# *Determination of antiradical properties of some essential oils after thermal processing*

Kordsardouei, H.[1]
[1]Department of food science and technology
Ferdowsi University
Mashhad, Iran
habibekord@gmail.com

[2]Barzegar, M. and [3]Sahari, M. A.
[2,3]Department of food science and technology
Tarbiat Modared University
Tehran, Iran
mbb@modares.ac.ir

*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 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 ˚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 ($P \leq 0.05$) 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 proerties 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 ($P \leq 0.05$) 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 ($P \leq 0.05$).

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 ($P \leq 0.05$).

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

## IV. DISCUSSION

Fazel *et al.* (2007) determined antiradical properties of *Thymus vulgaris L.* and *Satureja hortensis L.* essential oils and estimated $EC_{50}$ of essential oils 5800 and 8900 ppm, respectively [7]. Shahsavari *et al.* (2008) evaluated $EC_{50}$ of ZMEO and it was 2220±40 ppm [8]. $EC_{50}$ 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.

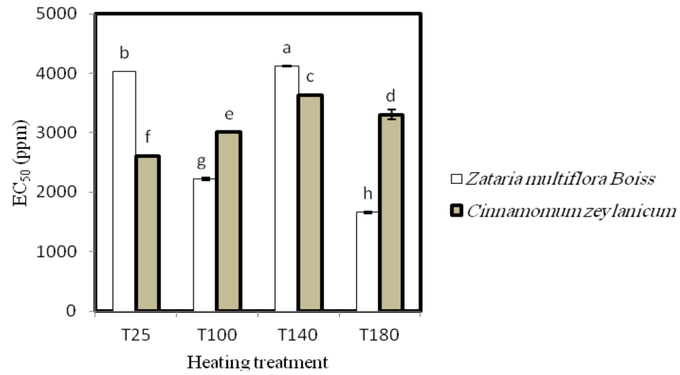


Figure 1. Antiradical activities of ZMEO and CZEO after 1 hourheating at 100, 140 and 180 ˚C and comparison with essential oils at ambient conditions. Columns with the same superscript letters are not significantly differrent ($P > 0.05$).

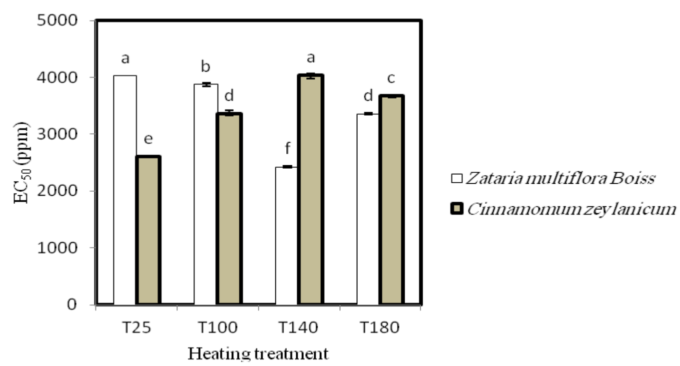


Figure 2. Antiradical activitie of ZMEO and CZEO after 2 hours heating at 100, 140 and 180 ˚C and comparison with essential oils at ambient conditions. Columns with the same superscript letters are not significantly differrent ($P > 0.05$).

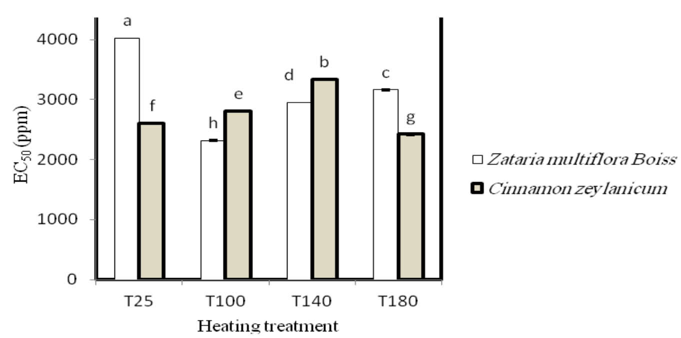


Figure 3. Antiradical activitie of ZMEO and CZEO after 3 hours heating at 100, 140 and 180 ˚C and comparision with essential oils at ambient conditions. Columns with the same superscript letters are not significantly differrent ($P > 0.05$).

## 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.


## ACKNOWLEDGMENT

The authors express their sincere appreciation the financial support received from Faculty of agriculture, Tarbiat Modares University for this research.


## REFERENCES


[1] M. S. Ali, M. Saleem, Z. Ali, and V. U. Ahmad, Chemistry of *Zataria multiflora* Boiss. (Lamiaceae). *Phytochemistry*. 2000, vol. 55, pp. 933–936.

[2] H. Hosseinzadeh, M. Ramezani, and G. Salmani, Antiinociceptive, anti-inflammatory and acute toxicity effects of *Zataria multiflora* Boiss. extracts in mice and rats. *Journal of Ethnopharmacology*. 2000, vol. 73, pp.379-385.

[3] A. Shaffiee, and K. Javidnia, Composition of essential oil of *Zataria multiflora*. *Planta Medica*. 1997, vol. 63, pp. 371–372.

[4] G. K. Jayaprakasha, P. S. Negi, B. S. Jena, and L. Roa, Antioxidant and antimutagenic activities of *Cinammon zeylanicum* fruit extracts. *Journal of Food Composition and Analysis*. 2007, vol. 20, pp. 330-336.

[5] L. Su, J. Yin, D. Charles, K. Zhua, J. Moore, and L. Yu, Total phenolic contents, chelating capacities, and radical-scavenging properties of black peppercorn, nutmeg, rosehip, cinnamon and oregano leaf. *Food Chemistry*. 2007, vol. 100, pp. 990-997.

[6] M. Locatelli, R. Gindro, F. Travaglia, J. D. Coisson, M. Rinaldi, and M. Arlorio, Study of the DPPH˚ scavenging activity: development of a free software for correct interpretation of data. *Food Chemistry.* 2009, vol. 114, pp. 889-897.

[7] M. Fazel, M. Barzegar, and H. A. Naghdibadi, Evaluation effect of heating on antiradical activity of *Thymus vulgaris* L., *Satureja hortensis* L. and *Syzygium aromaticum* L. by DPPH˚ method. *Journal of Medicinal Plants.* 2007, vol. 22, pp. 54-63. (Translated in Persian).

[8] N. Shahsavari, M. Barzegar, M. A. Sahari, and H. A. Naghdibadi Antioxidant activity and chemical characterization of essential oil of *Bunium persicum. Plant Foods and Human Nutrition.* 2008, vol. 63, pp. 183-188.

[9] Ayoughi F, Evaluation of antiradical and antioxidant effects of some medicinal plants. A Thesis of Master of Science in Food Science and Technology. Tarbiat Modares University. Agriculture Faculty. 2009, pp. 37-45.

[10] A. Tomaino, F. Cimino, V. Zimbalatti, V. Venuti, V. Sulfaro, A. Depasquales, and A. Saija , Influence of heating on antioxidant activity and the chemical composition of some spice essential oils. *Food Chemistry*. 2005, vol. 89, pp. 549-554.