Contemporary Engineering Sciences, Vol. 11, 2018, no. 77, 3841 - 3848
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/ces.2018.87356

Extraction and Evaluation of the Antioxidant Properties of Coriander (Coriandrum sativum) Seed Essential Oil

Liz Belcy González-Marrugo, Edgard Alexander Granados-Llamas and Clemente Granados-Conde*

Programa de Ingeniería de Alimentos, Grupo de investigación Ingeniería Innovación Calidad Alimentaria y Salud (INCAS), Facultad de Ingeniería
Universidad de Cartagena, Carrera 6 # 36-100
Cartagena de Indias D.T. y C., Colombia
*Corresponding author

Candelaria Nahir Tejada-Tovar

Programa de Ingeniería Química. Grupo de Investigación en Diseño de Procesos y Aprovechamiento de Biomasas (IDAB). Facultad de Ingeniería, Universidad de Cartagena. Colombia., Carrera 6 # 36-100. Cartagena de Indias D.T. y C., Colombia

Rodrigo Ortega-Toro

Programa de Ingeniería de Alimentos, Grupo de investigación Ingeniería de Fluidos Complejos y Reología de Alimentos (IFCRA), Facultad de Ingeniería
Universidad de Cartagena, Carrera 6 # 36-100
Cartagena de Indias D.T. y C., Colombia

Abstract

The oils are constituted mainly by saturated and unsaturated fatty acids. Depending on the seed, grain or bone they come from, they can have properties. Coriander (*Coriandrum sativum*) oil is a natural compound that can be used to prevent oxidation, its availability is extensive, and extraction methods are very varied, among

which pressure, solvent extraction and steam drag. These methods are relatively inexpensive, they are also safe and do not require safety tests by the legislation, being able to provide favourable organoleptic properties to the final product. In the present work, the antioxidant activity of coriander (*Coriandrum sativum*) seed oil was evaluated for its later use as a natural additive. The extraction of the oil was done by the Soxhlet method, then the major components were identified by Gas Chromatography coupled to Mass Spectrometry, and DPPH determined their antioxidant activity. The formulations employed for each oil treatment comprised concentrations of 50 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 and two reference samples were taken (control and ascorbic acid (0.05%) as an antioxidant). A direct relationship was observed between the oil concentration and the DPPH radical inhibition percentage. Five major components were identified: geraniol (24.32%), d-linanol (16.33%), borneol (7.43%), α-pinene (8.97%) and β-pinene (2.06%), which were the ones that contributed to its antioxidant properties.

Keywords: Essential oils, antioxidants, Gas Chromatography

Introduction

For years, various strategies have been developed to prevent the oxidative deterioration produced in the different products. One of these ways of reducing the appearance of oxidation phenomena is the use of antioxidants, whose primary function is to prevent or avoid the formation of free radicals in the product [1].

Currently, the trend of consumers has leaned on the consumption of natural foods, so it is interesting to study the antioxidant activity of Essential Oils (AE) of native plants, to recommend their potential use as natural additives in foods [2].

Plant extracts rich in phenolic compounds seem to be the best candidates for use as antioxidants since they are easily obtained from natural sources and prevent the occurrence of oxidative phenomena. The antioxidant properties of these compounds have been successfully tested in both model systems and meat products.

Coriander essential oil is one of the natural compounds that can be used to prevent lipid oxidation in meat-type foods. Its availability is wide, and its method of extraction is relatively inexpensive, it is also safe and does not require safety tests by the legislation, being able to provide organoleptic properties favourable to the final product [3].

Therefore, the present study was conducted to evaluate the antioxidant activity of coriander (*Coriandrum sativum*) seed oil, whose results present an attractive alternative as a food additive.

Materials and Methods

The methodological development of the work was executed in three stages. In the

first stage, the seeds were collected, and the extraction of the oil proceeded. In the second stage, the main components of coriander oil were identified. Finally, the antioxidant activity of the oil obtained was measured, and the statistical analysis was carried out.

Harvest of plant material

The vegetal material (seeds) was harvested in the city of Pamplona in Norte de Santander (Colombia). The seeds were identified considering the regional herbal of the Catatumbo of the Universidad de Pamplona. This area is characterised by a cold and humid climate, at an elevation of 2616 meters above sea level. After their collection, they were stored in a fresh place, then moved to the city of Cartagena for their analysis.

Oil extraction

The oil was obtained from seeds by the Soxhlet method. The extraction was carried out in two stages, which were differentiated in the amounts of plant material used for it. In the first stage, 172.6 g of the seeds were macerated and weighted. After, samples were introduced into a balloon, to which 1000 mL of water was added. The extraction time was 45 minutes. In the second stage, 103.1g of the sample was taken, and the same procedure was carried out as in the previous stage, the extraction time was 45 minutes.

The oil was separated from the solvent by means of decantation and then weighed on an analytical balance (Precisa Typ 120A) to establish the yield in the two stages and finally establish an average. The oil yield obtained is calculated by Equations 1, 2 and 3.

$$\%\, Yield_1 = \frac{gEO_1}{gvm_1} x100 \tag{1}$$

$$\%\, Yield_2 = \frac{gEO_2}{gvm_2} x100 \tag{2}$$

$$\%\, Yield_2 = \frac{\%\, Yield_1 + \%\, Yield_2}{2} \tag{3}$$

Where, gEO_1 and gEO_2 are the grams (g) obtained from the essential oil in the first and second stages respectively, and gvm_1 and gvm_2 correspond to the weight in grams (g) of the plant material in each stage.

Determination of the main components of coriander seeds oil
The instrumental technique of Gas Chromatography coupled to Mass Spectroscopy (GC-MS) was performed (Figure 1). A capillary column HP 5 ms, 30mm, 0.25mm was used and 0.25-micron film thickness. 1µL of oil was injected using an automatic injector in a 50: 1 ratio. The ionisation energy was 70 electron volts (eV), and the scanning degree was 40 to 500 amu. The identification of the essential oil compounds was established according to their retention rates. The temperature of the injector was 200 °C, the temperature of the detector was 250 °C, and the carrier gas was helium.

Oven conditions. The initial temperature of the oven was 60 °C, the oven was heated at a rate of 4 °C per minute up to 260 °C. Maintaining the last one for 20 min, the temperature of the detector was 300 °C.

Figure 1. Gas Chromatography coupled to Mass Spectrometry (GC-MS)

Measurement of the antioxidant capacity of the oil by inhibiting the DPPH radical

Preparation of the DPPH stock solution. 150 mg of DPPH (Sigma) were taken and dissolved in 7 mL of CH_3OH (Merck), the solution was kept under obscurity for 24 hours. After this time, it was taken and diluted with CH_3OH until obtaining an adjusted absorption of 0.300 ± 0.05 measured at a wavelength (λ) of 517 nm in the spectrophotometer. The control was pure CH_3OH.

Reaction tubes. A concentrated solution of the sample of essential oil (EO) of 10000 ppm, (50 mg in 5 mL of DMSO) (Merck) was prepared, and from it diluted solutions were prepared at different concentrations: 50, 100, 150, 200, 250 and 300 ppm. From each one, 40 µL were taken by adding 1960 µL of the solution of the $DPPH^{\bullet}$ radical. These tubes were prepared in triplicate.

Sample blank. From the cells of the diluted solutions, 40 µL was taken and taken to a test tube where 1960 µL of CH_3OH was added.

Reference sample. To 60 µL of DMSO was added 1960 µL of the solution of the DPPH • radical. These tubes were prepared in triplicate.

The test tubes were taken in darkness for 30 min. Subsequently, the absorbance at 517 nm was measured using a spectrophotometer (Milton Roy Company Spectronic Model 21). The data were reported, and the percentage inhibition (%Inh) was calculated using Equation 4.

$$\%Inh = \left[1 - \frac{A_{sample} - A_{blank}}{A_{reference}}\right] x100 \quad (4)$$

Statistical analysis
The analysis of variance was applied through the Software SPSS, version 14 for Windows.

Results and Discussion

Determination of the main components of coriander seeds oil
Figure 2 shows a chromatographic profile obtained by Gas Chromatography coupled to Mass Spectrometer (GC-MS), in which 5 main components were identified.

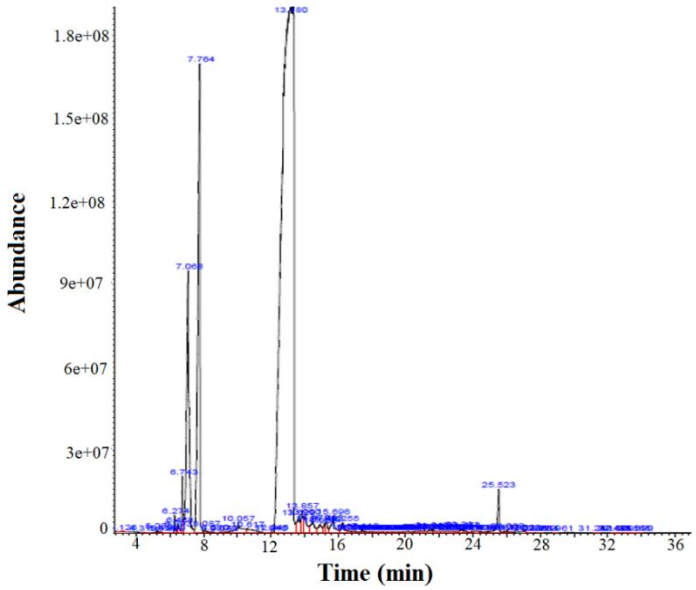

Figure 2. Characteristic chromatographic profile of Coriandrum sativum oil

According to the chromatographic profile of coriander seed oil, 5 main components were identified and quantified, among which geraniol (24.32%) and d-linanol (16.33%) stand out due to its higher concentration. The α-pinene (8.97%), borneol (7.43%), β-pinene (2.06%) were identified too. Other components as decyl aldehydes with different molecular weights and therefore different retention times representing proportions close to 15 %. These components are associated with the antioxidant activity of coriander oil.

Previous studies conducted on several species of coriander have reported the presence of d-linanol, α-pinene, β-pinene, geraniol, borneol as its major components. The significant components of the oil under study coincide with the results reported in the literature in which other coriander species were used [4]. Different authors claim that the variations obtained regarding the composition of essential oils depend on several factors such as geographical conditions (provenance, height, weather and season), botanical and agricultural (density of plant sown, amount of water used in irrigation) and the method of extraction [5].

Measurement of the antioxidant capacity of the oil by inhibiting the DPPH radical
When measuring the antioxidant capacity of the oil sample using different concentrations against the DPPH radical, the absorbance data were obtained that were replaced in Equation 4 to determine the inhibition percentages (% Inh) (Table 1).
As was expected, when conducting the tests with the oil, a direct relationship was observed between the oil concentration and the percentage of inhibition of the DPPH radical (% Inh). Obtaining a higher value of % Inh at 300pp, a lower value at 50ppm.

Table 1. Antioxidant capacity (% Inhibition) against the DPPH radical of coriander oil

Essential oil (mg/L)	*%Inh*
50	5.9 ± 0.3^{a}
100	6.52 ± 0.06^{b}
150	8.7 ± 0.2^{c}
200	10.31 ± 0.04^{d}
250	12.3 ± 0.2^{e}
300	14.7 ± 0.6^{f}

Different superscripts letters indicate significant differences ($p < 0.05$) among treatments

The antioxidant effect of coriander extracts has been attributed to the presence of n-decanol (15.2%), decanal (12.9%), (E) -2-decenal (8.5%), undecanal (3.9%) and nonane (3.4%) [6]. This description was like that reported by other authors [7], in this study they report that linalool is the main component of most essential oils obtained

from coriander. Concerning this, the differences found in the composition of coriander oil can be attributed to the age and physiology of the plant, in addition to the soil conditions, which influence the amount and location of the compounds in their tissues [8].

Conclusions

It is concluded that the antioxidant activity of coriander seed oil has a direct relationship with the percentage of inhibition of the DPPH radical. The treatment with the highest concentration (300 ppm) showed the highest percentage of inhibition (14.7 ± | 0.6). It is also observed that differences of 50 ppm are enough to promote significant changes in antioxidant activity ($p < 0.05$). According to the chromatographic profile of coriander seed oil (Coriandrum sativum), 5 major components were identified and quantified: geraniol (24.32%), d-linanol (16.33%), α-pinene (8.97%), borneol (7.43%) and β-pinene (2.06%). According to the antioxidant properties of the oil studied, it can be a suitable food additive to delay or inhibit some oxidative processes.

Acknowledgements. The authors thank the University of Cartagena for their support in the development of this work.

References

[1] B. Halliwell and J. Gutteidge, *Free Radicals in Biology and Medicine*, 2 ed., National Institute for Biological Standards and Control, Oklahoma Medical Research Foundation Claredon Press, Oxford, 1989.

[2] C. Granados, X. Yanñez and G. Santafé, Evaluación de la actividad antioxidante del aceite esencial foliar de *Calycolpus moritzianus* y *Minthostachys mollis* de Norte de Santander, *Bistua Revista De La Facultad De Ciencias Basicas*, **10** (2012), 1-16.

[3] G. Olmedo, *Aceite Esencial De Orégano Como Antioxidante Natural Para Aceite De Maní*, Química Biológica, Facultad de Ciencias Agropecuarias (UNC) – Imbiv-Conicet, Universidad de Córdoba, 2003.

[4] E. Torres, A. López and M. Sosa, Extracción, composición y caracterización de los aceites esenciales de hoja de semilla de cilantro (*Coriandrum sativum*), *Temas Selectos De Ingeniería De Alimentos*, **7** (2013), 97-103.

[5] M.S. Guala, H. Elder, P. Perez and A. Chiesa, Evaluación del poder antioxidante de fracciones de aceite esencial crudo de *Schinus molle l.* obtenidas por destilación al vacio, Universidad Nacional del Litoral, Serena, *Información Tecnológica*, **20** (2009), 83-88.

https://doi.org/10.4067/s0718-07642009000200011

[6] G. Tafurt, J. Martínez and E. Stashenko, Evaluación de la actividad antioxidante de aceites esenciales en emulsiones degradadas por radiación ultravioleta, *Revista Colombiana de Química*, **34** (2005), 43-55.

[7] D. Lamparsky and I. Klimes, Heterocyclic trace components in the essential oil of Coriander, *Perfumer and Flavorist*., **13** (1988), 17-25.

[8] Z. Lassanyi and C. Lorincz, Test on terpenoids presents in parts of *Coriandrum sativum l*. III. Histology of the developing structures of *Coriandrum sativum l*. var "luc" and properties of volatile oils canal, *Acta Agronomica Academiae Scientiarum Hungaricae*, **19** (1970), 5-32.

Received: August 12, 2018; Published: September 12, 2018