

New Express Technique for Determination of Antioxidant Activity of Humic Substances

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1. INTRODUCTION

Interest of analytical chemists to humic substances (HS) is instantly growing. First of all, it is connected to the current trend in agriculture directed toward application of organic and organic-mineral fertilizers and necessity in the corresponding quality control techniques. Another reason is that humic substances bind toxicants and cause disturbing impact on their determination in air, water, and soil. This research is devoted to a use of amperometric technique for determination of humic and fulvic acid. These natural compounds contain phenolic units that makes feasible amperometric detection.

2. MATERIALS AND METHODS

Standards. Quercetin (pure for analysis) was purchased from Fluka. Humic materials: three IHSS standard samples of humic materials from Suwannee River were used including fulvic acid (SR-FA), humic acid (SR-HA), and dissolved organic matter (SR-DOM). Commercial humate was potassium humate (PowHumus) produced from Leonardite by Humintech Ltd (Germany). Peat sample was obtained from Likhoslavl (Russia) and extracted with distilled water using volume ratio of 1:5.

Amperometric analysis. Amperometric detection (AD) is based on measuring electrical current produced by oxidation of analyzed compound on the surface of working electrode upon applying the certain electrode potential. Working electrode used was made of glassy carbon, which is the most universal electrode for determination of polyphenolic compounds. Electrode potential varied from 0 to 2 V. The signal was registered in the form of differential curves. The obtained data were processed using the specially designed software which enables calculation of peak areas, heights, and calibrations.

AD has a whole number of advantages for determination of antioxidants. First of all, this is express method: excluding sample preparation, time of one analysis takes only few minutes. Analysis (registration and data treatment) occurs during real time. Reproducibility of analysis is high due to precise injection using six-channel valve. Minimum detectable

concentration of polyphenols using AD technique lays in the range of nano- and picograms ($1 \cdot 10^{-9}$ - $1 \cdot 10^{-12}$ g). The principal scheme of the device is given in Figure 1.

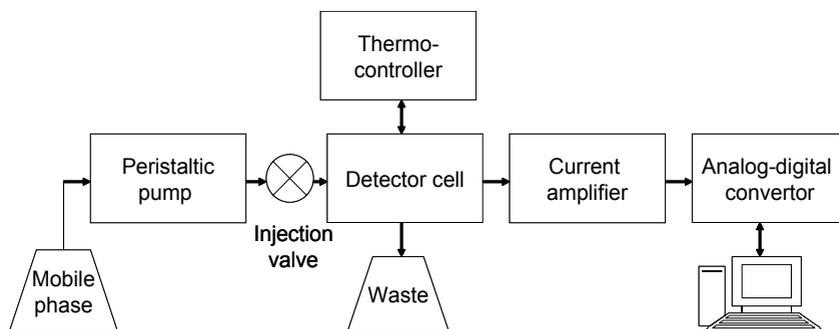


Figure 1. The block-scheme of the device Tswet-Yausa-01-AA.

The device represents a flow-injection system which enables express determination of antioxidant activity of HS. No other reagents except for standard are needed for this analysis. Quercetin (Fluka) is usually used as a standard for this determination.

RESULTS AND DISCUSSIONS

The results of antioxidant activity measurements are shown in Table 1. The samples of standard and commercially produced humic substances were used as well as water extract from peat.

Table 1. Antioxidant activity of humic materials and peat extract

Humic materials	Antioxidant activity (by quercetin), mg/g
SR-HA	15.4
SR-DOM	14.6
SR-FA	13.4
Potassium humate (PowHumus, Germany)	5.96
Water extract from Likhoslavl peat	0.50

The proposed method can be also used for express-determination of antioxidant activity of water extracts from soil, peat, sapropel, etc. The quantitative determination is feasible after calibration of the device using standard solutions of quercetin.

4. CONCLUSIONS

The amperometric technique is promising approach for automatic analysis of HS. The device "Tswet Yausa -01-AA" is included into the State List of measuring devices #20706-05, and the measuring protocol of HS is certified (# 31-07 from 04.05.2007).