

RAPID ESTIMATION OF ANTIOXIDANT CAPACITY OF SOME MEDICINAL PLANTS: ELECTROCHEMICAL AND PHOTOMETRIC APPROACHES



Naumova Galaba¹, Maksimova Viktorija¹, Mirceski Valentin^{1,2}, Ruskovska Tatjana¹,
Koleva Gudeva Liljana³, Gulaboski Rubin¹



¹Faculty of Medical Sciences, "Goce Delčev" University, Krste Misirkov bb, POB 201, 2000 Štip, Republic of Macedonia

²Institute of Chemistry, Faculty of Natural Sciences and Mathematics, "Ss. Cyril and Methodius" University, Arhimedova 5, Skopje, Republic of Macedonia

³Agricultural faculty, "Goce Delčev" University, Krste Misirkov bb, POB 201, 2000 Štip, Republic of Macedonia

contact: galaba.naumova@ugd.edu.mk

Introduction

Oxidative stress comprises a series of processes in which an excess of reactive oxygen species (ROS) are generated in living cells. Owing to their strong oxidizing activity, free radicals can damage most of the physiologically active molecules and increase the risk for many serious pathologies.

Antioxidants are compounds capable to either delay or inhibit the oxidation processes which occur under the influence of ROS.

Plant phenolic compounds (e.g. phenolic acids, flavonoids, quinones, coumarins, lignans, stilbenes, and tannins), nitrogen compounds (alkaloids, amines), carotenoids and vitamins are the most important plant substances presenting antioxidant activity.



Aim of the study

The aim of this study was to analyze the total antioxidant levels of medicinal plants collected in the region of Malesevo Mountain, by two different methods and compare the results.

Material and methods

The total antioxidant capacity (TAC) of some medicinal plants collected in the region of Malesevo Mountain was evaluated by:

- FRAP method (Ferric reducing/antioxidant power)
- cyclic voltammetry.

Infusions samples in the present research were prepared from: Mountain tea (*Origanum vulgare* L.), Lemon balm (*Melissa officinalis* L.), St. John's wort (*Hypericum perforatum* L.), Wild thyme (*Thymus serpyllum* L.) and Mint tea (*Mentha piperita* L.).

FRAP method

The total antioxidant capacity of herb infusions was determined using photometric FRAP method developed by Benzie and Strain. The FRAP assay, is presented as method for *in vitro* assessing "antioxidant power." This method measures the ferric reducing ability of infusions samples. At low pH, when a ferric-Trotriprydyltriazine (Fe^{3+} -TPTZ) complex is reduced to ferrous (Fe^{2+}) form, an intense blue color with an absorption maximum at 593 nm develops. FRAP values are obtained by comparing the absorbance change at 593 nm in test reaction mixtures with those containing ferrous ions in known concentration. The results are expressed as $\text{mmol Fe}^{2+} \text{ L}^{-1}$.

Cyclic voltammetry

The total antioxidant capacity of these medicinal plants has also been studied in an ethanol/water phase by means of cyclic voltammetry (electrochemical method), by measuring the rate of the homogeneous redox reaction with ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid)). ABTS^{*+} radical was electrochemically *in situ* generated at the surface of glassy carbon electrode by electrochemical oxidation of ABTS in ethanol electrolyte solution. The method is based on the well-known regenerative catalytic EC' mechanism, where the ABTS^{*+} radical serves as a redox mediator for catalytic oxidation of antioxidants present in the plant infusion.

Results

FRAP method

The total antioxidant capacity (TAC) values were determined to be:

- Mountain tea - $27.45 \text{ mmol Fe}^{2+} \text{ L}^{-1}$
- Lemon balm - $19.54 \text{ mmol Fe}^{2+} \text{ L}^{-1}$
- St. John's wort - $12.64 \text{ mmol Fe}^{2+} \text{ L}^{-1}$
- Wild thyme - $9.45 \text{ mmol Fe}^{2+} \text{ L}^{-1}$
- Mint tea - $8.14 \text{ mmol Fe}^{2+} \text{ L}^{-1}$

Method showed that mountain tea has the highest total antioxidant capacity.

Cyclic voltammetry

The results obtained with the voltammetric technique confirm the same trend of increasing of the anodic current as the TAC values in analyzed infusions.

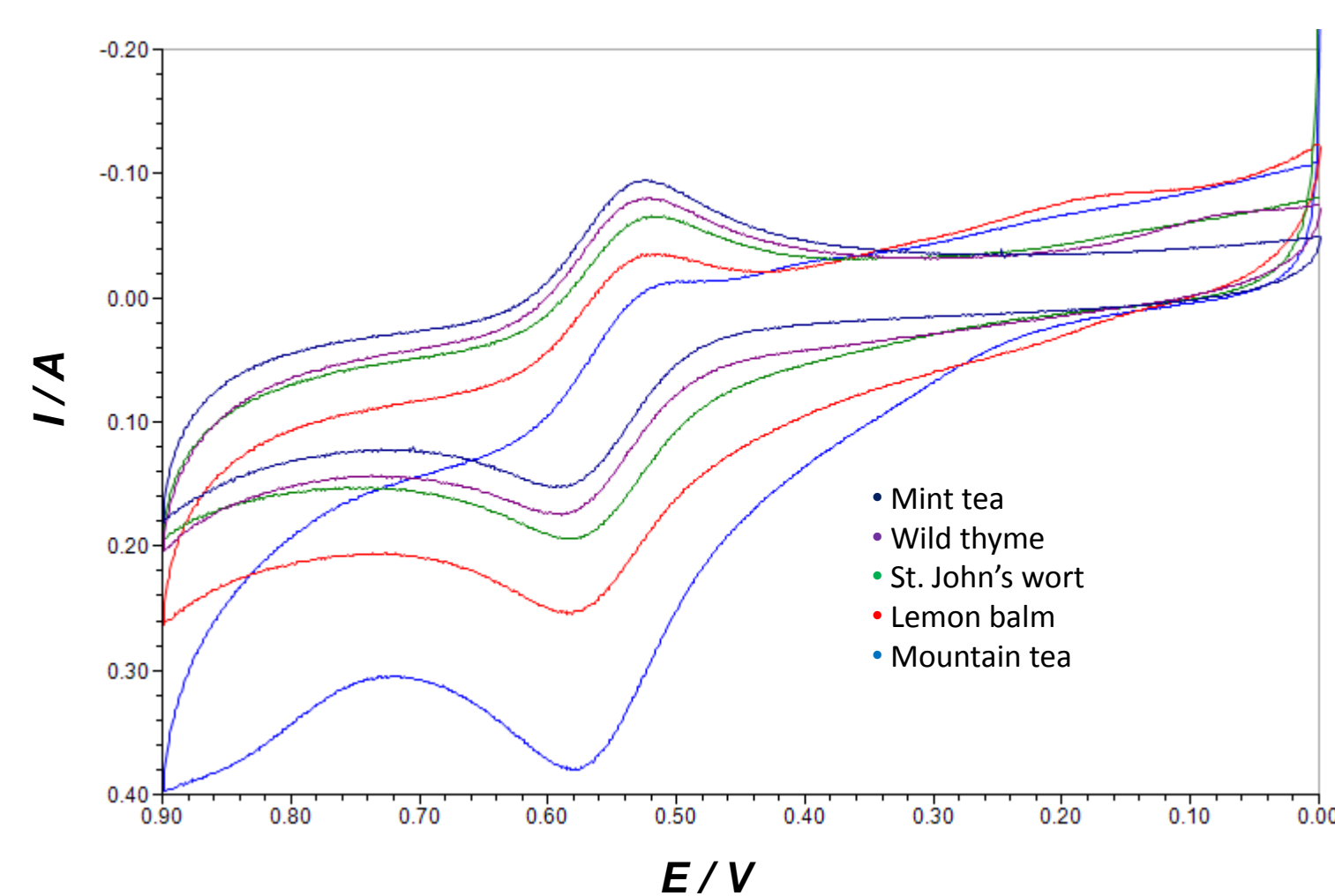
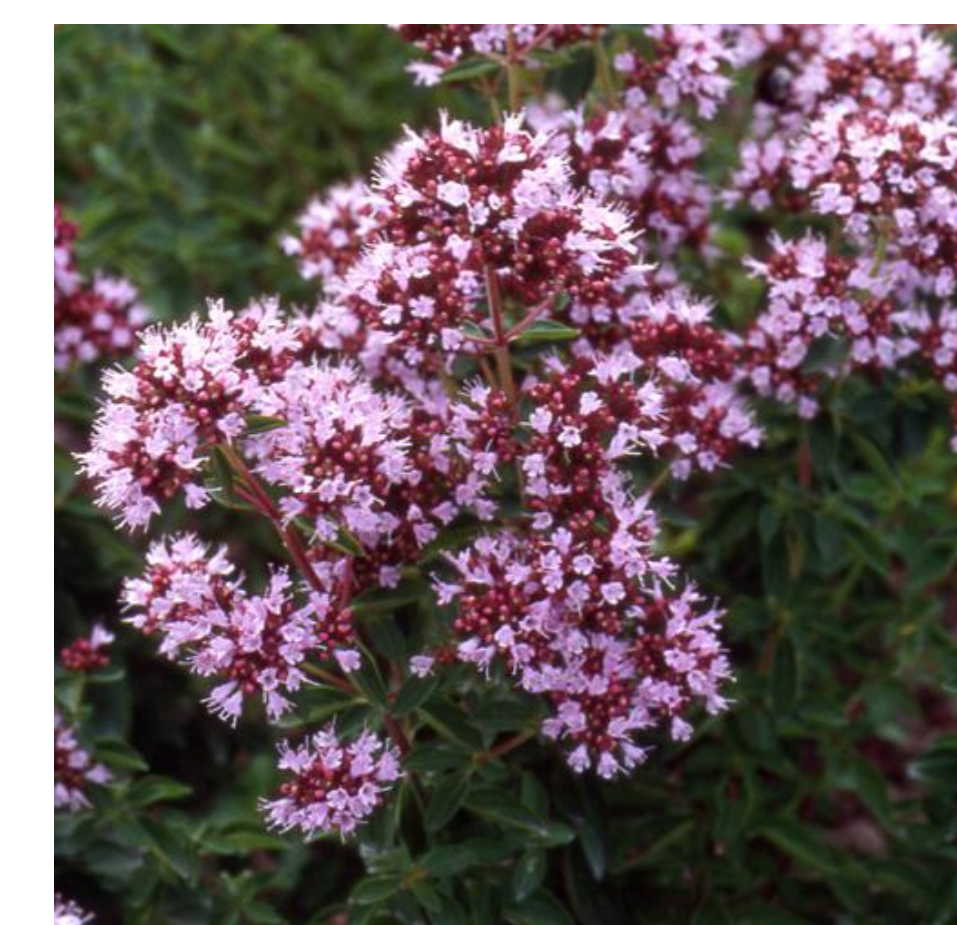


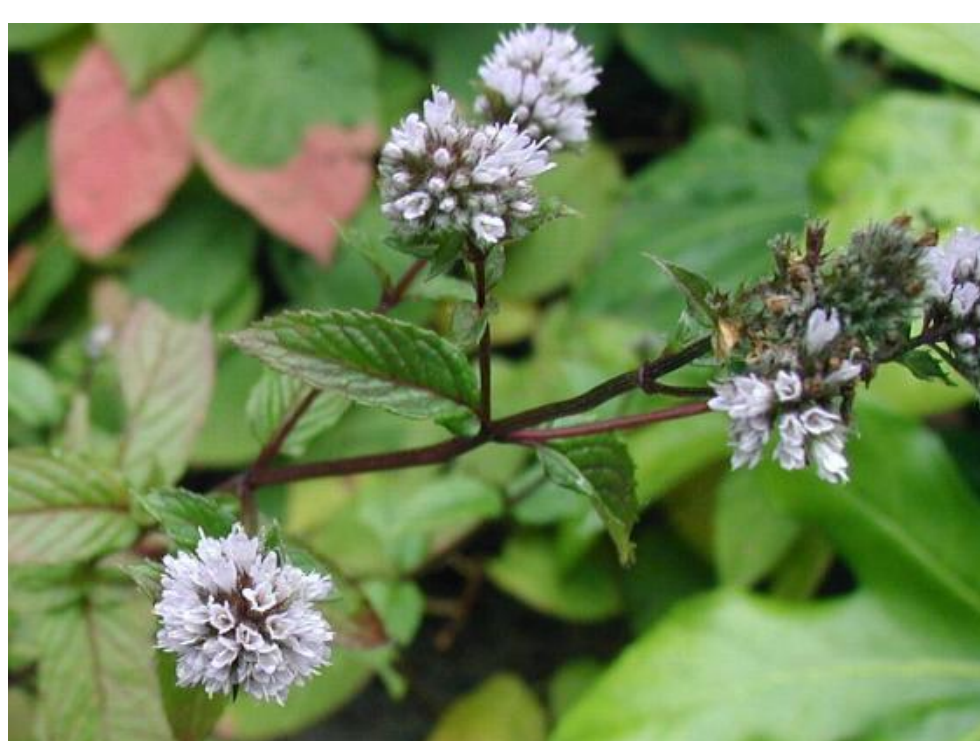
Figure 1. Cyclic voltammograms of Mountain tea (*Origanum vulgare* L.), Lemon balm (*Melissa officinalis* L.), St. John's wort (*Hypericum perforatum* L.), Wild thyme (*Thymus serpyllum* L.) and Mint tea (*Mentha piperita* L.). Extract recorded in 0.1 mmol/L ethanol solution of ABTS and solution of LiClO_4 at $v = 10 \text{ mV/s}$.



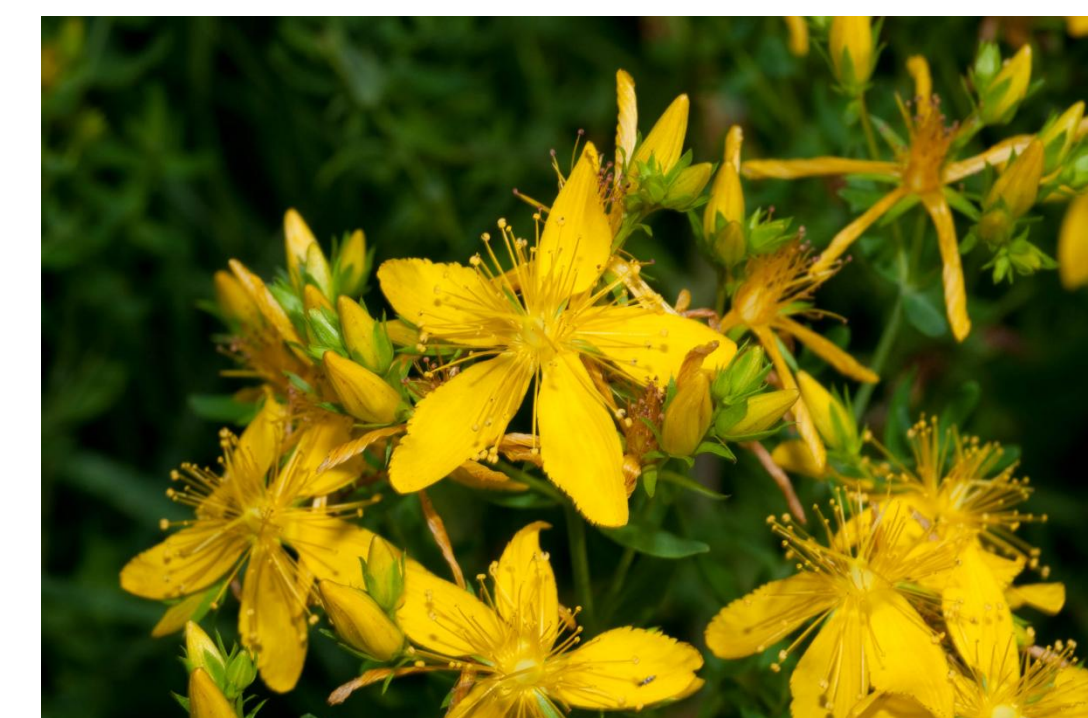
Origanum vulgare L. (Mountain tea)



Melissa officinalis L. Lemon balm



Mentha piperita L. (Mint tea)



Hypericum perforatum L. (St. John's wort)



Thymus serpyllum L. Wild thyme

Conclusion

- In the present study we developed a rapid and effective photometric and electrochemical methods for estimation of the total antioxidant capacity (TOC) in medicinal plants infusions.
- Infusions prepared from medicinal plants originated from our country exhibit strong antioxidant potential and this fact justifies their use as potent natural antioxidant agents.
- There were strong correlations between the results obtained with FRAP method and cyclic voltammetry and both methods can be used for evaluation of total antioxidant capacity in medicinal plants infusions.