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Kinetic study of nordihydroguaiaretic acid recovery from *Larrea tridentata* by microwave-assisted extraction

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Abstract

Nordihydroguaiaretic acid (NDGA) is a powerful antioxidant that can be found in plants like *Larrea tridentata* (*Zygophyllaceae*), also known as creosote bush, which grows in semidesert areas of Southwestern United States and Northern Mexico [1]. Several studies have demonstrated that NDGA has important biological activities with great interest in the health area, such as antiviral, cancer chemopreventive, and antitumorgenic activities [2]. Extraction of bioactive compounds from plants is conventionally performed using a heat-reflux extraction method. However, different techniques have been developed in order to decrease extraction time and solvent consumption, as well as to increase the extraction yield and enhance the extracts quality [3]. The objective of this study was to develop a microwave-assisted extraction (MAE) method for NDGA recovery from *Larrea tridentata* leaves, and compare the obtained results with those found by using the conventional heat-reflux extraction (HRE).

The MAE method consisted in suspending the leaves in methanol, and the obtained suspensions were irradiated with microwaves at 800 W in a pre-setting procedure where after each period of 1 min the sample was allowed to cool at room temperature. Different methanol concentrations (25, 50, 75 and 100 % v/v) and solid/liquid ratios (1/5, 1/10, 1/20 and 1/30 w/v) were tested. Conventional extraction of NDGA was performed using a heat-reflux system. The extraction temperature for both methods was 70 ± 2°C. NDGA was quantified by HPLC, and samples of the MAE treated material were examined by scanning electron microscopy in order to verify the treatment influence on the structure of the plant.

The extraction time of NDGA from *Larrea tridentata* leaves was significantly reduced (p<0.05) from 18 to 1 min when MAE was used instead of the HRE. In addition, significantly higher (p<0.05) yields of NDGA were obtained by MAE comparing with HRE (3.79 ± 0.65 and 3.42 ± 0.19 %, respectively). The optimum conditions for NDGA extraction consisted in using 50% (v/v) methanol as extraction solvent in a solid/liquid ratio of 1/10 (g plant material/ ml extraction solvent). Scanning electron micrographs demonstrated that the improvement of NDGA extraction by MAE might be related to a greater extent of cell rupture of the plant material. In conclusion, MAE was proved to be a fast and efficient method for NDGA extraction from *Larrea tridentata* leaves comparatively to conventional heat-reflux extraction.

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