

HOSTED BY



ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect



Oil and fatty acid accumulation during coriander (*Coriandrum sativum* L.) fruit ripening under organic cultivation



Quang-Hung Nguyen, Thierry Talou, Mureil Cerny, Philippe Evon, Othmane Merah*

Université Fédérale de Toulouse Midi-Pyrénées, INP-ENSIACET, Laboratoire de Chimie Agro-industrielle, F-31030 Toulouse, France
Institut National de Recherche Agronomique, UMR 1010 CAI, F-31030 Toulouse, France

ARTICLE INFO

Article history:

Received 22 January 2015

Received in revised form

26 March 2015

Accepted 1 June 2015

Available online 6 June 2015

Keywords:

Oil content

Petroselinic acid

Coriander

Organic cultivation

Fatty acid accumulation

ABSTRACT

To evaluate the accumulation of oil and fatty acids in coriander during fruit ripening, a field experiment was conducted under organic cultivation conditions in Auch (near Toulouse, southwestern France) during the 2009 cropping season. The percentage and composition of the fatty acids of coriander were determined by gas chromatography. Our results showed that rapid oil accumulation started in early stages (two days after flowering, DAF). Twelve fatty acids were identified. Saturated and polyunsaturated acids were the dominant fatty acids at earlier stages (2–12 DAF), but decreased after this date. After this stage, petroselinic acid increased to its highest amount at 18 DAF. In contrast, palmitic acid followed the opposite trend. Saturated and polyunsaturated fatty acids decreased markedly and monounsaturated fatty acids increased during fruit maturation. It appears that the fruit of coriander may be harvested before full maturity.

© 2015 Crop Science Society of China and Institute of Crop Science, CAAS. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Coriander (*Coriandrum sativum* L.), an annual herb belonging to the Apiaceae family, is a Mediterranean indigenous plant [1]. The species is grown mostly in temperate areas around the Mediterranean basin and in India, China, Thailand, and Eastern Europe [2]. It is used as an herbal condiment in many culinary preparations. The plant is cultivated for its seeds, which are used for many purposes including aromatherapy, food, drugs, cosmetics, and perfumery. The seeds also have medicinal uses in treatment of rheumatism, gastrointestinal complaints, flatulence and gastralgia, worms, insomnia, anxiety, loss of appetite, and glycemia [3,4]. In industry, the main product from

coriander is distilled oil and solvent-extracted oleoresin for aroma and flavor production [5]. Coriander oils are familiar not only in the perfumery, food, beverage, and pharmaceutical industries, but also in medicine. They are used as antioxidants, in treatment of nervous disorders, for gut modulation, blood pressure lowering, and diuretic activity, as an anti-diabetic and antimicrobial agent, and in many traditional remedies for various diseases [6–8]. The use of coriander seeds as a spice is widespread. Coriander represents 25–40% of curry powder, and is used to flavor liqueurs, being an important flavoring agent in gin production. Coriander seeds are also used in the preparation of baked goods and tobacco products [1].

Interest in coriander seed oil has increased since the European Union authorized the use of coriander oil as a food supplement. The accumulation of oil in coriander seed is thus of great interest for food use. Knowledge of its seed oil accumulation with the aim of maximizing oil production has become important.

* Corresponding author. Tel.: +33 534323523; fax: +33 534323597.

E-mail address: othmane.merah@ensiacet.fr (O. Merah).

Peer review under responsibility of Crop Science Society of China and Institute of Crop Science, CAAS.

Petroselinic acid is an unusual fatty acid that occurs primarily in seeds. This fatty acid composes nearly 85% of the total fatty acids of Apiaceae seeds [9]. It can be oxidatively cleaved to produce a mixture of lauric acid, a compound useful in the production of detergents, and adipic acid, a C₆ dicarboxylic acid used in the synthesis of nylon polymer [10].

To our knowledge, aside from two reports [10,11], the accumulation of lipids and fatty acids during the seed development of *C. sativum* L. has been little studied. Moreover, both studies were performed under conventional cultivation or in the greenhouse. No study of the accumulation of fatty acids in coriander seeds under organic conditions has been reported. The aim of this study was the evaluation of oil content and fatty acid composition from flowering to maturity of coriander fruits under organic cultivation.

2. Material and methods

2.1. Location and plant experiment

A field trial was conducted in south-western France at the Regional Centre of Experimentation in Organic Agriculture at Auch (near Toulouse, southwestern France, 43°38'47" N, 0°35'08" E) during the 2009 cropping season. Sowing was performed on March 23, 2009. Seeds of the French coriander cultivar Dourou (GSN, Riscle, France) were directly sown by hand into the field at a rate of 1.2 g m⁻² to a depth of 3 cm.

The crops were managed under completely organic and rainfed conditions without chemical addition. Weeds were mechanically removed. The soil was a clay loam (organic matter content: 3.2%; pH 8.1) with a depth of about 1.2 m. Flowering started at the end of May and maturation occurred at the beginning of August.

Table 1 shows temperatures and rainfall during the plant cycle in comparison to weather data for the last 55 years. Indeed, rainfall was at least 50 mm lower than the half-century precipitation observed for the same period in this area. The 2009 growing season was less rainy and hotter than the mean values of 55 years.

Table 1 – The prevailing weather condition during the 2009 plant cycle.

Month	Rainfall		Temperature	
	2009	55 years	2009	55 years
January	95.4	65.0	4.9	5.7
February	40.4	55.9	5.8	6.9
March	23.6	57.1	8.7	9.2
April	105.4	66.6	11.7	11.5
May	44.4	77.2	16.8	15.3
June	39.4	61.1	20.1	18.9
July	41.2	47.1	21.7	21.5
August	20.0	58.3	22.7	21.3
September	46.8	55.9	18.9	18.5
October	35.6	56.8	15.0	14.4
November	102.2	57.2	10.9	9.0
December	34.6	68.1	5.9	6.2
Mean: sum over year	629.0	726.3		
Mean: sum Mar.–Sept.	320.8	423.3		
Mean: sum May–July	125.0	185.4		

2.2. Oil and fatty acid composition measurements

Seed sampling was performed every five (on average) days from flowering to maturity. Harvesting continued from 2 days after flowering (DAF) to 53 DAF. The fruit's color and relative moisture content were adopted as ripening criteria. Seed water content (SWC in % of the seed dry matter) was measured for each sample as an indicator of stage of physiological maturity. Moisture contents were determined by heating in an air oven at 60 °C to constant weight.

Dry coriander seeds were ground in an electric grinder (IKA MF-10-basic Microfine grinder, Sigma Aldich, Frankfurt, Germany). Triplicate samples of 20–30 g were subjected to conventional extraction for 5 h with cyclohexane in the dark. The solvent was removed in a rotary evaporator under low pressure at 35 °C. The vacuum system was used to dry the oil at 35 °C overnight. The oil yield was determined. Oil (20 mg) was extracted in a Soxhlet extractor for 5 h, and then 1 mL tert-butyl methyl ether was added. The mixture was filtered through a glass fiber filter (GHP, 0.45 μm, small diameter). At this step 100 μL of filtrate was added to 50 μL of trimethylsulfonium hydroxide 0.5 mol L⁻¹ in methanol and stirred gently. Fatty acid analysis was performed by gas chromatography (GC-3900) with a flame ionization detector with a CP-select CB for FAME fused silica WCOT column of length: 50 m, internal diameter: 0.25 mm, and film thickness: 0.25 μm. The carrier gas was helium with a flow rate of 1.2 mL min⁻¹ and the split ratio was 1:100. The initial oven temperature was programmed to 185 °C for 40 min, increasing at 15 °C min⁻¹ to 250 °C and held for 10.68 min. (analysis time: 55.0 min). The injection and detector temperature were held at 250 °C for 55 min. Analyses were performed in triplicate.

All data were subjected to variance analysis using the GLM procedure of SAS (SAS Institute, Cary, NC, USA). Mean comparisons were performed with a Duncan test at the 0.05 probability level.

3. Results and discussion

The changes in oil yield of coriander from flowering period to maturity (53 days) are presented in Table 2. Water content decreased markedly from flowering to maturity (Table 2). Oil yield varied between 4.6% and 25.1% at different stages of fruit ripening (Table 2). Oil content increased gradually from flowering to maturity. Oil content increased threefold from 2 to 12 DAF. At maturity, the oil content reached its highest level (25.1%). The oil yield in the mature stage of ripening was slightly lower than that previously reported for coriander under conventional agriculture [10,12] but higher than the values reported by Angelini et al. [9]. This result was expected, given that organic cultivation is considered a stress condition [13]. Moreover, it is well known that oilseeds produce and accumulate less oil under drought than under favorable conditions [14,15]. This difference may be explained by the genetic origins of the cultivars used in these studies [13]. The oil yield increased rapidly from days 10 to 34 after the flowering sampling period and reached its maximum level at maturity, when the oil yield was maximal and its value was similar to those of other reports describing

Download English Version:

<https://daneshyari.com/en/article/2079464>

Download Persian Version:

<https://daneshyari.com/article/2079464>

[Daneshyari.com](https://daneshyari.com)