Talanta 82 (2010) 613–619

Contents lists available at ScienceDirect

Talanta

journal homepage: www.elsevier.com/locate/talanta

Discrimination of apple juice and herbal liqueur brands with solid-state electrodes covered with polyaniline and thiacalixarenes

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ARTICLE INFO

Article history:
Received 29 January 2010
Received in revised form 19 April 2010
Accepted 10 May 2010
Available online 19 May 2010

Keywords:
Solid-contact ion-selective electrode
Thiacalixarene
Principal component analysis
Linear discriminant analysis

ABSTRACT

Solid-contact ion-selective electrodes based on glassy carbon electrode covered with electropolymeriz polyaniline and tetrasubstituted thiacalix[4]arene ionophores with hexyl and *o*-pyridylamido functio groups at the lower rim have been developed and examined in the discrimination of the brands of ap juices and herbal liqueurs. For this purpose, the liquids tested were diluted and spiked with a const amount of Fe^{3+} ions. The variation of the signal toward Fe^{3+} ions was achieved due to their involvem in the reactions with the organic ligands and the antioxidants present. As was shown, the combinat of the three electrodes with various receptors makes it possible to predict the brand of apple juices a herbal liqueurs using linear discriminant analysis in 95–100% cases. The discrimination procedure ma it possible to discriminate liquids within 20 min. Besides, the electrodes developed make it possible detect individual antioxidants (ascorbic, malic, oxalic acids, hydroquinone, and quercetin) in the ra from 5.0×10^{-6} to 1.0×10^{-2} M in direct potentiometric measurements and redox titration.

1. Introduction

Increasing demands for fast and inexpensive methods for the assessment of food quality stimulate intensive development of sensor devices applicable for this purpose [1]. The analysis of volatile substances in foodstuffs with gas sensors and multisensor systems, e.g. electronic noses, makes it possible to detect bacterial spoiling or classify aroma and other qualities of foodstuffs [2–4]. Meanwhile, the analysis of liquids becomes more and more important. In comparison with conventional analytical tools applied for this purpose, e.g. chromatography, IR and UV spectroscopy, sensors have milder demands to labor staff and offer extended opportunities for continuous monitoring as well as semi-quantitative testing.

From 1985 [5], various sensor systems have been developed for food analysis. At first, multisensor systems were based on voltammetric techniques [6–8]. Simultaneously, potentiometric sensor systems also called electronic tongue with conventional and/or specially designed ion-selective electrodes (ISEs) have been developed and successfully applied for food quality assessment [9–11]. Two of them, i.e. taste sensor based on planar electrodes covered with lipid membranes (Taste Sensing System SA 401, Anritsy Corp. [9]) and liquid and taste analyzer with a set of silic transistors (α-Astree, Alfa MOS [12]) are commercially availab Photovoltaic cells [13] and SAW sensors [14] were also examin for the characterization of various complex samples. The signals the sensors with cross-selectivity toward analyte components a commonly processed using various chemometric approaches pattern recognition like principal component analysis (PCA), lin discriminant analysis (LDA), etc. [15,16]. The efficiency of discri ination of the foodstuffs was proved by comparison of the resu obtained with multisensory systems to those of FTIR spectrosco HPLC [17] and sensory panel [18].

Solid-contact sensors based on polymeric coatings with imp mented ionophores directly attached to the electrode surfa provide some advantages over conventional membrane ISEs w internal filling and a reference electrode. They are easier to mar facture and operate and flexible in the geometry and dimensi of a sensing surface. Thus, a microsensor array of solid-cont sensors was produced by printed circuit board technology o solid support. Au microdisk transducers were covered with pl tic membranes containing plasticizers, conventional ionopho toward some metal cations and inorganic anions and lipoph salts. The sensor array were tested for the determination of amm nia and some alkali and alkali-earth metals and then used the discrimination of juices [19] and milk brands [20]. Polya line (PANI) covered with a PVC membrane containing ionopho was used in all-solid ISEs for detecting K^+ [21], Ca^{2+} ions [22] a

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doi:10.1016/j.talanta.2010.05.016