Evaluation of volatile compounds in a value-added jerky by incorporating Ajwain and Thyme essential oils

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INTRODUCTION

- **Essential oils (EOs)** are organic products extracted from aromatic plants containing volatile components possessing antimicrobial and antioxidant effects.
- They are **potential substitutes** for food additives and preservatives in the food processing industry.

Ajwain (*Trachyspermum ammi L.*)

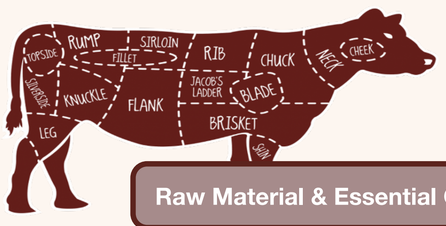
Family: Apiaceae
Origin: Egypt, **India**, Iran, Pakistan & some regions of Central Europe
Description: Widely known for its culinary use and pharmacological effects (e.g. gastrointestinal disorders, respiratory disorders, etc.)

Thyme (*Thymus vulgaris L.*)

Family: Lamiaceae
Origin: Southern Europe & Northern Africa
Description: Its essential oil is highly recognized in food industry for its antimicrobial and flavouring properties.

- This study aimed to identify the volatile compounds in Thyme essential oil (TEO) and Ajwain essential oil (AEO) and quantify the chemical composition in our value-added jerky product.

MATERIALS & METHODS



Raw Material & Essential Oil

- Hovězí zadní **(CZ)** or Beef rump.
- Rectangular slices (5 cm x 2.5 cm x 1cm)
- Essential Oils (EOs): **Ajwain Essential Oil** & **Thyme Essential Oil**
- **Doses**: 0 mL, 0.75 mL, 1.5 mL

Image 1: Raw meat slices

Sample Preparation

- **Meat Preparation**
  - In salt solution (12 g NaCl L^{-1}) for 10 min before treatment.
- **Hot Air Blanching (HAB)**
  - Filter paper with AEO & TEO.
  - Meat in a conventional dryer for 10 min at 35°C.
- **Oil Treatment (OT)**
  - Meat immersed in 20 mL sunflower oil mixed with EOs for 10 min at 25 °C.

Image 2: Hot air blanching

Drying

- **Dryer temperature**: 55°C
- **Drying time**: 6 hours (meat samples flipped after 3 hours)

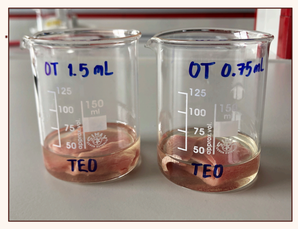


Image 3: Oil Treatment

Volatile Compounds Analysis

- **Headspace-Solid Phase Microextraction (HS-SPME)**
  - 1 g of homogenized dried meat in a 4 mL vial.
  - SPME fiber injected into the vial and exposed for 30 min at 25°C.
- **Gas Chromatography / Mass Spectrometry (GC/MS)**
  - SPME fiber inserted into the inlet (250°C) of the GC/MS.
  - GC Column: HP/5MS
  - Temperature program: 45(5)-10-250-20-280(5)
  - Volatile compounds identification by comparison of retention indices and mass spectra with the NIST 7 Mass Spectral Library.

Image 4: Drying of meat slices

Image 5: SPME fiber injected into vial

Statistical Analysis

- **Statistica 13®**
- **ANOVA** for means behavior of area %
- **Tukey-HSD** for comparison of mean differences

Fig. 1. Process flow diagram for the experimental procedure

RESULTS

- In Table 1, four major compounds were found for **Ajwain Essential Oil** and **Thyme Essential Oil,** β-pinene, *p-cymene*, γ-Terpinene, and Thymol.
- A total of **10 and 11 constituents** were identified for both pure TEO and AEO, respectively.

Table 1. Principal constituents of TEO and AEO with their relative percentages of total Chromatogram area and Retention Indices (RI)

Compounds	RI Lit[a]	Ajwain		Thyme	
		RI[b]	Area %	RI[b]	Area %
α-Thujene	931	924	0.2	924	0.18
α-Pinene	937	930	0.3	931	0.26
β-Pinene	980	975	2.24	975	1.89
β-Myrcene	992	990	0.33	990	0.32
α-Terpinene	1018	1016	0.27	1017	0.27
p-Cymene	1027	1027	23.67	1028	18.32
γ-Terpinene	1062	1062	35.75	1065	26.78
Isoterpinolene	1086	1090	0.04	-	-
p-Cymenene	1090	1093	0.07	1093	0.08
Limonene oxide	1183.9	1172	0.09	-	-
Thymol	1290	1315	37.03	1307	46.98
Carvone	1242	-	-	1259	0.07

Note: [a]RI Adam's Library. [b] Retention index Compound identification was based on Retention Index (RI) and comparison with NIST database.

- In Table 2, β-pinene was reported higher in Ajwain and Thyme OT samples for both doses due to the incorporation of sunflower oil which, may have increased its quantity (Adams, 2007).
- *p*-Cymene was recorded significantly higher in Ajwain HAB 1.5 mL.
- γ-Terpinene was higher for Thyme HAB 1.5 mL and significantly higher for Ajwain 1.5 mL.
- Thymol was observed higher in Thyme HAB samples and higher in Ajwain OT samples, which may be caused by the increase of the precursors (γ-Terpinene and *p*-Cymene) in thymol biosynthesis (Condors et al., 2013; Gomori et al, 2018)

Table 2. Quantification of the mean (area %) ± standard deviation (SD) of the compounds for both essential oils and treatment type

Pre-treatment type			Mean ± SD of Area % (n=6)			
Essential Oil	Treatment	Dose (mL)	β-Pinene	*p*-Cymene	γ-Terpinene	Thymol
Thyme	Control	0	0.04 ± 0.09[a]	7.72 ± 4.36[a]	3.65 ± 2.03[ab]	1.42 ± 1.49[a]
Thyme	HAB	0.75	0.22±0.12[a]	11.55 ± 6.28[ab]	4.28 ± 2.55[ab]	12.87 ± 3.80[e]
Thyme	HAB	1.5	0.63 ± 0.13[ab]	25.09 ± 5.42[c]	11.73 ± 3.33[bcd]	11.89 ± 3.91[de]
Thyme	OT	0.75	2.29 ± 1.44[cd]	24.53 ± 8.75[c]	9.45 ± 4.85[abcd]	5.93 ± 1.90[bc]
Thyme	OT	1.5	1.30 ± 0.68[abc]	19.94 ± 6.04[bc]	7.08 ± 1.95[abc]	11.63 ± 5.41[de]
Ajwain	Control	0	0.10 ± 0.16[a]	7.05 ± 8.36[a]	1.83 ± 2.44[a]	0 ± 0[a]
Ajwain	HAB	0.75	0.46±0.49[a]	20.67 ± 5.15[bc]	9.59 ± 2.48[abcd]	6.66 ± 1.72[bc]
Ajwain	HAB	1.5	1.14 ± 0.55[abc]	40.84 ± 6.91[d]	16.15 ± 7.66[d]	7.81 ± 0.85[bc]
Ajwain	OT	0.75	1.75 ± 0.63[bcd]	20.82 ± 2.48[bc]	8.84 ± 2.98[abcd]	5.26 ± 1.30[b]
Ajwain	OT	1.5	2.79 ± 0.38[d]	27.47 ± 5.48[c]	12.52 ± 4.56[cd]	8.82 ± 2.19[cd]

Note: HAB = Hot air blanching; OT = Oil Treatment. Values are given as mean ± SD (n=6). Values represent means of three replicates/ trials. Values in the same column followed by different high case letters are significantly different at $p < 0.05$.

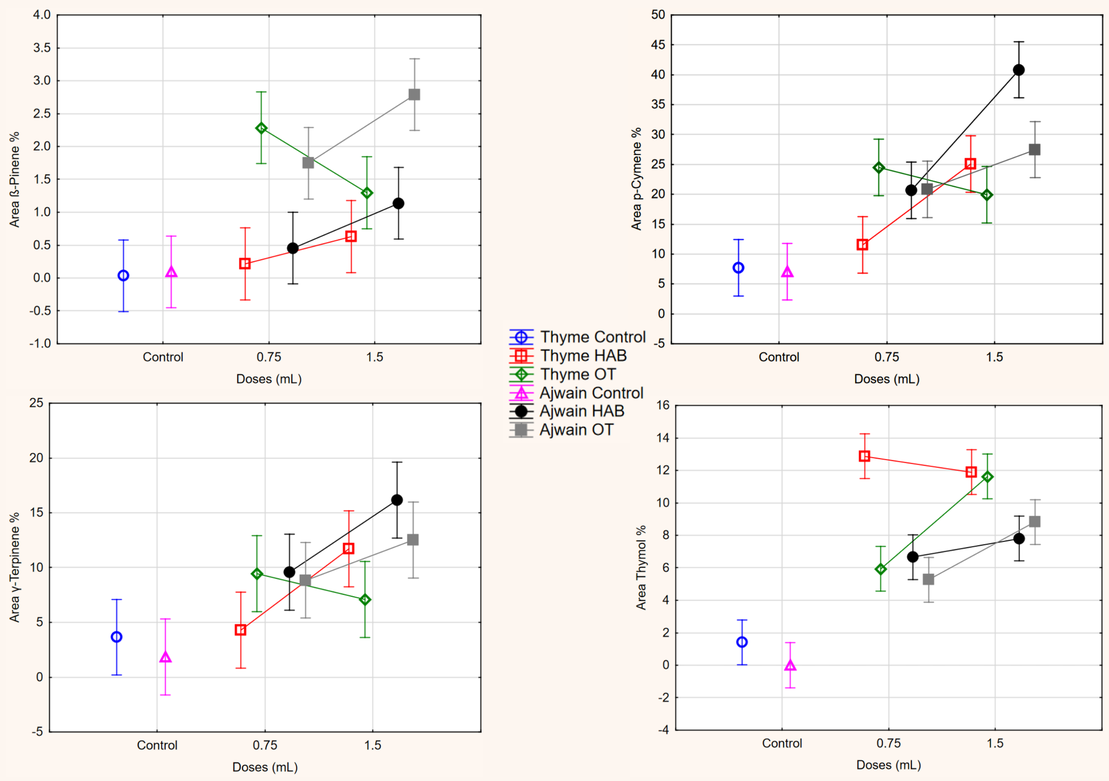


Fig. 2. The behavior of Means (Area %) vs. Doses (mL) per type of treatment and component

- Controls were almost zero in β-pinene, *p*-cymene, and γ-Terpinene, while other HAB and OT samples showed an increase in those components as the dose gets higher except for Thyme OT.
- OT treatments have shown a higher rise in Thymol as the dose increases and samples treated with thyme have the highest content of Thymol.

CONCLUSIONS

- **Ajwain and Thyme** comparatively possess **similar volatile compounds**.
- **Ajwain essential oil** can serve as a **potential substitute** for Thyme essential oil.
- Four significant **volatile constituents** were found **β-pinene, *p*-cymene, γ-Terpinene, and Thymol** as the remarkable constituents in both EOs.
- For further research, we will continue with the sensory evaluation of the best-ranked treatment types.

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