Development of an electrochemical method for estimation of the antioxidative capacity of syringic and ferulic acid with ABTS as a redox mediator

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INTRODUCTION AND AIM

Aim of this study was to develop an electrochemical method for investigation of the antioxidative potential of ferulic and syringic acid, by comparing its antioxidative potential with that of Vitamin C, used as a referent substance. Ferulic acid is a hydroxycinamic acid. It is seen as an effective topical antioxidant which is used as an efficient photoprotective for the skin. It is already known that ferulic acid can be an effective scavenger of free radicals and it has been approved in certain countries as food additive to prevent lipid peroxidation. Syringic acid, a naturally occurring O-methylated trihydroxybenzoic acid monomer extracted from *Rosmarinus officinalis* L., *Origanum vulgare* L. and *Thymus* L. that acts as an antioxidants capable to neutralize free radicals.

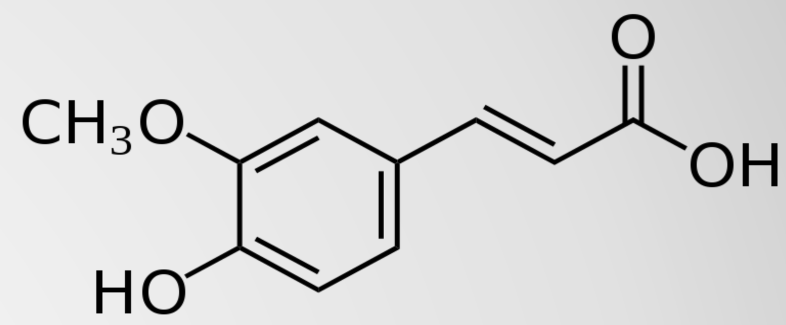

Figure 1. Chemical structure of ferulic acid

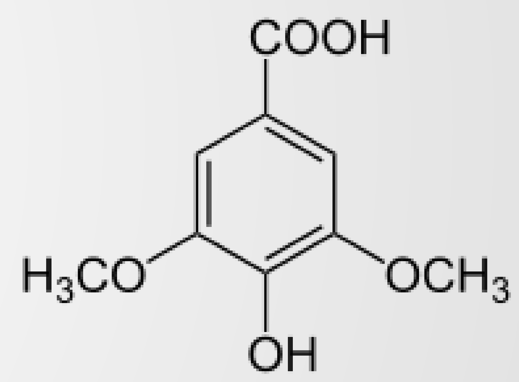

Figure 2. Chemical structure of syringic acid

MATERIALS AND METHODS

Standard solutions of syringic and ferulic acid at concentrations of 5 mmol/L, ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) at concentration of 1 mmol/L and Vitamin C, 5 mmol/L were used as standard solutions. Electrochemical analyses were performed by the means of cyclic voltammetry in a standard 5 mL electrochemical cell with three electrodes: glassy carbon electrode, as a working electrode, reference electrode (Ag/AgCl), and a counter platinum electrode. All the experiments were performed in acetic buffer solution (pH = 4.6) and KCl (0.001 mol/L) as an electrolyte.

RESULTS

Ferulic acid in concentration of 0.1 mmol/L gives a rise of the current of the oxidation peak of ABTS (E_{pa}= 0.55 V) for 0.452 μA, while syringic acid (0.1 mmol/L) have shown an increase of 0.827 μA. In comparison, Vitamin C, in the same concentration as phenolic acids, has shown an increase of 0.464 μA. This indicates that antioxidative potential of ferulic acid is approximately the same as the potential of Vitamin C. Syringic acid have shown the highest antioxidative potential from the examined substances.

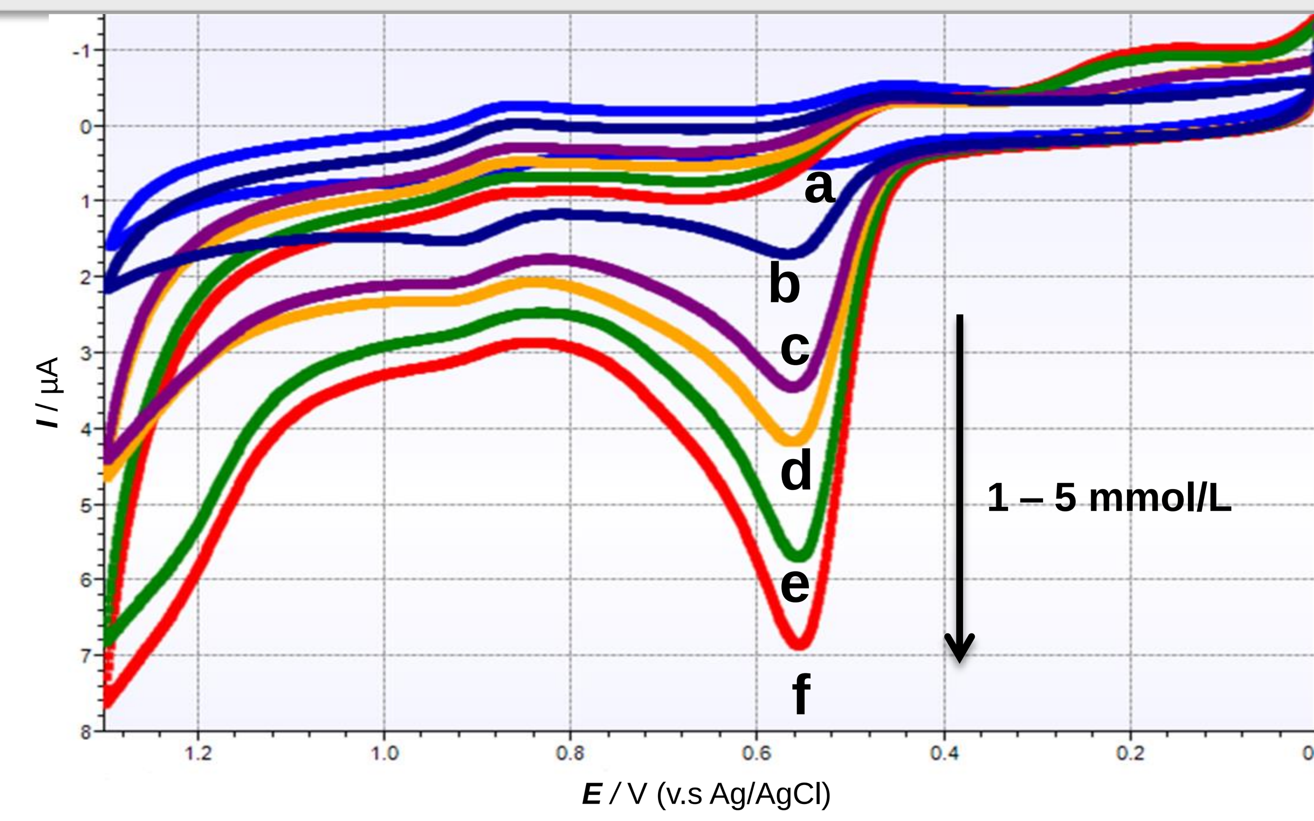

Figure 3. Cyclic voltammograms of: **(a)** ABTS (1 mmol/L) and **(b), (c), (d), (e) and (f)** syringic acid in concentration of 1 – 5 mmol/L.

CONCLUSIONS

This method can be further developed and improved for estimation of the antioxidative potential of many phytochemicals obtained from the medicinal plants. Moreover this method could serve for routine investigation of mechanism of oxidation of ferulic and syringic acid, which cannot be predicted by other commonly used spectroscopic method for measuring the antioxidative potential.

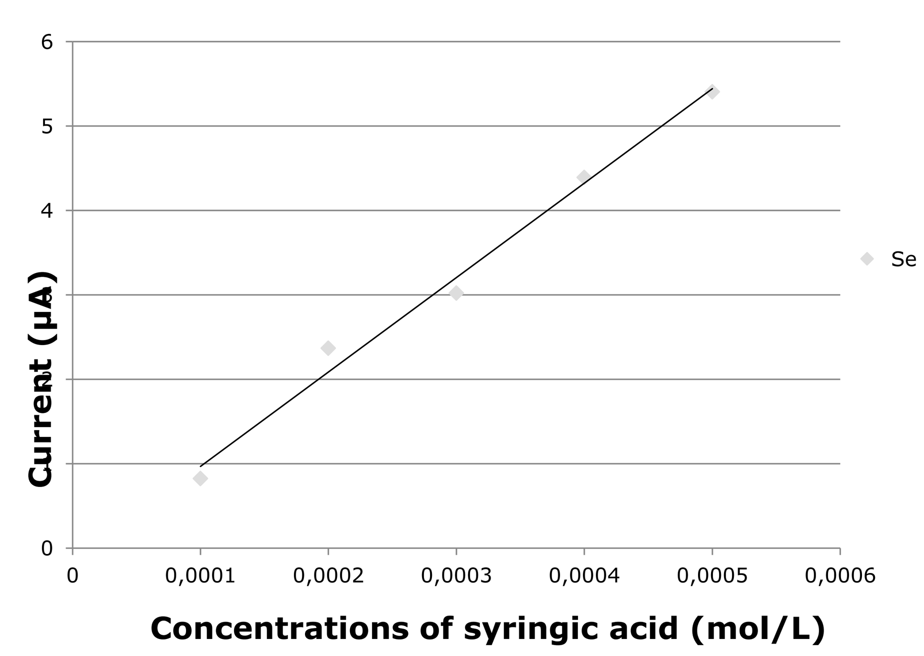

Figure 4. Linear dependency of the current (μA) and concentration of syringic acid (1 – 5 mmol/L) aded to ABTS (1 mmol/L).

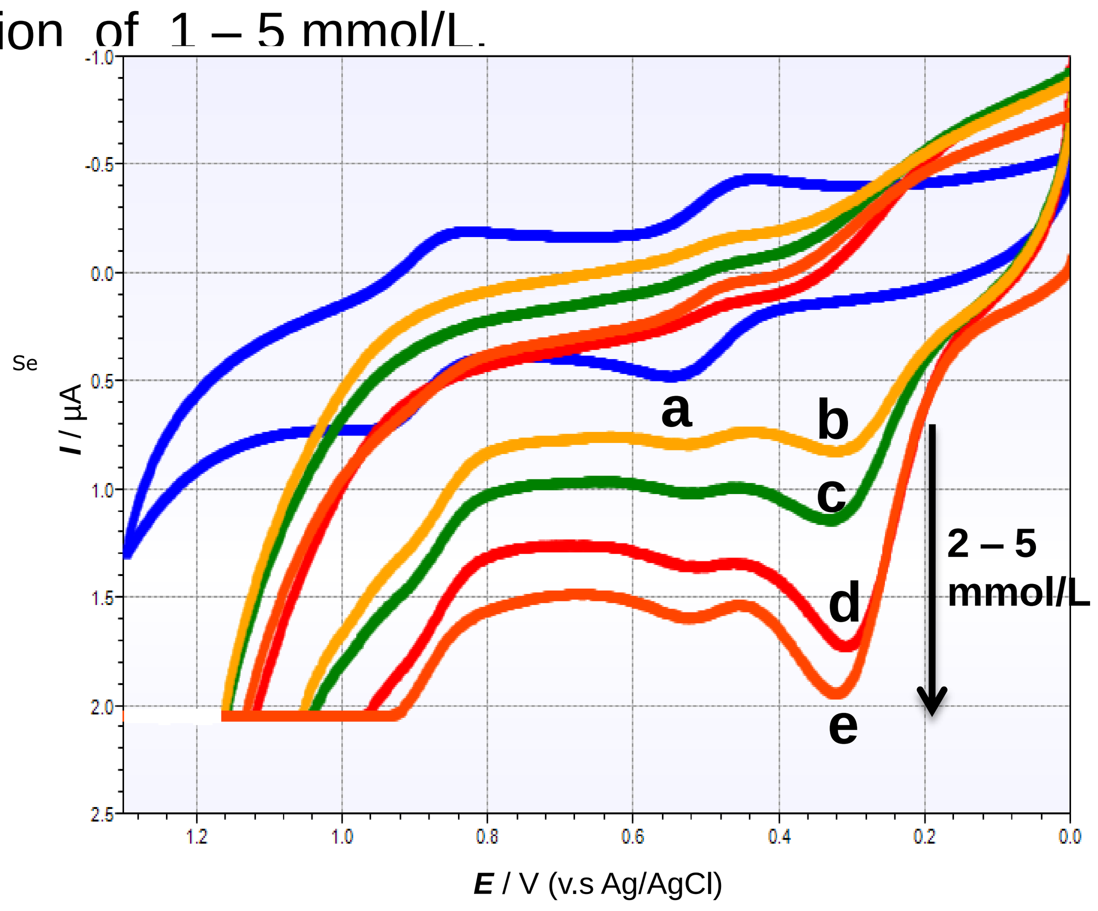

Figure 5. Cyclic voltammograms of: **(a)** ABTS (1 mmol/L) and **(b), (c), (d),** and **(e)** Vitamin C in concentration of 2 – 5 mmol/L.

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