Evaluation of different vinegars electrochemical fingerprints

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Abstract

Vinegar is produced from the alcoholic and subsequent acetous fermentations of carbohydrate sources under highly aerobic conditions wherein the ethanol is oxidized to acetic acid. Depending on the source materials, many different types of vinegar are produced, as the former do not only provide different acidity and sour taste to the latter, but also play a key role in vinegar flavour as well as in its chemical composition.

As for many other food products, several frauds have been perpetrated in the production and commercialization of vinegar given the huge variety of vinegars available in the market in terms of quality, types and prices. Unfortunately there is not a specific methodology that allows the detection of such adulterations with traditional methods, but current approaches rely on the quantification of certain physical properties or chemical compounds which have been reported as genuineness indicators.

In this direction, the application of a voltammetric electronic tongue (ET) towards the classification and authentication of vinegar is presented herein. Vinegar samples of different varieties were analysed with a three-sensor array, without performing any sample pre-treatment, but only an electrochemical cleaning stage between sample measurements to avoid fouling onto the electrode surfaces. Next, the use of discrete cosine transform (DCT) for the compression and reduction of signal complexity in voltammetric measurements was explored, and the number of coefficients was optimized through its inverse transform. Finally, the obtained coefficients were analysed by principal component analysis (PCA) to attempt the discrimination of the different vinegars and by linear discriminant analysis (LDA) to build a model that allows its categorization. Satisfactory results were obtained overall, with a classification rate of 100% for the external test subset (n = 15).

Keywords: Vinegar; Classification; Authentication; Electronic tongue; Discrete cosine transform; Principal component analysis; Linear discriminant analysis