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Original Scientific Paper

Comparative study of total phenolic content and radical scavenging activity of conventionally and organically grown herbs

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ABSTRACT: The aim of the present study was to measure the relative phenolic content in commonly available conventionally and organically grown herbs and to evaluate their antioxidant capacity. Sage (*Salvia officinalis*), lemon balm (*Melissa officinalis*) and peppermint (*Mentha x piperita*) leaves, corriander (*Corriandrum sativum*) and fennel (*Foeniculum vulgare*) seeds were used in the present investigation. Total phenolic content (TPhC), measured by Folin-Ciocalteu method, and radical scavenging activity (RSA), using DPPH method were determined in infusions prepared from above mentioned herbs. TPhC ranged from 75.9 to 1126.5 gallic acid equivalents (GAE) mg/l infusion and RSA - from 7.03 to 91.65%. The obtained data also showed that infusions prepared from organically grown sage, peppermint and lemon balm were slightly higher than those obtained from conventionally grown herbs.

Key words: organically and conventionally grown herbs; total phenolic content; DPPH radical scavenging activity.

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INTRODUCTION

During the last decade, consumers have started to look for safe and well controlled foods produced in environmentally friendly, authentic and local systems. Consumer studies suggest multiple reasons for buying organic fruits and vegetables, for example, they taste better, are healthier and safer (Cooper *et al.* 2007). Increased market demand for organic products has stimulated research interest in evaluating the effect of organic farming on the quantity and quality of nutrients in fruits, vegetables, grains, etc. Furthermore, it has been hypothesized that organically grown foods could be healthier due to a higher content of phytochemicals (for example, phenolics, carotenoids, vitamins, sugars, etc.). Some recent studies have partly confirmed this opinion (Anttonen MJ & Karjalainen RO 2006; Györéne *et al.* 2006; Tarozzi *et al.* 2006; Khalil *et al.* 2007; Wang *et al.* 2008; Stracke *et al.* 2009).

The aim of this study is to measure the relative phenolic content in commonly available conventionally and organically grown herbs and to evaluate their antioxidant capacity. Sage (*Salvia officinalis* L.), lemon balm (*Melissa officinalis* L.) and peppermint (*Menha x piperita*) leaves as well as coriander (*Coriandrum sativum* L.) and fennel (*Foeniculum vulgare* Mill) seeds were selected for investigation.

MATERIALS AND METHODS

Chemicals: 2.0 M Folin-Ciocalteu phenol reagent, gallic acid, anhydrous sodium carbonate (all from Sigma-Aldrich, Germany), DPPH (2,2´-diphenyl-1-picrylhydrazyl) (from Fluka, Switzerland).

Plant material: Conventionally and organically grown herbs were purchased from the herbal drugstore.

Preparation of infusions: 2.8g of air-dried and ground

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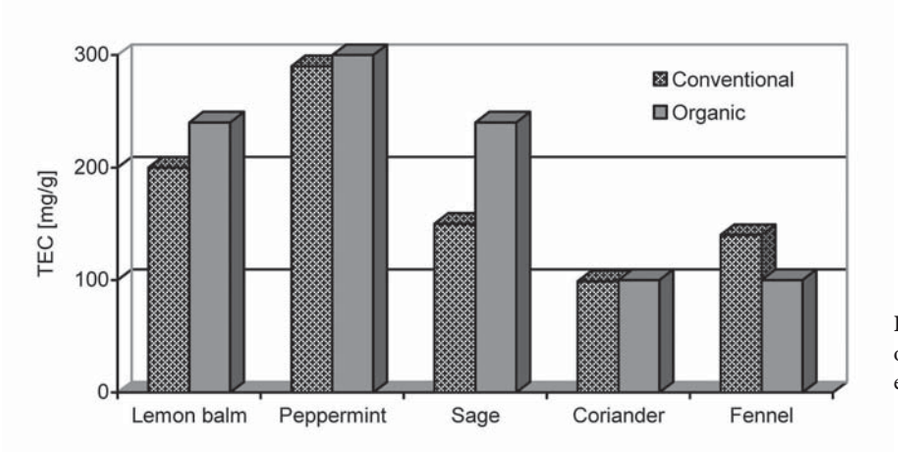

Fig. 1. Total extract content (TEC) of organically and conventionally grown herbs expressed as mg/g dry material

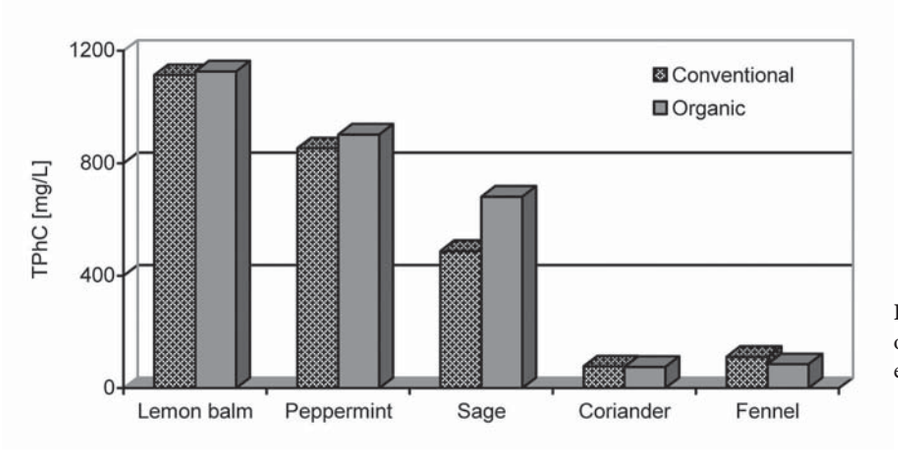

Fig. 2. Total phenolic content (TPhC) of organically and conventionally grown herbs expressed as mg/L infusion

plant material were infused into 140mL of hot distilled water for 6min, filtered through Whatman no. 4 paper and then concentrated under vacuum to dryness at a temperature between 50 and 60°C to obtain total extract content (TEC). TEC was calculated in mg per gr dried mass (g dm) and re-dissolved in distilled water to measure total phenolic content (TPhC) and radical scavenging activity (RSA).

Determination of total phenolic content (TPhC): using Folin-Ciocalteu colorimetric method (Singleton & Rossi 1965; Miliauskas *et al.* 2004) calibrated against gallic acid as the reference standard, and the results were expressed as mg GAE (gallic acid equivalents) per L infusion. Experiment was repeated three times.

Measurement of the DPPH (2,2'-diphenyl-1--picrylhydrazyl) radical scavenging activity (RSA): The samples were analyzed with DPPH solution at 517nm, according to the method reported by Brand-Williams et al. (Brand-Williams *et al.* 1995; Horžić *et al.* 2009). The results were expressed as a percentage of reduction (inhibition) of the DPPH (RSA), which is defined by following expression: RSA (%) = $100x(A_0-A_t)/A_0$ where A_0 is the initial absorbance and A_t is the value of absorbance of the antioxidant at t=20 min. All determinations were performed in triplicate.

RESULTS AND DISCUSSION

Sage, lemon balm, peppermint, coriander and fennel are well-known culinary and medicinal herbs. The obtained data for TEC of conventionally and organically grown herbs are presented in the Fig. 1. It can be seen, that TEC of conventionally and organically grown coriander seeds were almost equal, while those for organically grown sage, peppermint and lemon balm were higher. TEC of conventionally grown fennel was higher than organic seeds.

Further, total phenolic content (TPhC) in infusions prepared from above mentioned herbs was determined by Folin-Ciocalteu method (Fig. 2). TPhC ranged from 75.9 to 1126.5 mg/L gallic acid equivalents (GAE). Among the samples, lemon balm and peppermint contained relatively high total phenolics amount. The infusions obtained from coriander and fennel seeds exhibited lowest TPhC (75.9 -

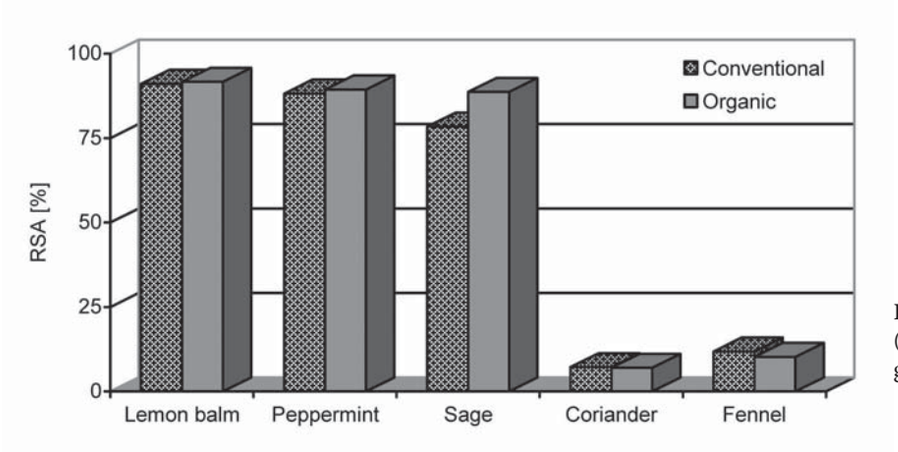

Fig. 3. DPPH radical scavenging activity (RSA) of organically and conventionally grown herbs

112.2 mg/L GAE). It was also found that TPhC in infusions prepared from organically grown sage, peppermint and lemon balm were slightly higher than those obtained from conventionally grown herbs.

DPPH radical scavenging method was used to evaluate free radical scavenging ability (RSA) by the selected infusions. In the presence of antioxidants the purple colour of the DPPH radical solution changes to a bright yellow and the intensity of this change can be monitored spectrophotometrically at 517nm. As can be seen from Fig. 3, sage, peppermint and lemon balm infusions were effective DPPH radical scavengers with RSA between 88.21 and 91.65%. Coriander and fennel infusions displayed lower RSA (7.03-11.76%). The obtained data also showed that infusions prepared from organically grown sage, peppermint and lemon balm were slightly higher than those obtained from conventionally grown herbs.

Among 5 selected commercial herbs, sage, lemon balm and peppermint leaves were richer in total phenolics and their infusions had high level of DPPH radical scavenging activity. The results also showed a trend of higher levels of TPhC and RSA in organically grown herbs. However, these preliminary results are necessary to be supported by further experiments.

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Botanica SERBICA

REZIME

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Cilj rada bio je da se utvrdi relativni sadržaj fenola kod konvencionalno gajenih I spontano raslih odabranih predstavnika biljaka. Analizirana su semena sledećih vrste: *Salvia officinalis*, *Melissa officinalis, Mentha x piperita, Corriandrum sativum* i *Foeniculum vulgare.* Ukopni sadržaj fenola (TPhC), odredjivan je prema metodi Folin-Ciocalteu dok je aktivnost radikala (RSA) odredjivana DPPH metodom u prethodno pripremljenim infuzijama pomenutih biljaka. TPhC je varirao od 75.9 do 1126.5 akvivalenta galične kiseline (GAE) mg/l infuzije dok je RSA varirao u opsegu 7.03-91.65%. Dobijeni podaci pokazuju da su infuzije prirodno raslih biljaka *Salvia officinalis*, *Melissa officinalis, Mentha x piperita* blago jače od onih pripremljenih iz konvencionalno gajenih biljaka.

Ključne reči: gajene i spontano rasle biljke; ukupni sadržaj fenoila; DPPH aktivnost radikala.