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A Comparative Study between the Essential Oils in Laurel Oil Extracted from Laurel Fruits by the Traditional Method and by Heat Reflux Extraction Using a Modified Clevenger Apparatus

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Abstract

The effect of the traditional method of extracting laurel oil from triturate laurel fruits (fleshy part and kernel) and the modern method of extracting it by heat reflux was studied. It was found that heat reflux extraction is much better and the percentage of extracted laurel oil increased significantly. The Clevenger apparatus in its normal form and its modified form were used to extract essential oils, the modified form made clear progress; the percentage of essential oils increased by about 2.43 times. Light oils such as **(E)-2-Hexanal**, **Tricyclene**, and **3-Hexan-1-ol** were almost nonexistent using the traditional method, and they became present using heat reflux extraction, especially with the modified Clevenger apparatus, at 15.354%, 0.415%, and 6.775%, respectively.

Keywords: Laurel oil, Traditional method, Heat reflux extraction, Modified Clevenger apparatus.

1. Introduction

Fragrances are an integral part of beauty products and are often seen as a key factor in consumers choice of cosmetics. Fragrances play a major role in masking unpleasant odors caused by fatty acids, oils, and surfactants commonly used in cosmetic formulations. Essential oils are vital assets in the cosmetics industry, as in addition to imparting pleasant scents to various products, they can act as preservatives and active agents, while also offering various benefits to the skin. Furthermore, the increasing demand for natural ingredients has significantly contributed to a

renewed interest in plant-derived products, especially essential oils, in the cosmetics and wellness industries. This has prompted popular cosmetics companies to promote natural fragrances and opt for minimally processed natural ingredients, given the potential adverse health risks associated with synthetic fragrance chemicals, which are essential ingredients in cosmetics. One of the valuable essential oils used in the perfume industry is laurel oil, which contains several essential oils such as linalool, geraniol, and limonene, which are very essential aromatic components used in various cosmetics[1-4]. Laurus nobilis L., also known as true laurel, is an aromatic evergreen tree or large shrub with smooth green leaves native to the Mediterranean region and belonging to the Laurelaceae family[5]. The plant's oval-shaped, single-seeded fruits, known as laurel fruits, are dark purple, turning black when fully ripe. These fruits are encased in a thin, brittle, wrinkled shell, which when broken exposes the seed kernel. Laurel fruits also contain fixed and essential oils that are primarily used in the manufacture of laurel soap[6].

1.1 Laurel Oil

Bay berries when combined with coconut and palm kernel oils are effective in treating skin conditions such as dermatitis[7]. Due to their anti-dandruff properties, bay berries are commonly included in scented soaps and hair care products. In addition, laurel oil is used to treat skin conditions such as eczema, rashes, and peeling. The leaf and seed oils inhibit the proliferation of cancer cells[8]. Laurel oil consists of several main fatty acids, including laurel acid, palmitic acid, oleic acid, and linoleic acid, and their percentages are (20-38%), (12-21%), (30-40%), and (16-28%), respectively. Laurel acid is considered one of the most important industrial acids in the manufacture of laurel soap (Aleppo soap), which is healthy for the hair and skin[9].

1.2 Essential Oils

The term "aromatic" describes the quality of giving off a pleasant or unpleasant odor to the nose. However, in the language of chemistry, an aromatic compound has a chemical arrangement that causes the electrons to be delocalized, resulting in increased molecular stability. Thus, essential oils may be a mixture of aromatic and aliphatic (non-aromatic) compounds, all of which contribute to the perceived odor[10]. Essential oils are soluble in alcohol and ether but insoluble in water. These essential oils are generally liquid and colorless at room temperature. It has a distinctive odor and its density is less than one, except in a few cases. Terpenes constitute the largest group in essential oils, and their classification is based primarily on the number of isoprene units present in their structure. Monoterpenes are the most abundant in essential oils (about 90%), with a great diversity of structures[11-12]. Several studies have been conducted on laurel oil, including a study on the effect of the ripening date of laurel fruits (from the Kassab region in Syria) between October and December on the chemical composition of essential oils in laurel oil extracted from laurel fruits (green, brown and black). It was found that the growth date of the fruits and their ripening time affect the chemical composition of laurel oil, especially essential oils. It was found for the first time that light oils (such as hexanal and 3-hexen-1-ol) are present in large quantities, especially in green fruits. Therefore, it is recommended to use laurel oil extracted specifically from green laurel fruits in the manufacture of hair and skin care products, as well as in the manufacture of Aleppo laurel soap, as analysis using gas chromatography and gas chromatography-mass spectrometry of essential oils allowed the identification of 26 compounds representing 99.4% of the total content, which were identified immediately after the extraction of laurel oil. There are eleven essential oils, which constitute more than 88%, namely: hexanal, 3-hexen-1-ol, alpha-pinene, sabinene, beta-myrcene, alpha-terpinene, o-cymene, 1,8-cineole, bornyl acetate, alpha-terpinyl acetate and eugenol methyl ether (24.263%, 14.250%, 7.562%, 2.827%, 7.120%, 1.596%, 11.211%, 9.574%, 3.628%, 5.394% and 1.547% in green fruits), (8.667%, 3.098%, 8.385%, 8.956%, 6.222%, 1.538%, (6.216%, 41.311%, 3.089%, 3.378% and 1.002% in black fruit)[13]. A study was devoted to comparing the

chemical composition of bay leaves and the antibacterial activity of their essential oil (EO) from wild trees in Greece and Georgia. The main components of the essential oils and their proportions in Greek bay plants were found to be 1,8-cineole (30.8%), alpha-terpinyl acetate (14.9%), alpha-terpineol (8.0%), sabinene (7.9%) and terpene-4-ol (6.0%). The main components of the essential oils of Georgian laurel plants were 1,8-cineole (29.2%), α-terpinyl acetate (22.6%), sabinene (12.2%), and methyl eugenol (8.1%), and the content of essential oils was 1.42% and 4.54% in the leaves from Greece and Georgia, respectively. The previous study showed that the main group of components in the essential oils of Greek and Georgian laurel leaves consisted of oxygenated monoterpenes 1,8-cineole, α-terpinyl acetate, α-terpineol, and terpinen-4-ol. The essential oils showed antimicrobial activity against pathogenic and spoilage microorganisms[14]. The demand for natural ingredients has contributed significantly to the renewed interest of the cosmetics industry in plant derivatives, especially essential oils. Essential oils are vital assets in the cosmetics industry. In addition to adding a pleasant scent to various products, they can act as preservatives and active agents[15]. In addition, they can enhance the dermatological cosmetic properties of the final product, not only by protecting against microbial infections but also by contributing to the preservation of the cosmetic[16-17]. Essential oils contain oils that are beneficial for the skin and hair, such as tricyclic oils, camphene, and alpha-pinene. Interestingly, they are also used to induce additional skin benefits such as anti-acne, anti-aging, skin lightening, and sun protection, among others in cosmetic products, making them highly valuable for the cosmetic industry[18-20]. Alpha-pinene essential oil repairs and improves skin exposed to UV rays. There is also the essential oil linalool, which protects the scalp and gives hair softness, in addition to the compound o-cymene, which is used in the perfume industry due to its strong smell. 1,8-cineole and Bornyl acetate which constitutes the largest percentage in laurel oil are considered broad-spectrum anti-inflammatory agents. Several biologically active compounds have also been found in the essential oil of *L. nobilis*, and the essential oil extracted from the fruits of *L. nobilis* has been used to treat indigestion and flatulence[6, 11, 21-23]. Essential oils are one of the most important components of laurel oil due to their health and practical benefits, especially in laurel soap, which is famous locally and internationally and is called in international references as Aleppo soap[24]. Environmental soil, climatic conditions, season, location, and time of plant harvest affect the chemical composition of essential oil (EO). In addition, drying methods, extraction methods, and analysis methods affect the EO content[25]. Research conducted on laurel oil extracted from its fruits using heat reflux extraction and supercritical carbon dioxide extraction methods revealed that laurel fruits contain a laurel oil percentage ranging from 15% to 35.87%. The production and composition of bay leaf oil may vary across different studies in the literature, which may be due to factors such as the origin of the plant, the extraction method used, and other influencing factors[26] .

2. Materials and Methods

2.1 Instruments and Apparatus

A Shimadzu GC-2010 gas chromatograph with a capillary column (TRB-1 0.5 µm, 30 m × 0.25 mm, serial number: J-2031612), an AOC-20i auto-injector and a FID (flame ionization detector) was used is the most common gas detector due to its reliability and sensitivity in detecting organic vapors and is non-selective compared to many specific detectors. The detectors (FID) can detect most carbon-containing materials, making them very suitable for the analysis of most essential oils[27]). The dilution pipette model DIP-1 (Shimadzu) contains a 100 µL sample syringe and five continuously adjustable pipettes covering a volume range of 10 to 5000 µL (model Piptman P, GILSON). A SARTORIUS TE64 electronic balance with a sensitivity of 0.01 mg was used to weigh the samples. The reflux extraction apparatus was used to extract laurel oil from its fruits, in addition to using the Clevenger apparatus in its natural form and its modified form to extract the essential oils.

2.2 Reagents

Hexane and methanol (extra pure) were purchased from Merck. Two standards of Essential oils CAN-TERP-MIX 1 & 2, which each contain 21 compounds by focus each 100 $\mu g.mL^{-1}$ were used.

2.3 Development of the Clevenger Apparatus

The extraction of essential oils by the Clevenger apparatus[28] (either from crushed fruits or from laurel oil extracted from laurel fruits) was found to be different from the extraction of essential oils by the modified Clevenger apparatus, as we modified the Clevenger apparatus by adding cooling (with water) to the area where the essential oils were collected, ensuring that particularly light essential oils did not escape due to the heat of the apparatus generated by the air temperature or the temperature of the distiller, see Figure 1. It was found that the amount of essential oils increased using the modified Clevenger apparatus, and this effect was more pronounced when the air temperature was less than 20°C.

2.4 Sample preparation

Samples of laurel fruits were taken from the Kassab region in Syria. We ground 200 grams of fruits with pulp using an electric blender and divided the result into two parts, each of 100 grams. Then we extracted laurel oil using the traditional method and by extraction by heat reflux with hexane. We used the Clevenger apparatus and the modified Clevenger apparatus and calculated the amount of the resulting essential oils. Table 1 shows that the amount of essential oils extracted from the oil using heat reflux extraction was greater than the essential oils extracted using the traditional method. The difference was greater when using the modified Clevenger apparatus (1.10 times the traditional method and 1.15 times the heat reflux apparatus). The percentage of essential oils extracted using the modified Clevenger apparatus was 2.43 times greater than the similar traditional method.

Table 1: Comparison between the amount of essential oils in the oil extracted by the traditional method and the heat reflux extraction using the Clevenger apparatus and modified Clevenger apparatus.

Amount of essential oils in laurel oil extracted by the heat reflux extraction with hexane		Amount of essential oils in the laurel oil extracted in the traditional way	
Modified Clevenger Apparatus	Clevenger Apparatus	Modified Clevenger Apparatus	Clevenger Apparatus
3.21%	2.80%	1.32%	1.20%

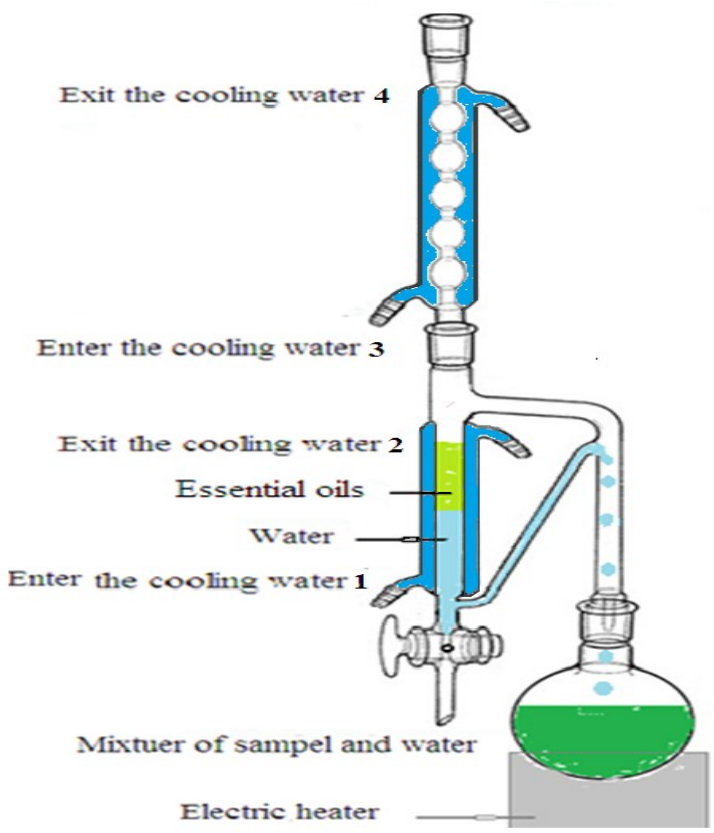

Figure 1: Modified Clevenger apparatus.

3. Extraction methods

The yield and chemical composition of essential oils obtained by different extraction methods vary, indicating that we must choose the appropriate extraction method when extracting essential oil from plant materials[29].

3.1 The traditional method

The process of extracting laurel oil from laurel fruits from the town of Kassab in Syria is done in three stages as follows: In the first stage, laurel seeds are placed in a large pot to prepare for boiling and covered with water. The boiling process continues for about an hour, then the laurel seeds are whipped, then water is added and left to reach the boiling stage. After that, the pot is removed from the fire, and water is added to separate the oil. After that, the cooling stage begins. At this point, the oil has floated to the surface of the water, where it is left for two hours, then it is purified from the surface. After that, it is left for half an hour to settle impurities and the filtration process begins. In the last stage, the same previous steps are repeated to obtain laurel oil again. This means that extraction in the old way leads to a significant loss in the quantity and quality of essential oils.

3.2 Heat reflux extraction

Extraction and separation are the initial stages of research, to obtain raw extracts containing active ingredients from natural sources, enabling subsequent work on separation and analysis. Based on the principle of extraction, natural products are mainly extracted from plants by solvent extraction, such as heat reflux extraction[30]. Heat reflux extraction is a method that uses essential organic solvents, such as ethanol and hexane, to extract components from raw materials or plant materials. Its principle is as follows: the extracted liquid is heated and distilled, with the essential solvent condensed and returned to the extraction vessel for repeated

soaking of the raw materials. This cycle is repeated until the active ingredients are completely refluxed. Heat reflux extraction improves the extraction rate and reduces the use of solvents, which is one of the advantages of reflux distillation, and its disadvantage is that it is not suitable for extracting raw materials that are easily damaged by heat due to the long heating time[31, 32].

4. Results and Discussion

4.1 Analytical procedure

Programmed column temperature 60°C for 5 min and then increased it to 220°C with an increasing temperature rate of 2°C/min, but the temperature should not exceed 220°C, flow rate of N_2 carrier gas 2.1 mL.min^{-1}, the injection volume 2 µL with split injection mode 2.5, injected port temperature 250°C, and temperature of FID 250°C.

4.2 Using the traditional method with a Clevenger apparatus (A)

It was found that the amount of essential oils in this case was as low as possible **1.20%** and the percentage of light essential oils was low and some of them did not appear at all **(E)-2-Hexanal, Tricyclene**. As for the oils (**beta-Myrcene, alpha-Terpinene, o-Cymene, 1.8-Cineol**), they had maximum values and constituted **60.274%** of the total percentage of essential oils **99.688%**, see Figure 2 and Table 2. Table 2 shows the molecular formula, molecular weight and boiling point of the essential oils extracted from laurel oil.

4.3 Using the traditional method with a modified Clevenger apparatus (B)

Extracting essential oils from laurel oil in this way led to an increase in the percentage of total essential oils which became **1.32%** and the essential oil **Tricyclene** appeared while **(E)-2-Hexanal** did not appear. The percentage of light essential oils became more than in the previous case and the oils (**beta-Myrcene, alpha-Terpinene**, **o-Cymene, 1.8-Cineol**) remained almost constant and reached **61.590%** of the percentage of total essential oils **99.794%**, while the percentages of other essential oils decreased in general, see Figure 3 and Table 3.

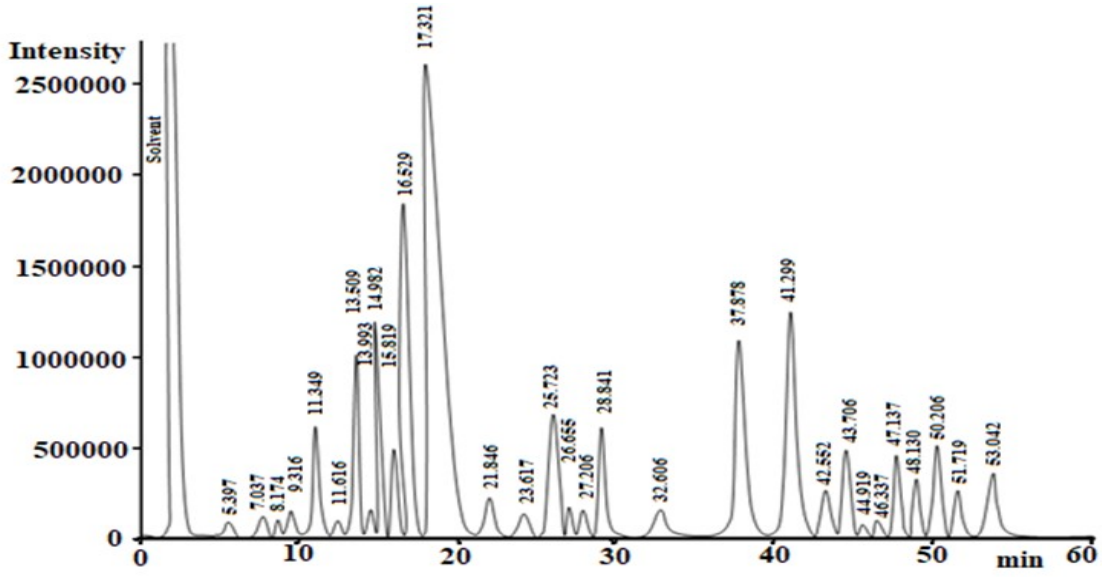

Figure 2: Gas chromatographic analysis of essential oils in laurel oil extracted from ripe fruits using the traditional method with a Clevenger apparatus (A) (Programmed column temperature 60°C for 5 min and then increased to 220°C with an increasing temperature rate of 2°C/min, but the temperature should not exceed 220°C, flow rate of N_2 carrier gas 2.1 mL.min^{-1}, the injection volume 2 µL with split injection mode 2.5, injected port temperature 250°C, and temperature of FID 250°C).

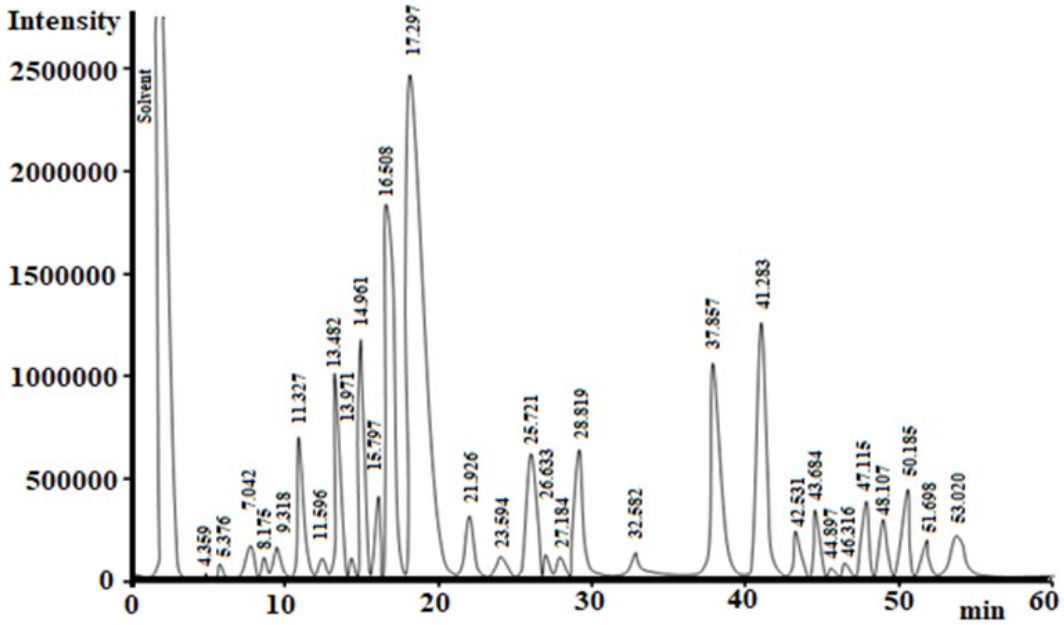

Figure 3: Gas chromatographic analysis of essential oils in laurel oil extracted from ripe fruits using the traditional method with a modified Clevenger apparatus (B) (Programmed column temperature 60°C for 5 min and then increased to 220°C with an increasing temperature rate of 2°C/min, but the temperature should not exceed 220°C, flow rate of N_2 carrier gas 2.1 mL.min^{-1}, the injection volume 2 µL with split injection mode 2.5, injected port temperature 250°C, and temperature of FID 250°C).

Table 2. Components of essential oils extracted by traditional method from the ripe Laurel fruits using Clevenger apparatus and FID gas chromatographic analysis (type A).

N°	Name of essential oil	Molecular formula	Molecular weight, g	Boiling pointe, °C	Retention time, min	Concentration, %
1	(E)-2-Hexanal	$C_6H_{10}O$	98.143	146-147	-	-
2	Tricyclene	$C_{10}H_{16}$	136.238	152-153	-	-
3	3-Hexan-1-ol	$C_6H_{12}O$	100.161	156-157	5.397	0.024
4	Unknown	-	-	-	7.037	0.100
5	Unknown	-	-	-	8.174	0.087
6	*a*lpha-Thujene	$C_{10}H_{16}$	136.238	151	9.316	0.101
7	*a*lpha-Pinene	$C_{10}H_{16}$	136.238	156	11.349	2.562
8	Camphene	$C_{10}H_{16}$	136.238	159	11.616	0.114
9	Sabinene	$C_{10}H_{16}$	136.238	163-164	13.509	3.978
10	*b*eta-Pinene	$C_{10}H_{16}$	136.238	166	13.993	0.212
11	*b*eta-Myrcene	$C_{10}H_{16}$	136.238	167	14.982	6.500
12	*a*lpha-Terpinene	$C_{10}H_{16}$	136.238	173.5-174.8	15.819	1.601
13	o-Cymene	$C_{10}H_{16}$	136.238	178	16.529	10.617
14	1.8-Cineol	$C_{10}H_{18}O$	154.249	176-177	17.321	41.556
15	gamma-Terpinene	$C_{10}H_{16}$	136.238	181-183	21.846	0.924

16	cis-Sabinene hydrate	$C_{10}H_{18}O$	154.253	200-201	23.617	0.298
17	Linalool	$C_{10}H_{18}O$	154.253	198-199	25.723	2.756
18	p-Ment-2-en-1-ol	$C_{10}H_{18}O$	154.253	213-214	26.655	0.591
19	Unknown	-	-	-	27.206	0.287
20	Terpinen-4-ol	$C_{10}H_{18}O$	154.253	211-213	28.841	2.483
21	*a*lpha-Terpineol	$C_{10}H_{18}O$	154.253	218-221	32.606	0.501
22	Bornyl acetate	$C_{12}H_{20}O_2$	196.29	223-224	37.878	6.043
23	Eugenol	$C_{10}H_{12}O_2$	164.204	254	41.299	6.754
24	*a*lpha-Terpinyl acetate	$C_{12}H_{20}O_2$	196.29	220	42.552	1.248
25	Cyclosativene	$C_{15}H_{24}$	204.36	243.4-250	43.706	1.925
26	Unknown	-	-	-	44.919	0.543
27	Unknown	-	-	-	46.337	0.537
28	Eugenol methyl ether	$C_{11}H_{14}O_2$	178.23	254.7	47.137	1.997
29	*b*eta-Elemene	$C_{15}H_{24}$	204.36	251-253	48.130	1.046
30	*b*eta-Caryophyllene	$C_{15}H_{24}$	204.36	262-264	50.206	2.245
31	Cinnamyl acetate	$C_{11}H_{12}O_2$	176.21	265	51.719	0.713
32	Isoeugenyl methyl ether	$C_{11}H_{14}O_2$	178.23	263	53.042	1.345
			Total			99.688

Table 3. Components of essential oils extracted by traditional method from the ripe Laurel fruits using modified Clevenger apparatus and FID gas chromatographic analysis (type B).

N°	Name of essential oil	Retention time, min	Concentration, %
1	(E)-2-Hexanal	-	-
2	Tricyclene	4.359	0.012
3	3-Hexan-1-ol	5.376	0.041
4	Unknown	7.042	0.167
5	Unknown	8.175	0.154
6	*a*lpha-Thujene	9.318	0.115
7	*a*lpha-Pinene	11.327	2.978
8	Camphene	11.596	0.151
9	Sabinene	13.482	4.143
10	*b*eta-Pinene	13.971	0.235
11	*b*eta-Myrcene	14.961	6.541
12	*a*lpha-Terpinene	15.797	1.611
13	o-Cymene	16.508	10.601
14	1.8-Cineol	17.297	41.613
15	gamma-Terpinene	21.926	1.224
16	cis-Sabinene hydrate	23.594	0.294
17	Linalool	25.721	2.567
18	p-Ment-2-en-1-ol	26.633	0.624
19	Unknown	27.184	0.306
20	Terpinen-4-ol	28.819	2.511

21	*a*lpha-Terpineol	32.582	0.512
22	Bornyl acetate	37.857	5.972
23	Eugenol	41.283	6.614
24	*a*lpha-Terpinyl acetate	42.531	1.213
25	Cyclosativene	43.684	1.824
26	Unknown	44.897	0.415
27	Unknown	46.316	0.437
28	Eugenol methyl ether	47.115	1.876
29	*b*eta-Elemene	48.107	0.986
30	*b*eta-Caryophyllene	50.185	2.142
31	Cinnamyl acetate	51.698	0.672
32	Isoeugenyl methyl ether	53.020	1.243
Total			**99.794**

4.4 Using the heat reflux extraction with the Clevenger apparatus (C)

This method led to a very clear increase in the total amount of essential oils, which became **2.80%**, and the percentage of light essential oils increased, as the percentage of **(E)-2-Hexanal** reached 13.011%, the percentage of **Tricyclene** 0.345%, and the percentage of **3-Hexan-1-ol** 5.934%, while the percentages of essential oils (**beta-Myrcene, alpha-Terpinene, o-Cymene, 1.8-Cineol**) decreased to **42.046%**, and the percentages of the remaining essential oils also decreased slightly, see Figure 4 and Table 4.

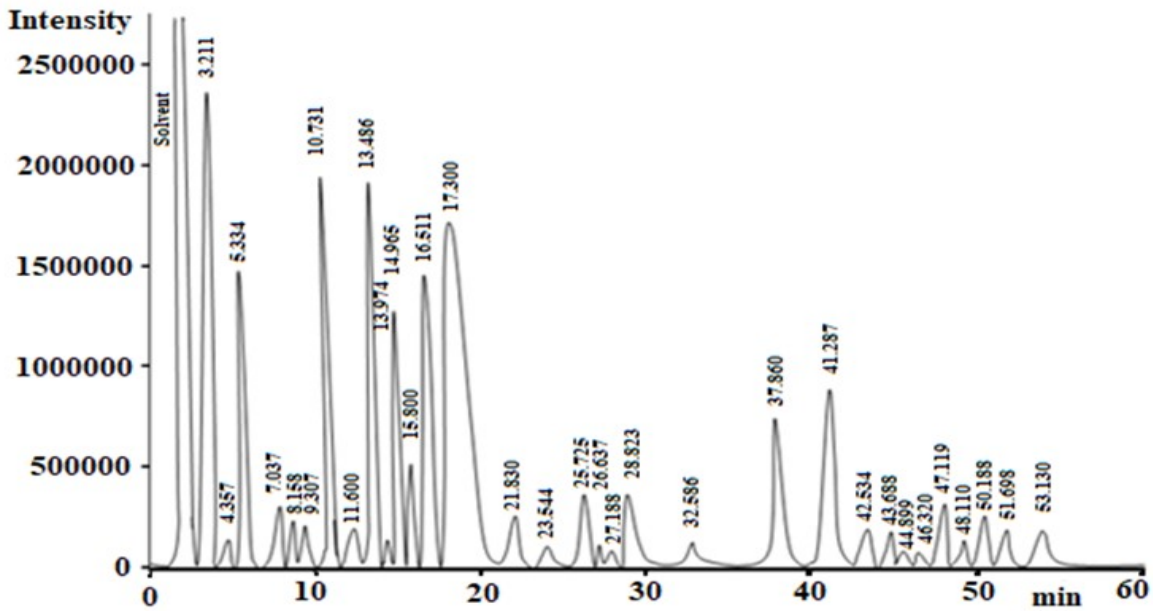

Figure 4: Gas chromatographic analysis of essential oils in laurel oil extracted from ripe fruits using the heat reflux extraction with the Clevenger apparatus (C) (Programmed column temperature 60°C for 5 min and then increased to 220°C with an increasing temperature rate of 2°C/min, but the temperature should not exceed 220°C, flow rate of N_2 carrier gas 2.1 mL.min^{-1}, the injection volume 2 µL with split injection mode 2.5, injected port temperature 250°C, and temperature of FID 250°C).

4.5 Using the heat reflux extraction with the modified Clevenger apparatus (D)

The use of the modified Clevenger apparatus led to a clear increase in the percentage of essential oils up to **3.21%** (the percentage of light essential oils increased). For example, the percentage of **(E)-2-Hexanal** increased to 1.18% the sum of the percentages of (**beta-Myrcene, alpha-Terpinene, o-Cymene, 1.8-Cineol**) remained at its maximum and equal to **38.526%** and the percentages of the other essential oils decreased slightly, see Figure 5 and Table 5.

Table 4. Components of essential oils extracted the heat reflux extraction by hexane from the ripe Laurel fruits using Clevenger apparatus and FID gas chromatographic analysis (type C).

N°	Name of essential oil	Retention time, min	Concentration, %
1	(E)-2-Hexanal	3.211	13.011
2	Tricyclene	4.357	0.354
3	3-Hexan-1-ol	5.334	5.943
4	Unknown	7.037	0.455
5	Unknown	8.158	0.217
6	*a*lpha-Thujene	9.307	0.186
7	*a*lpha-Pinene	10.731	7.824
8	Camphene	11.600	0.384
9	Sabinene	13.486	7.244
10	*b*eta-Pinene	13.974	0.486
11	*b*eta-Myrcene	14.965	6.654
12	*a*lpha-Terpinene	15.800	1.724
13	o-Cymene	16.511	7.241
14	1.8-Cineol	17.300	26.427
15	gamma-Terpinene	21.830	0.748
16	cis-Sabinene hydrate	23.544	0.159
17	Linalool	25.725	1.664
18	p-Ment-2-en-1-ol	26.637	0.398
19	Unknown	27.188	0.121
20	Terpinen-4-ol	28.823	1.622
21	*a*lpha-Terpineol	32.586	0.325
22	Bornyl acetate	37.860	4.014
23	Eugenol	41.287	5.033
24	*a*lpha-Terpinyl acetate	42.534	0.847
25	Cyclosativene	43.688	1.399
26	Unknown	44.899	0.324
27	Unknown	46.320	0.224
28	Eugenol methyl ether	47.119	1.425
29	*b*eta-Elemene	48.110	0.625
30	*b*eta-Caryophyllene	50.188	1.318
31	Cinnamyl acetate	51.698	0.453
32	Isoeugenyl methyl ether	53.130	0.902
Total			99.751

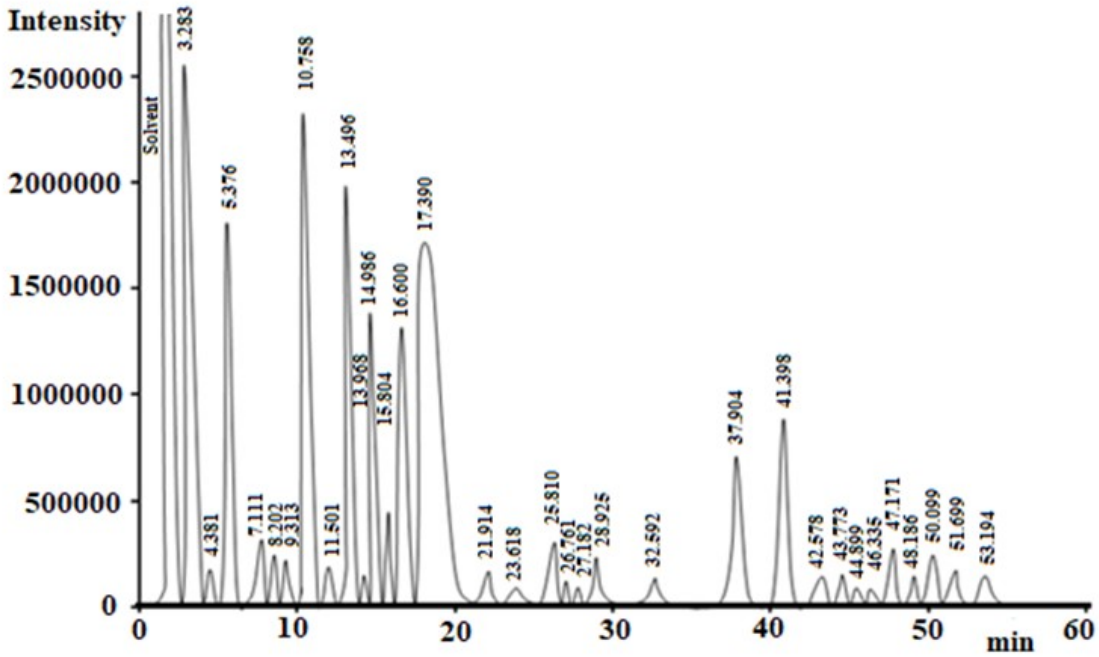

Figure 5: Gas chromatographic analysis of essential oils in laurel oil extracted from ripe fruits using the heat reflux extraction with the modified Clevenger apparatus (D) (Programmed column temperature 60°C for 5 min and then increased to 220°C with an increasing temperature rate of 2°C/min, but the temperature should not exceed 220°C, flow rate of N_2 carrier gas 2.1 mL.min^{-1}, the injection volume 2 µL with split injection mode 2.5, injected port temperature 250°C, and temperature of FID 250°C).

Figure 6 shows a general summary of the previous study and the distribution of essential oils and their proportions according to the laurel oil extraction mechanism (traditional method and heat reflux extraction) and the benefits resulting from the modified Clevenger apparatus. Since laurel oil in Syria is mainly used in the manufacture of laurel soap, this soap is made with laurel oil extracted by heat reflux extraction and the modified Clevenger apparatus will be of great industrial and health importance because it contains most of the essential oils found in laurel fruits. In addition, the difference in cost using this modern method is offset by the large production in the manufacture of laurel soap and its many health benefits.

Table 5. Components of essential oils extracted the heat reflux extraction by hexane from the ripe Laurel fruits using the modified Clevenger apparatus and FID gas chromatographic analysis (type D).

N^o	Name of essential oil	Retention time, min	Concentration, %
1	(E)-2-Hexanal	3.283	15.354
2	Tricyclene	4.381	0.415
3	3-Hexan-1-ol	5.376	6.775
4	Unknown	7.111	0.520
5	Unknown	8.202	0.234
6	*a*lpha-Thujene	9.313	0.211
7	*a*lpha-Pinene	10.758	8.842
8	Camphene	11.501	0.422

9	Sabinene	13.496	8.548
10	*b*eta-Pinene	13.968	0.554
11	*b*eta-Myrcene	14.986	6.704
12	*a*lpha-Terpinene	15.804	1.653
13	o-Cymene	16.600	6.512
14	1.8-Cineol	17.390	23.657
15	gamma-Terpinene	21.914	0.713
16	cis-Sabinene hydrate	23.618	0.142
17	Linalool	25.810	1.581
18	p-Ment-2-en-1-ol	26.761	0.381
19	Unknown	27.182	0.112
20	Terpinen-4-ol	28.925	1.472
21	*a*lpha-Terpineol	32.592	0.300
22	Bornyl acetate	37.904	3.652
23	Eugenol	41.398	4.572
24	*a*lpha-Terpinyl acetate	42.578	0.791
25	Cyclosativene	43.773	1.122
26	Unknown	44.899	0.301
27	Unknown	46.335	0.204
28	Eugenol methyl ether	47.171	1.248
29	*b*eta-Elemene	48.186	0.605
30	*b*eta-Caryophyllene	50.099	1.223
31	Cinnamyl acetate	51.699	0.311
32	Isoeugenyl methyl ether	53.194	0.621
Total			99.752

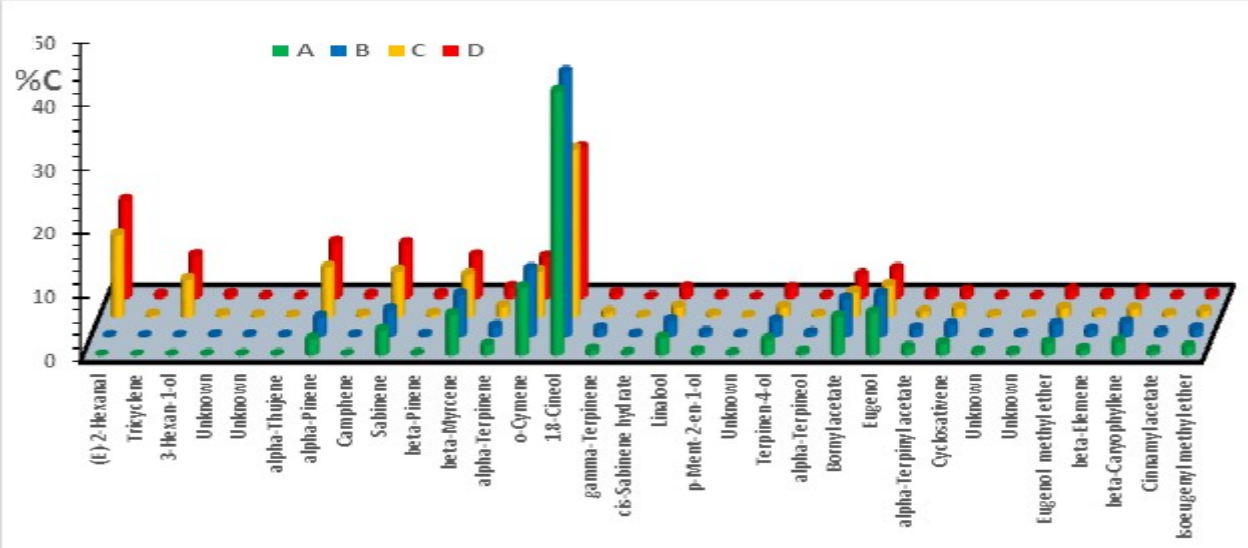

Figure 6: The effect of extraction method and the use of modified Clevenger apparatus on the percentage of essential oils in laurel oil extracted from ripe fruits in the Syrian Kassab region using gas chromatographic analysis.

5. Conclusion

The Clevenger in its normal form and its modified form apparatus was used to extract essential oils, the modified form made a clear progress; the percentage of essential oils increased by about 2.43 times. Light oils such as **(E)-2-Hexanal**, **Tricyclene** and **3-Hexan-1-ol** were almost non-existent using the traditional method and became clearly present using the heat reflux extraction, especially with the modified Clevenger apparatus, at 15.354%, 0.415% and 6.775%, respectively. It was found that using the modified Clevenger apparatus contributed to preserving the light essential oils, and thus we obtained laurel oil rich in light essential oils that we did not find in the laurel oil extracted by the Clevenger apparatus in its natural form. Light essential oils have very important health benefits in addition to their economic benefits when using laurel oil that contains all its basic components of volatile oils. This is evident in the manufacture of cosmetics, skin and hair care products, and in the manufacture of Aleppo laurel soap.

Data Availability Statement

The data supporting this study's findings are available from the authors upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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