



Short communication

Essential oil profiling of Ajowan (*Trachyspermum ammi*) industrial medicinal plant

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ARTICLE INFO

Keywords:

Inflorescence
Metabolomics
 γ -Terpinene
 ρ -Cymene
Thymol
Volatile oil

ABSTRACT

Ajowan (*Trachyspermum ammi* L.) is a highly valued medicinally important seed spice from Apiaceae family, which contains essential oil, exhibiting a chemical composition that can be strongly altered with developmental stages of the inflorescence. In order to investigate the changes of metabolite profile of Ajowan, the inflorescence harvested in ten developmental stages. The oil of each inflorescence stage collected by hydrodistillation and analysed by GC/MS. The essential oil concentrations were in a range of 3.71% (stage 1)–5.08% (stage 8). In this study, fourteen components were identified, which thymol, γ -terpinene, and ρ -cymene comprised between 94% and 96% of the essential oil. The results showed that during the anthesis stages, the thymol percentage in the essential oil of Ajowan was decreased, but the γ -terpinene percentage was increased. Hence, during the fruit ripening stages, the thymol and ρ -cymene percentages were increased but the γ -terpinene percentage was decreased. There was a negative correlation of γ -terpinene, ρ -cymene, and thymol. The results suggested that different harvest stages of Ajowan inflorescence have a significant effect on the essential oil concentration and composition. Furthermore, the anthesis stage was an important turning point of the main component percentage of the volatile oil composition of Ajowan inflorescence.

1. Introduction

Metabolite profiling (metabolomics) is essential in plant metabolite research and concentrate on the large group of metabolites analysis, which is associated with a specific metabolic pathway or a group of compositions, particularly in medicinal plants (Desai and Alexander, 2013; Wolfender et al., 2015). GC/MS technique is regularly and effectively used for the analysis of essential oils and has been extensively applied to metabolite profiling in medicinal plants (Mirzahassemi et al., 2017; Rubiolo et al., 2010; Rusanov et al., 2011).

Ajowan (*T. ammi* L. Sprague ex. Turill, syn. *T. copticum* Linn and *Carum copticum* Benth and Hook), belonging to the family Apiaceae, is an important annual herbaceous plant and a highly valued medicinally seed spice (Malhotra and Vashishtha, 2005; Malhotra and Vijay, 2004). Until now, research on Ajowan plant has been focused on its essential oil concentration and composition (Baby et al., 2012; Mirzahassemi et al., 2017; Zarshenas et al., 2014; Soltani Howyzeh et al., 2018). In this study, we report the metabolite profiling of the chemical composition and oil content of different developmental stages using gas chromatography/mass spectrometry (GC/MS), in order to recognize the major changes in the essential oil composition during flowering and

seed ripening in Ajowan.

2. Materials and methods

2.1. Plant materials

Ajowan seeds were purchased from a medicinal plants bazaar in Ahvaz, Iran. Ajowan seeds were identified by M. Soltani Howyzeh and a voucher specimen (no: 20112) deposited in College of Abouraihan, University of Tehran. Seeds were planted in an experimental field in Ahvaz in January 2015. After the emergence of flower buds in May 2015 until fruit maturation stage in July 2015, in order to investigate the changes of essential oil metabolite profile of *T. ammi* during flower development, the process of inflorescence development, based on the morphological traits, was divided into ten consecutive developmental stages (~5 days between each stage) (Fig. 1). The ten developmental stages of inflorescence were described for the first time by the authors as below.

Stage 1: Primary umbels are visible but umbellets are not developed and are not visible in each umbel.

Stage 2: The umbellets of each umbel are visible but petals are not

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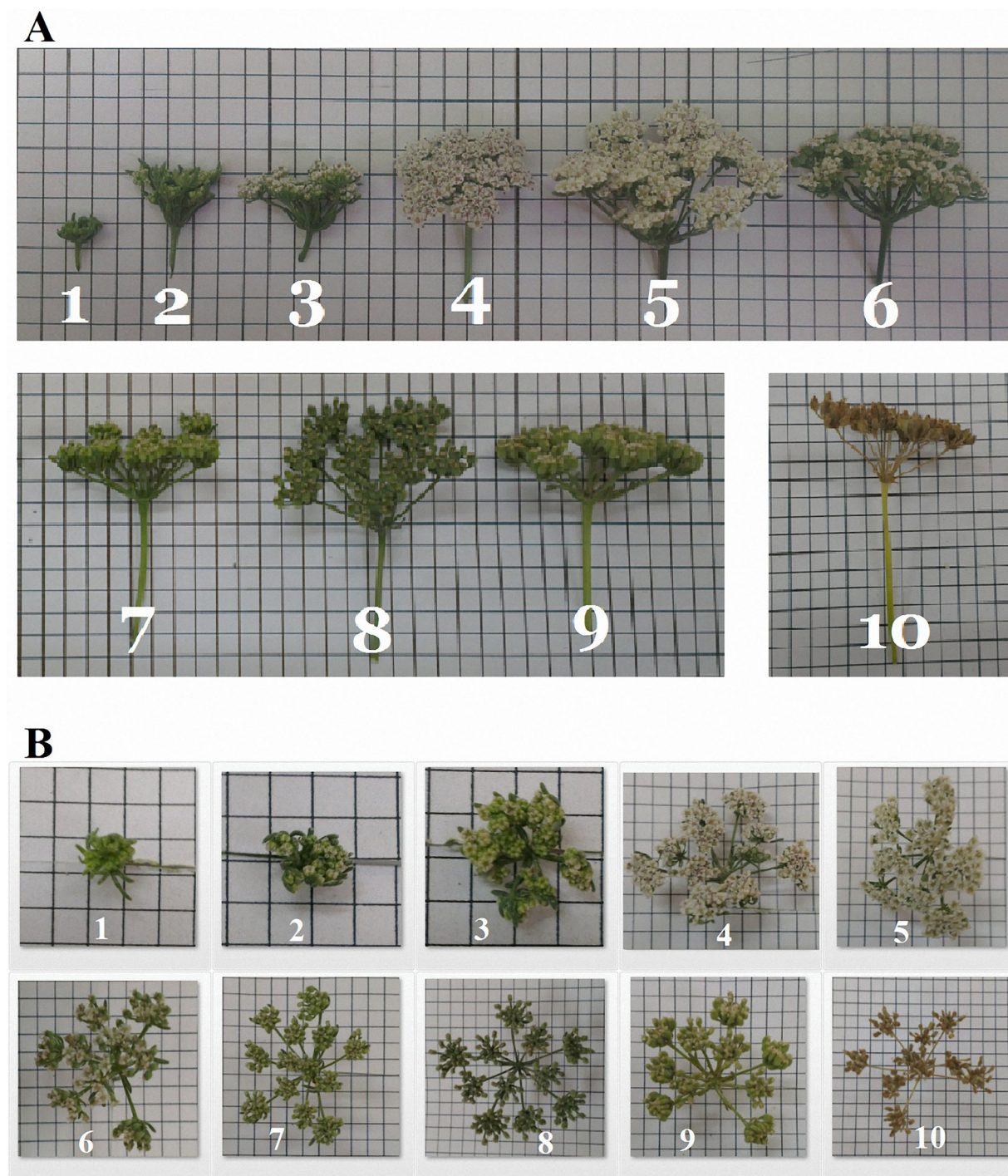


Fig. 1. Stages of *T. ammi* inflorescence development used in the present study. A) Side view. B) Top view. Numbers show the inflorescence stages in tandem.

visible.

Stage 3: The umbellets are fully developed, and the petals are visible.

Stage 4: The petals are fully opened and in the middle of them red colour is visible. The red colour comes from the anther of the stamen. Anthers in this stage are not opened.

Stage 5: Anthesis happens and the red colour in the middle of petals is not observable. The filaments of the stamens are visible and anthers start to pollinate.

Stage 6: The anthesis of all umbellets is completed and the white petals start to fall.

Stage 7: The petals are fully fallen, and green fertilized ovaries

appear. Above each ovary, the remains of style and stigma are visible.

Stage 8: Only dark-green fruits are visible. Each fruit is swollen and juicy.

Stage 9: The fruits ripened and the colour the fruits become light green to some yellow.

Stage 10: The fruits fully ripened and the inflorescence dried. The colour of the fruits becomes brownish.

2.2. Essential oil isolation

The harvested samples from each inflorescence stage (3 replications) were dried at room temperature and ground to a coarse powder

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