapid authentication of wines depending on the variety and age.
- The use of DSA-doped Poly-pyrrol modified screen printed electrodes ensures the differentiation of old wines (older than 5 years) from young ones, suggesting that the electrochemical fingerprint of the wines is closely related to the aging processes that take place in aging wines.
- The "electronic language" based on the use of screen-printed sensors modified with SWCNT and MWCNT allowed the differentiation of white and red wines depending on the variety.
- One drawback to the application of the methodologies based on electrochemical techniques for measuring and authenticating a large number of wine samples is the difficulty of automating the stage of handling the samples, being obligatory the operator's presence.
- Quantitative UV-Vis spectrophotometric methods for estimating the bioactive characteristics of wines can be used for the wine authentication process, such measurements being easy to perform in most laboratories for quality control of food products.
- Despite the good ability to discriminate between different categories of wines, the UHPLC-MS/MS technique-based approach requires costly tools and specialized personnel to use and process spectral data, being used in the process of authenticating wines in prestigious laboratories.