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ORIGINAL RESEARCH ARTICLE

Effect of different drying methods on the variation of volatile oil composition in different parts of *Trachyspermum ammi* (L.)

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ABSTRACT

Trachyspermum ammi (L.) Sprague (Family: Apiaceae), commonly known as Ajwain, is widely grown in India, Afghanistan, Iran, Egypt, Pakistan, etc. Conventionally distillation of the Ajwain crop is done before the formation of the seed for extraction of the essential oil. The quality and quantity of essential oil production depend not only on genetic factors but also on the plant's developmental stage, post-harvest treatments, etc. Thus, the present study was undertaken to find out the effect of six factors like drying of the herb in the shade, sun, and oven (after seed formation), harvesting before and after seed formation, and powdering the material after seed formation on the essential oil yields and chemical composition. A marked difference was noted in the essential oil yields in all the experiments, with maximum yield being observed in the sun-drying method (3.2%). In contrast, a low yield was noted in the powdered material(0.3%). The chemical composition of the essential oil showed an interesting pattern. The major component γ-terpinene was observed more in the essential oil obtained in the after-seed harvest material (74.201%), whereas its low abundancy was noted in the oven-dried material (31.756%). Powdering the material has influenced the thymol content evident from the essential oil obtained from the unpowdered material (37.916%)to the powdered material (3.99%); both were done before seed harvest. Based on the above results, it can be concluded that the essential oil characteristics of Ajwain are greatly influenced by drying temperature, methods of sample preparation, and storage of herbage.

INTRODUCTION

Trachyspermum ammi (L.) Sprague (Family: Apiaceae), commonly known as Ajwain is widely grown in arid and semi-arid regions and also grown in saline soils (Joshi S, 2000). The herb is glabrous or minutely pubescent and grows up to 90 cm (Chatterjee ASC, 1995). It is mostly found in Indian cooking, where it is also known as bishop's weed or carom (Davidson and Jaine, 2014). This plant is generally cultivated in October & November and harvested in May & June (Ranjan B *et al.*, 2012). The dehulled matured seeds are used in nutritional disorders and culinary (Chauhan *et al.*, 2012).

T. ammi exhibit numerous biological activities like digestive stimulant actions, gastroprotective activity (Platel and Srinivasan, 2001),

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hepatoprotective activity, antihypertensive and broncho-dilating activity (Gilani *et al.*, 2005), antiplatelet-aggregatory (Srivastava, 1988), antilithiasis and diuretic activity (Ahsan *et al.*, 1989), nematicidal activity (Park *et al.*, 2007), antifilarial activity (Mathew *et al.*, 2008), anti-spasmodic, antitussive effects (Boskabady*et al.*, 2005).

The seeds of Ajwain contain up to 5% essential oil (Minija J and Thoppil JE, 2002), with thymol (39.1%) being the major component along with *p*-cymene (30.8%), γ-terpinene (23.2%), β-pinene (1.7%), terpinene-4-ol (0.8%). Similarly, acetone extract of ajwain showed the thymol (39.1%) being the major compound followed by oleic acid (10.4%), linoleic acid (9.6%), (γ-terpinene (2.6%), p-cymene (1.6%), palmitic acid (1.6%) and xylene (0.1%) (Singh *et al.*, 2004). More polar glycosidic constituents such as 6-hydroxycarvacrol 2-O-β-D-glucopyranoside and 3, 5-dihydroxytoluene 3-O-β-D-galactopyranoside have been reported from its fruits (Gang *et al.*, 1980). Also, a steroid-like substance and a compound, namely 6-O-β-glucopyranosyloxythymol, have been isolated from the fruits (Garg 1998). Water-soluble portion of Ajwain fruit have 3,7-dimethyloct-3(10)-ene-1,2,6,7-tetrol; (2S,6Z)-3,7-dimethyloct-3(10)-ene-1,2,6,7-tetrol-1-O-β-D-glucopyranoside and 6-hydroxythymol-3-O-β-D-glucopyranoside;2-methyl-3-buten-2-ol-β-D-glucopyanoside, benzyl-β-D-glucopyranoside and (3R)-2-hydroxymethylbutane-1,2,3,4-tetrol (Ishikawa *et al.*, 2001; González *et al.*, 1988).

The present paper reports the role of drying methods, stages of harvest, and texture of the sample on the essential oil yield and chemical composition of Ajwain.

MATERIALS AND METHODS

Plant material collection

Different parts of the Ajwain herb were collected from a farmer's field in the Kurnool district of Andhra Pradesh in February 2020. They were identified by a taxonomist, Dr. Venkat Ramana, Assistant Professor, Department of Botany, Nizam College, Osmania University, Hyderabad, India. A voucher specimen (CIMAP-TA/20) was deposited at CSIR-Central Institute of Medicinal and Aromatic Plants, Research Center, Hyderabad, India.

Sample preparation

Influence of factors like post-harvest treatments (such as drying of the plant material under the sun at about 36-38°C for 24-32 hrs, under shade at ambient temperatures for four days, in a hot air oven at 45°C for 6hrs) and different growth stages (such harvesting of the plant material after seed formation, before seed formation and after seed harvest)on the yield and chemical composition of the essential oil of Ajwain was studied. The plant material tested at different growth stages was collected at given stages of growth and dried under shade for four days and hydrodistilled for essential oil.

Extraction of essential oil

The extraction of the essential oil was done using the hydrodistillation method in a Clevenger type apparatus by adding 200 gm of sample in a 2L flask with 1L of distilled water. Hydro-distillation was carried for about 5 hours, and the condenser was cooled with water. The oil samples were stored at 0-5°C in air-tight containers until analysis. The oil samples were dried over anhydrous sodium sulfate and filtered before the Gas Chromatographic (GC) analysis.

Gas chromatography parameters

The essential oils were analyzed on a Varian CP-3800 model gas chromatograph with a Galaxy software system equipped with a flame ionization detector (FID) and an electronic integrator. Separation of the compounds was achieved by employing a Varian CP-Sil 5CB capillary column (ID: 50 m X 0.25 mm; film thickness 0.25 ìm). Nitrogen was used as the carrier gas at a constant flow rate of 0.4 mL/min. The column temperature was programmed from 60° C (held for two min.) then changed to 220° C (held for six min.) at a rate of 5° C/min; later column temperature was increased to 245° C at a rate of 5° C/min. The injector and detector temperature were set at 250° C and 300° C, respectively. Samples (0.2 µL) were injected with a 20:100:20 split ratio. Retention indices were generated with a standard solution of n-alkanes (C_6-C_{19}). The composition was reported as a relative percentage of the total peak area without FID response factor correction.

RESULTS AND DISCUSSION

Effect of seed on the oil yield and composition

Ajwain samples were collected during different growth stages were distilled for oil recovery and composition studies. The samples collected after seed formation have shown slightly higher oil recovery (2.5%) when compared to the sample collected before the seed formation stage (2.1%) (Figure 1). But the sample collected after the seed harvest has shown a drastic reduction in the essential oil content (0.35%).

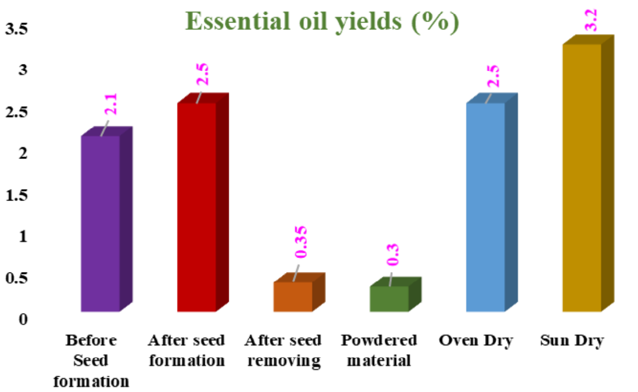

Figure 1: Essential oil yields in Ajwain samples.

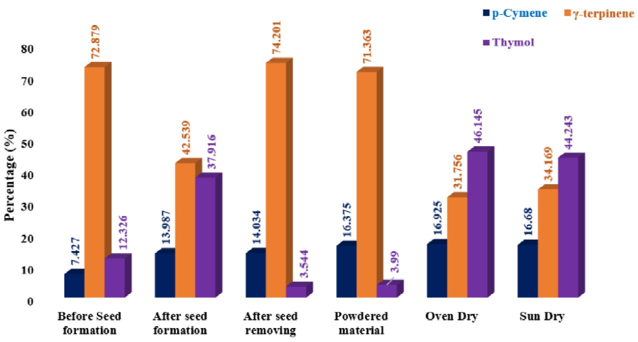

Figure 2: Volatile Compounds (%) in the Essential Oils of Ajwain.

Altered chemical composition was observed in the essential oil of different samples. γ-terpinene was recorded at the highest percentage in the sample before seed formation (72.879%), which was reduced in the samples collected after seed formation (42.539%). So, γ-terpinene played a major role in the formation of the seed in the Ajwain herb due to the combustion of γ-terpinene for developing the seed. The essential oil extracted from the plant sample resulting after seed harvest showed an increased percentage of γ-terpinene (74.201%). Meanwhile, another major compound, thymol was increased from before seed (12.326%) to seed formation stage (37.916%) (Figure 2). The *p*-cymene was also increased (7.247 to 13.987%) like thymol.

Effect of different drying methods on ajwain oil recovery (%)

The influence of different drying methods (under shade, sun, and hot air oven (45° C)) were studied on the herb with seed. The sun-dried sample showed a higher recovery of essential oil (3.2%) when compared to the shade (2.5%) and oven drying (2.5%) methods. The drying of the herb at a controlled temperature under a hot air oven has given similar oil yields as obtained from shade dried material but at a lesser time. Thymol is one of the major components of these essential oils to determine the quality of Ajwain oil. The highest thymol percentage (46.145%) was noticed in the sample dried in a hot-air oven at 45°C (Figure 3). Interestingly, the γ-terpinene was decreased in sun-dried (34.169%) and hot air oven-dried (31.756%) samples when compared to shade-dried samples (42.539%). Another minor compound, p-cymene, was also higher in the sun (16.680%) and oven-dried

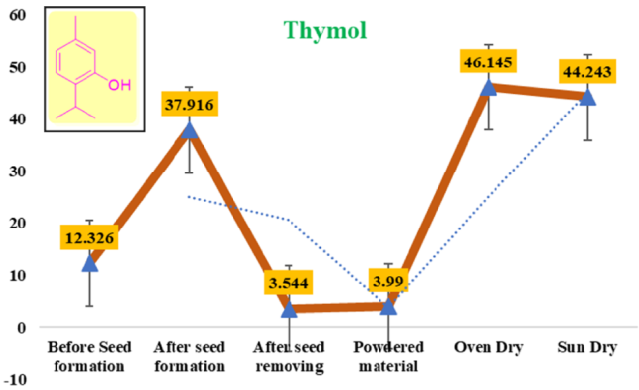

Figure 3: Variations of thymol content in different Ajwain samples analyzed.

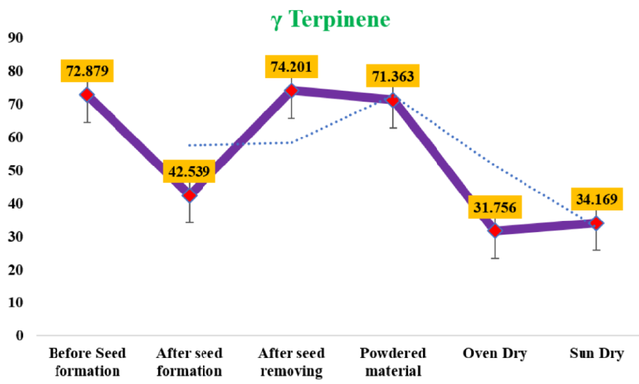

Figure 4: Variations of γ-terpinene content in different Ajwain samples analyzed

(16.925%) samples, as compared to the shade-dried sample (13.978%).

Effect of powdering on the essential oil recovery and chemical composition

Another experiment was conducted to know the effect of powdering on essential oil yields and compositions. The powdered material yielded a significantly lower percentage of the essential oil (0.3%). The mechanical friction generated during the powdering process might have lessened the essential oil recovery and hence is not recommended. Powdering of the planting material was also contributed to the altered chemical composition of the essential oil. The principal compound thymol was drastically reduced (3.544%) in a powdered sample compared to the unpowdered material (37.916%). But interestingly, γ-terpinene was recorded the highest content (71.363%), and p-cymene showed a slight content (13.987 to 16.375%) in the powdered material. (Figures 3, 4, 5).

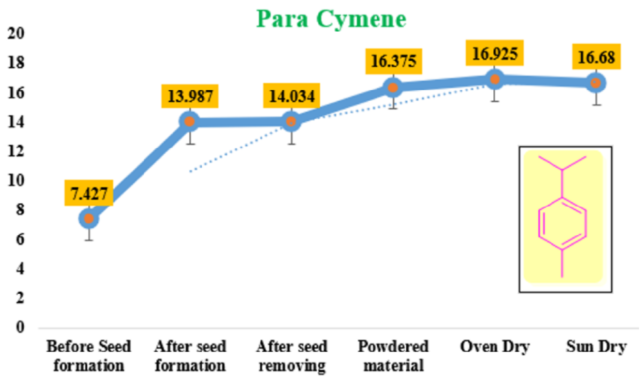

Figure 5: Variations of *p*-cymene content in different Ajwain samples.

Value addition studies

Generally, farmers cultivate Ajwain herb only for its seeds, and subsequently, after collecting the seed, the left-out plant material is utilized for compost or cooking cane purposes. Our study does prove that this deseeded material does contain a considerable quantity, i.e., up to 0.35% of essential oil. The chemical composition of the extracted essential oil has shown a high percentage of γ-Terpinene (74.201%) and p-cymene (14.034%) (Figures3, 4, 5).

CONCLUSION

The method of drying temperature significantly influences the quantity and quality of the active ingredients present in Ajwain essential oil. Hot air oven drying is an excellent option to get a better yield of essential oil at a shorter drying time. Drying at 45°C in a hot air oven gave an oil recovery of 2.5% as similar to shade drying. It is also observed that the essential oil composition of the ajwain herb is greatly influenced by drying temperature. Drying the plant material under Sun and hot air oven has also shown a significant difference in the yield (3.2% and 2.5%) but a lesser change in the composition of the resulting essential oil. The powdering of the material resulted in a wealthy percentage of the γ-terpinene component. The deseeded plant material contains a considerable amount of essential oils and can become a source of additional income to the farmer if distilled and sold in the market.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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