Evaluation of the antioxidant capacity of wines using electroanalytical and spectrophotometric techniques.

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Abstract

Phenolic compounds identification in wines have been performed by high pressure liquid chromatography with electrochemical detection using a flow cell with a glassy carbon electrode This methodology, in gradient elution mode was successfully used to identify the presence of phenolic compounds in red and white wines. The total antioxidant activity of the wines, using the electrochemical quantitative index (EI), and the method of capture of diphenilpicrilhydrazil (DPPH•) free radical "efficient concentration" (EC_{50}), was evaluated. A very good correlation between EI and EC_{50} assays has been obtained.

Introduction

The oxidation of flavonoids is of great relevance, since they act as antioxidants with the ability to scavenge radicals by an electron transfer process. Electroanalysis, since it only detects the redox active compounds present, is an important methodology to detect flavonoids and evaluate their antioxidant capacity in wines. Differential pulse (DP) voltammetry is a simple and sensitive technique that has the ability to provide relevant information even when used for coloured and turbid samples, and for these reasons the electrochemical detection is an alternative to traditional spectrophotometric methods. The limits of detection and quantification of flavonoids were significantly lowered using the electrochemical (EC) detector because only the redox active compounds in the sample are detected, so the selectivity is increased. Therefore the presence of voltammetric signals at low anodic potentials indicated the presence of polyphenolic compounds of high antioxidant capacity, while oxidation at high potentials denotes polyphenolic compounds of low antioxidant activity. The electrochemical index (EI) is defined as the total phenolics concentration. The EI is obtained using electrochemical techniques. Different spectrophotometric methods have been used for the determination of the total antioxidant activity of phenolics, including different compounds, such as DPPH• (1,1-diphenyl-2-picrylhydrazine), ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) and DMPD (*N*,*N*-dimethyl-*p*-phenylendiamine). The DPPH• free radical scavenging assay involves a stable and commercially available radical, is easy to perform, and leads to highly reproducible and accurate results. The decrease in absorbance is monitored at λ = 516 nm and the DPPH• scavenging radical efficiency is calculated The total antioxidant activity is expressed as "efficient concentration" or EC_{50}, representing the amount of extract to produce 50% of decolourization of DPPH• relative to the methanol blank control. The present work focuses on the investigation of the antioxidant capacity in different Portuguese red and white wines.

Results and Discussion

The amount of antioxidant necessary to decrease the absorbance of DPPH• by 50% of the initial absorbance, "efficient concentration" or EC_{50}, as well as antiradical power, ARP = $1/EC_{50}$, in order to evaluate the total antioxidant capacity of the different wines was determined. The lowest EC_{50}, corresponding to highest ARP value. In this work, much higher EC_{50} values were obtained for some red wines compared with the phenolics standard. A good correlation with the results obtained from DP voltammetry was achieved, since the EC_{50} and EI are inversely proportional. In the same phenolic group, the compound with the lowest EC_{50} exhibited the highest EI, showing the accuracy of both methods for the total antioxidant capacity evaluation.

Conclusions

The electrochemical detection allowed the determination of much lower concentrations of the analyte and without interferences. These results showed the excellent sensitivity of electrochemical detection and its suitability for the detection of low levels of electroactive phenolic compounds in white and red wines.

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