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## Investigation of using carbon nanotube mixed with several metal phthalocyanine compounds for electronic tongue applications

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Carbon nanotube (CNT) has an excellent property in high electrical conductivity and can be mixed with an active compound in order to use as a functional electrode. Due to variety of metal phthalocyanine (MPc) compound can be formed by different metal atom, the MPc with several metal spices was used as an array detection in electronic tongue classification for a number of coffee types. In this work, 100 mg of CNT and 100 mg of MPc including CoPc, FePc, ZnPc, and MnPc powders blended with 700 $\mu$ l of paraffin oil were used as working electrodes by embedding in a hollow Teflon rod. Electrochemical characteristics of the fabricated electrodes in Robusta, Arabica, blend coffee and cocoa were investigated by scanning cyclic voltammogram (CV) with scanning rate of 0.05V/s from -1.5 to 1.5V respectively to Ag/AgCl electrode for five scanning loops. The CV of blended CNT with some MPc indicated the effect of catalytic oxidation of saccharides and/or polyphenol on the sensor surface. This led to distinguish pattern of CV for successful classification in these four groups. The obtained main feature of electrochemical information was analyzed by using wavelet analysis and then the principal components analysis (PCA) was implemented to represent the distribution in the first few principle components. The PCA results indicated separate groups with total contribution more than 90% representing from the PC1 and PC2 and the major feature extraction can be described by components of wavelet analysis.

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