Determination of antiradical properties of some essential oils after thermal processing

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Abstract— Oxidation of fats causes rancidity and reduces sensory quality of foodstuffs. The use of antioxidant can solve these problems. Today, new tendency has created to use of natural compounds such as essential oils for preserving foodstuffs. In this study, we determined the effect of thermal processing on antiradical activity of Zataria multiflora Boiss. essential oil (ZMEO) and Cinnamon zeylanicum essential oil (CZEO). at different temperatures (25°, 100°, 140° and 180° C) and times (1, 2 and 3 hours).

The antiradical properties of ZMEO and CZEO were evaluated by using 1,1-Diphenyl-2-picrylhydrazyl radical (DPPH^{*}). At ambient temperature, EC_{50} of ZMEO and CZEO was 4026.67±2.2 and 2605.01±15.57 ppm, respectively. According to these results, ZMEO and CZEO showed good antiradical properties and resisted at common temperatures of food processing.

Keywords: Antiradical, Zataria multiflora, Cinnamon zeylanicum, Essential oil, , Chemical composition

I. INTRODUCTION

Zataria multiflora Boiss. is a member of Laminaceae family that geographically grows in Iran, Pakistan and Afghanistan [1, 2]. This plant with folk name of Avishan Shirazi (in Iran) has been used as anesthetic, antiseptic and antispasmodic [2]. This plant is widely used as flavor compound in extensive range of foodstuffs in Iran. The main constituents of ZMEO are phenolic compounds such as carvacrol and thymol [3].

Cinnamon belongs to Lauraceae family and many species of cinnamon produce volatile oil on distillation. The most important cinnamon oils are from C. *zeylanicum*, C. *cassia* and C. *camphora* [4]. Cinnamon is common flavouring compound, widely used in foods. In addition to its flavouring role, cinnamon has exhibited health benefits such as antimicrobial activity, controlling glucose intolerance and diabetes, inhibiting the proliferation of various cancer cell lines, and treating common cold [5].

DPPH° is a resistant radical of organic nitrogen, by a typical deep purple colour and a maximum absorbance in the range of 515–520 nm. The DPPH° method is a simple technic and needs only a UV–vis spectrophotometer to perform: in the presence of a hydrogen/electron donor (free radical scavenging antioxidant) the absorption intensity is decreased, and the radical solution is discoloured according

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to the number of electrons captured. The results of DPPH° assay are often expressed by EC_{50} parameter, defined as the concentration of substrate that brings about 50% loss of the DPPH° [6].

The aim of this work was the evaluation of heat resistance of ZMEO and CZEO at different temperatures and times by using DPPH[°] method.

II. MATERIALS AND METODS

Air-dried aerial parts of *Zataria multiflora* Boiss. and bark of *Cinnamon zeylanicum* were used to steam distillation by using Clevenger-type apparatus. The obtained essential oils were dried over anhydrous sodium sulphate and after filtration, they were stored at +4 $^{\circ}$ C for testing and analyzing. All chemical were purchased from Merck Chemical Co. (Darmstadt, Germany).

A. Thermal processing

three ml of essential oils were droped in thermal resistant bottle, then heated at 100, 140 and 180 °C during 1, 2 and 3 hours by using Memert oven (Germany).

B. DPPH° assay

Two ml of different concentrations of essential oils were added to 1 ml of solution of DPPH° in ethyl acetate (0.2 mM) [9]. then absorbance was read at 517 nm, by using a Scinko Spectrophotometer (South Korea). Different sample concentrations were used to obtain calibration curves and to find the EC_{50} values [6].

C. Statistical analysis

Statistical analysis of data was done by ANOVA using SPSS (version, 11.5). significant differences ($P \le 0.05$) of means were calculated using Duncan's multiple range tests.

III. RESULTS

 EC_{50} of ZMEO and CZEO were 4026.7±2.2 and 2605.0±15.6 ppm at 25 ° C, respectively. Comparison of antiradical properties of both essential oils at 25, 100, 140 and 180 °C and 1, 2 and 3 hours shown at Figure 1, 2, 3.

A higher DPPH radical-scavenging activity is associated with a lower EC_{50} value. Antiradical property of CZEO was more (P \leq 0.05) than ZMEO at room temperature (Fig. 1). After 1 hour heating at 100, 140 and 180 °C, antiradical properties of CZEO was declined. About ZMEO, antiradical properties during heating at 100 and 180 °C increased. but at 140 °C, was the lowest (P \leq 0.05) antiradical properties among all samples.

After 2 hours heating (Fig. 2), antiradical properties of CZEO was declined and the most ($P \le 0.05$) reduction was at 140° C. but about ZMEO, the antiradical properties of it increased and the most increase was at 140° C. among all of samples, ZMEO at 140° C showed maximum of antiradical property ($P \le 0.05$).

After 3 hours heating, antiradical properties of ZMEO increasd in all samples compared with sample at 25 °C and the highest antiradical property belonged to 100 °C. About CZEO, antiradical properties of CZEO at 100 and 140 °C declined and the highest antiradical property was shown at 180 °C ($P \le 0.05$).

Among all samples, ZMEO at 180° C showed maximum and ZMEO at 140°C exhibited minimum antiradical properties after 1 hour heating ($P \le 0.05$).

IV. DISCUSSION

Fazel et al. (2007) determined antiradical properties of Thymus vulgaris L. and Satureja hortensis L. essential oils and estimated EC₅₀ of essential oils 5800 and 8900 ppm, respectively [7]. Shahsavari et al. (2008) evaluated EC₅₀ of ZMEO and it was 2220±40 ppm [8]. EC₅₀ of Artemisia dracunculus and Matricaria chamomilla reported 3190±130 and 5630±200 ppm, respectively [9]. According to these results, the antiradical property of ZMEO and CZEO was comparable with other natural antiradicals. Tomaino et al. (2005) studied the effect of thermal processing on some spice essential oils at 80, 100, 120 and 180 °C. Heating basil, cinnamon, clove, oregano and thyme oils (up to 180 °C) did not affect their chemical composition and their antioxidant activity measured by DPPH° method. Conversely, when heated at 180 °C, nutmeg oil showed a significantly higher antiradical activity with a significant loss of α -pinene, β -pinene and an evident increase in safrole and myristicin contents. That was observed higher antiradical capacity of the nutmeg oil might be related to a heating induced increase in the content of these two components [10]. Heating process can decrease or increase some antiradical components of essential oils. These changes in antiradical activities depend on kind of essencial oils and their components and amount of functional compounds.



Figure 1. Antiradical activities of ZMEO and CZEO after 1 hourheating at 100, 140 and 180 °C and comparison with essential oils at ambient conditions. Columns with the same superscript letters are not significantly differrent (P > 0.05).



Figure 2. Antiradical activitie of ZMEO and CZEO after 2 hours heating at 100, 140 and 180 °C and comparison with essential oils at ambient conditions. Columns with the same superscript letters are not significantly differrent (P > 0.05).



Figure 3. Antiradical activitie of ZMEO and CZEO after 3 hours heating at 100, 140 and 180 °C and comparision with essential oils at ambient conditions. Columns with the same superscript letters are not significantly differrent (P > 0.05).

V. CONCLUSION

This study evaluated effect of heating process on essential oils and showed the ZMEO and CZEO had good antiradical properties. Heating process decreased antiradical properties of CZEO and increased antiradical property of ZMEO at 100, 140 and 180 °C after 1, 2 an 3 hours. Despite disadvantages of synthetic antioxidants, ZMEO and CZEO can be added to the foodstuffs without any negative effects. further investigation like GC/MS analysis of heated essential oils and other antioxidant assayment methods are warranted.

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