

**Volatile composition and antioxidant activity of essential oils extracted from crude organic propolis and its residues from propolis extract production**

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Propolis has received considerable attention as a natural antioxidant source. The ethanolic extraction of propolis generates great amount of residues since 90% of crude propolis is considered as waste after the extraction (1). The possibility of using these residues would aggregate value to the propolis extract chain (2). The essential oils can concentrate many antioxidant compounds present in its raw material, therefore it was hypothesized that essential oils from propolis ethalonic extraction residues could be a substitute to synthetic antioxidants (3, 4). To check this hypothesis, this study evaluated the antioxidant activity of essential oils from crude propolis (PEO) and its residues, moist (MREO) and dry (DREO). EOs extraction was performed by hydrodistillation for 4 hours using a rate of water to solid material of 5:1. Antioxidant activity was performed by ABTS and DPPH free radical scavenging assay and ferric iron reducing antioxidant power (FRAP). Quantification of phenolic content was measured by Folin-Cioucateu method. Headspace GC/MS was used to investigate the volatile composition of EOs. The crude propolis presented the highest EO yield (1.13%) while the moist residue and dry residue produced 0.12% and 0.16% of EO, respectively. EEP present higher antioxidant activity than the EOs measured by ABTS (3.2  $\mu\text{mol TE}/\text{mg}$ ), DPPH (0.15  $\mu\text{mol TE}/\text{mg}$ ) and FRAP (1,386.14  $\mu\text{mol Fe}^{\text{II}}/\text{g}$ ) assays. In ABTS free radical scavenging assay, EOs from crude propolis and from its residues exhibited nearly the same activity (0.41; 0.56; and 0.58  $\mu\text{mol TE}/\text{mg}$ , respectively). In DPPH assay, the EOs demonstrated irrelevant antioxidant activity. In FRAP assay, EO from moist residue (MREO) presented the highest activity (462.67  $\mu\text{mol Fe}^{\text{II}}/\text{g}$ ) among the EOs. For phenolic content, EEP exhibited the highest content (136.99  $\mu\text{mol GAE}/\text{g}$ ). Volatile composition analysis showed that the propolis essential oil (PEO) and its residues EOs presented the same major components:  $\alpha$ -pinene,  $\beta$ -pinene, and thuja-2,4(10)-diene. However, these compounds were presented in lower proportions in the EOs from the moist and dry residues. The EOs of crude propolis and its residues seem to have minor antioxidant activity. The use of EOs from crude organic propolis and its residues as a natural antioxidant source may be improbable whereas the low yield and limited antioxidant activity.

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