HNUE JOURNAL OF SCIENCE DOI: 10.18173/2354-1059.2023-0030
Natural Sciences 2023, Volume 68, Issue 2, pp. 159-163
This paper is available online at http://stdb.hnue.edu.vn

DETERMINATION OF COMPONENTS AND PHYSICO-CHEMICAL INDEXES OF FRESH ONION LEAF ESSENTIAL OIL IN HAI DUONG PROVINCE

Nguyen Van Loi[1] and Do Thi Hanh[2]
[1]*Faculty of Environmental Sciences, University of Science, Vietnam National University, Hanoi*
[2]*Faculty of Chemical Technology, Hanoi University of Industry*

Abstract. This study aimed to primarily analyze the components and physico-chemical indexes of the essential oil of fresh onion leaf collected from Kinh Mon District, Hai Duong Province. By GC-MS method, 39 components in the essential oil of fresh onion leaf have been identified. In which, there are ten out of them were hydrocarbons (such as monoterpenes 11.58%, sesquiterpenes 4.02%) and the rest were oxygenated ones (like aldehydes 14.87%, alcohols 45.64%, ketones 4.43%, esters 1.24%, acid 1.37%, oxide 1.69% and others 13.36%). The density of essential oil was 0.82, the acid index was 0.67 (mgKOH/g) and the ester index was 0.74 (mgKOH/g).

Keywords: components, essential oil, fresh onion leaf, physico-chemical index.

1. Introduction

The onion tree, scientifically known as *Allium fistulosum*, is grown largely in Vietnam, especially in the provinces of Hai Duong, Hung Yen, Bac Ninh, Bac Giang, Vinh Phuc, Son La, Soc Trang, Quang Ngai, Ninh Thuan, Tien Giang, and Lam Dong Province. Onions are vegetables with high nutritional value, in 100 g of the edible part, there are 92.5 g of water, 1.3 g of protein, 4.3 g of glucide, 0.9 g of cellulose, 80 mg of calcium, 1 mg of iron, 23 mg of magnesium, 0.26 mg manganese, 41mg phosphorus, 123 mg potassium, 18mg sodium, 0.44 mg zinc, 60 mg vitamin C, 0.03 mg vitamin B_1, 0.1 mg vitamin B_2 and 1 mg vitamin PP [1]. Onions are used a lot in daily meals, and have the effect of increasing digestion, strengthening the immune system, controlling blood sugar and preventing diabetes, preventing colds, preventing cancer. They are good for the eyes and good for the cardiovascular system and help keep bones strong. Onion leaves have a high content of essential oils, and onion leaves have a characteristic and attractive aroma and are widely used in food and cosmetics [2, 3]. But currently, in Vietnam, the research in effective exploitation and recovery of onion essential oil has

Received June 9, 2023. Revised June 23, 2023. Accepted June 30, 2023.
Contact Nguyen Van Loi, e-mail address: nguyenvanloi@hus.edu.vn

not received much interest, while the source of raw materials for onion leaves is very diverse and rich. However, the fresh onion leaf essential oil's components and physico-chemical indexes have not been evaluated yet. Therefore, this study aimed to primarily analyze the components and physico-chemical indexes of the fresh onion leaf essential oil collected from Kinh Mon District, Hai Duong Province.

2. Content

2.1. Materials and methods

2.1.1. Material

The fresh onion leaves were collected from Kinh Mon District, Hai Duong Province in 2022. The essential oil was obtained by steam distillation after drying with Na_2SO_4, so the moisture was 0.5%. The essential oil content in onion leaves accounts for about 0.28 to 0.32% compared to the amount of fresh onion leaves.

2.1.2. Methods

- *Gas chromatography - mass spectrometry (GC-MS)*

Gas chromatography (GC) analysis was performed on an Agilent Technologies HP 6890 Plus Gas chromatograph equipped with an FID and fitted with HP-5MS columns (30 m x 0.25 mm, film thickness 0.25 µm, Agilent Technology). The temperature program was as follows: the column temperature was programmed from 80 to 150 ^oC in 23.3 min at a rate of 3 ^oC/min and then from 150 to 220 ^oC in 8.75 min at a rate of 8 ^oC/min. The *MS* conditions were as follows: ionization voltage was 70eV, transfer temperature was 250 ^oC, the carrier gas was helium used at a flow rate of 0.5 mL/min, and the split ratio of the injector was 1:5. The *MS* fragmentation patterns were compared with known patterns of other oils and with those in the literature by using Wiley (Wiley 9^{th} Version), NIST 08 Libraries (on ChemStation HP). The percentage of each component was calculated by the percentage of its peak area [3-5].

- *Determination of the physical-chemical index of the fresh onion leaf essential oil*

Density, angle of rotation, refraction index, acid index and ester index of the oil were determined by the anthology of the National Standards for essential oil-testing methods [6, 7].

2.2. Results and discussion

2.2.1. The components of the fresh onion leaf essential oil

The components of the fresh onion leaf essential oil, identified by GC-MS, are presented in Table 1 and Figure 1.

Table 1. The components of the fresh onion leaf essential oil

No.	Components	RT (min)	RI	Proportion (%)
1	Allyl sulfydrate	2.889	665	1.04
2	Isovaleraldehyde	3.332	679	1.12
3	Methyl ethyl disulfde	3.425	684	6.31
4	Pentanal	3.475	740	6.08

5	Isopentanol	3.533	760	6.43
6	Dimethyl disulfde	3.820	761	0.97
7	Hexanal	4.176	819	7.13
8	Methyl propyl disulfde	4.403	929	1.08
9	Camphene	4.641	944	0.27
10	Dimethyl trisulfde	4.859	963	3.96
11	Sabinene	5.125	971	0.98
12	p-Cymene	5.334	1018	6.14
13	1,8-cineole	5.827	1023	0.89
14	γ-Terpinene	6.025	1054	0.92
15	Terpinolene	6.849	1084	3.27
16	Linalool	7.116	1099	7.53
17	Tanacetone	7.200	1101	0.49
18	Nonanal	7.453	1104	0.54
19	Thujone	7.544	1106	0.97
20	Borneol	7.600	1158	6.39
21	Nerol	7.841	1165	6.17
22	Terpinen-4-ol	8.052	1171	6.23
23	α-Terpineol	8.370	1187	7.29
24	bornyl acetate	8.875	1282	0.96
25	Lavandulyl acetate	9.036	1291	0.28
26	β-lonone	9.925	1482	2.69
27	Pentadecane	10.525	1499	0.32
28	Spathulenol	11.858	1564	2.48
29	Caryophyllene oxide	12.125	1569	1.69
30	Hexadecane	12.853	1598	2.47
31	Cedrol	13.083	1605	1.31
32	β-Eudesmol	13.717	1651	0.28
33	Heptadecane	13.942	1699	0.46
34	Octadecane	14.034	1799	0.52
35	Fitone	14.309	1837	0.28
36	Nonadecane	14.594	1899	0.25
37	Isophytol	14.900	1942	0.64
38	n-Hexadecanoic acid	14.983	1957	0.92
39	Linoleic acid	15.142	2097	0.45
	Monoterpenes			*11.58*
	Sesquiterpenes			*4.02*
	Aldehydes			*14.87*

	Alcohols			*45.64*
	Ketones			*4.43*
	Esters			*1.24*
	Acid			*1.37*
	Oxide			*1.69*
	Others			*13.36*
	Total			**98.19**

Noted: (%) was calculated by the percentage of chromatographic peak area; RT: Retention time; RI: Retention indices

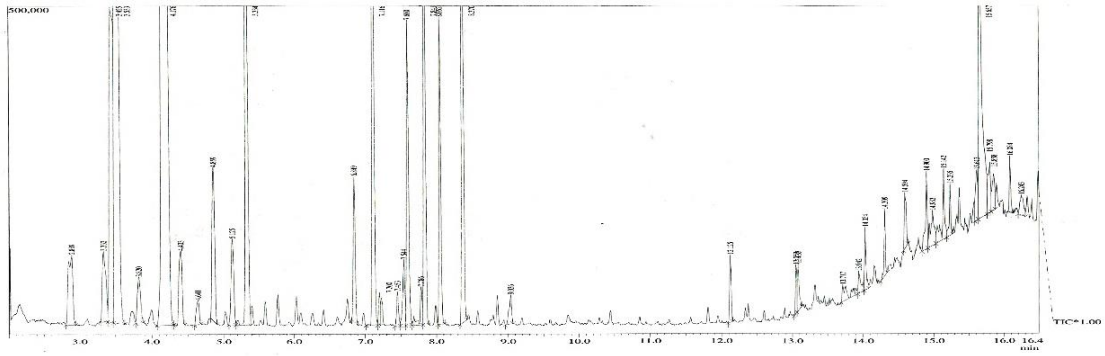

Figure 1. Gas chromatogram of the components of the fresh onion leaf essential oil

Table 1 shows that 39 components were identified in the components of the fresh onion leaf essential oil. In which, there are ten out of them were hydrocarbons (such as monoterpenes 11.58%, sesquiterpenes 4.02%) and the rest were oxygenated ones (like aldehydes 14.87%, alcohols 45.64%, ketones 4.43%, esters 1.24%, acid 1.37%, oxide 1.69% and others 13.36%). Including some high percentage constituents as linalool 7.53%, α-terpineol 7.29%, hexanal 7.13%, isopentanol 6.43%, borneol 6.39%, methyl ethyl disulfide 6.31%, terpinen-4-ol 6.23%, nerol 6.17%, p-cymene 6.14%, pentanal 6.08% and dimethyl trisulfde 3.96%. The results of this study are also consistent with the published results by *Li M et al.* [3].

2.2.2. The physico-chemical indexes of the components of the fresh onion leaf essential oil

The density, angle of rotation, refraction index, acid index, and ester index of the essential oil of the fresh onion leaf essential oil were presented in Table 2.

Table 2. Physico-chemical indexes of the fresh onion leaf essential oil

No.	Physico-chemical indexes	Result
1	Density (20°C)	0.82
2	Anglerotation α^{20}_D	85° 24’
3	Refractive index n^{20}_D	1.46
4	Acid index (mg KOH/g)	0.67
5	Ester index (mg KOH/g)	0.74

These results were consistent with that of the essential oil of fresh onion leaf. In particular, the oil had a density (0.82), smaller than 0.9, and a refractive index (1.46), smaller than 1.47. The value of the angle rotation of the sample showed that the essential oil was capable of being dissolved in polar organic solvents as well as in nonpolar organic solvents. The acid index of the sample showed that the essential oil could be less oxidation. The obtained results of this study are also consistent with the published results by *Li M et al.* [3].

3. Conclusions

By GC-MS method, 39 components in the fresh onion leaf essential oil have been identified. In which, there are ten out of them were hydrocarbons (such as monoterpenes 11.58%, sesquiterpenes 4.02%) and the rest were oxygenated ones (like aldehydes 14.87%, alcohols 45.64%, ketones 4.43%, esters 1.24%, acid 1.37%, oxide 1.69% and others 13.36%). The density of essential oil was 0.82, the acid index was 0.67 (mgKOH/g) and the ester index was 0.74 (mgKOH/g).

REFERENCES

[1] Institute of Nutrition, 2007. Vietnamese food composition table. *Medical Publishing House*, pp. 119-120.

[2] Yuasa M, Ueno M, Kawabeta K, Morikawa M, Uemura M, Matsuzawa T, Tominaga M, 2022. Taste characteristics, volatile components, sensory properties, and antioxidant activity of fresh onion (*Allium cepa* L.) leaves. *Bulletin of the National Research Centre*, 46, pp. 1-12.

[3] Li M, Zhao X, Xu M, 2022. Chemical composition, antimicrobial and antioxidant activity of essential oil from *Allium tenuissimum L.* Flowers. *Journal of Food*, 11 (3876), pp. 1-16.

[4] Wen Y, Zhao X.Y, Wang C, Liu X.L, 2022. Flavor characteristic analysis of fried *Allium tenuissimum* L. flowers by electronic nose and headspace-gas chromatography-ion mobility spectrometry. *Journal of Food Science*, 43, pp. 267-273.

[5] Sawamura M and Thao N.T, 2008. Development of an analytical method for identification and differentiation of citrus fruits by GC-MS. *Journal of Chemistry*, 46, pp. 432- 436.

[6] Anthology of the National Standards for essential oil-testing methods, 2010, pp. 37- 42.

[7] Loi N.V, Minh Tu N.V, Hoa H.D, 2015. Study on components, physico-chemical indicators, and biological activity of Bac Giang Liquidambar formosana Hance leaves oil. *Journal of Science and Technology*, 53(4B), pp. 81- 87.