Essential oil composition and antiproliferative activity of *Ecballium elaterium* (L). aerial parts:A Medicinal essential oil bearing plant from Jordan

Reem Raeq Jebara[1], Mohammad M.D. Hudaib [1,2]*, Yasser K. Bustanji[1], Noor T. Alhourani[1], Reem AlAbbassi[1] and Violet N. Kasabri[1]

[1]School of Pharmacy, The University of Jordan, Amman, Jordan
[2] College of Pharmacy, Alain University of Science and Technology, Abudhabi, UAE
*Corresponding author: The University of Jordan, School of Pharmacy, Amman, Jordan

ABSTRACT

Background & aims: This study aims to provide GC-FID and GC-MS analyses of the essential oil of dried aerial parts of Ecballium elaterium L. grown in Jordan and examining its cytotoxicity capacity. **Methods**: Essential oil was obtained by hydrodistillation using Clevenger apparatus. MTT assay method was used to investigate the plant's in vitro antiproliferative activity against MCF-7, Caco-2 and Panc-1 cancer cell lines in addition to normal fibroblast cells. **Results**: E. elaterium hydrodistilled oil yielded thirty one components, accounting for 76.3% of the total oil content. High contents of nonterpenoidal compounds, sesquiterpenes, and monoterpene characterized the volatile fractions with hinesol (17.2%), the principal compound, benzaldehyde (12.3%) and E-β-ionone (7.8%) as the major constituents. E. elaterium ethanolic extract showed good activity against MCF-7 and Caco-2 cells (IC50 values=29.67 µg/mL and 17.64 µg/mL, respectively). Moreover, all extracts were safe on normal human cells. In conclusion: Evaluation of E. elaterium volatile oil has been conducted for the first time in Jordan; also various extracts were tested for the first time against Panc-1 cells. Furthermore, based on the obtained results, ethanol extract of E. elaterium may be advocated as candidate for breast and colorectal cancers management.
Keywords: *Ecballium elaterium* L., essential oil, Jordan, antiproliferative activity, MCF-7, Caco-2, Panc-1..

Abbreviations

EOs	Essential oils
RI	Retention index
DMSO	Dimethyl sulfoxide
DMEM	Dulbecco's modified Eagle's medium
GC-MS	Gas chromatography – mass spectroscopy
GC-FID	Gas chromatography – flame ionization detector

INTRODUCTION

Natural products still stand as a significant source of new drugs especially those used as anticancer and antihypertensive[1]. Drugs of plants origin accounts for 25% of the total drugs prescribed worldwide with 121 active compounds still used until now, and according to the World Health Organization (WHO) 11% of 252 basic and essential drugs come from plant origin[2]. Although Jordan is considered a small country, it is rich in plant species, as a result of the diversity of geography and climate circumstances[3]. About 2,543 plant species, of which about 485 species, belonging to 99 families, are recorded as medicinal plants [4].

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Ecballium elaterium (L.) A. Rich is called squirting cucumber in addition to many other common names such as spitting cucumber, bitter melon, and wild balsam-apple. Squirting cucumber of *Ecballium* is poisonous wild decumbent perennial herb, restricted to the Mediterranean Basin[5]. The plant leaves are fleshy, prostate, covered by bristly and coarse hairs, the flowers have a yellowish petal leaf, the fruits are green hairy, have plum-shape and explode when they are ripe to scatter stream of mucilaginous liquid containing their brown egg shaped seeds violently to a considerable distance in response to light pressure[6]. Squirting cucumber of *Ecballium* occupied an important position in traditional medicine prescriptions and had a long tradition of uses in the Mediterranean region, as a natural remedy for several indications, especially as an analgesic, antipyretic and antiphlogistic, also was used as a emetic, purgative, for the treatment of jaundice, oedema, otitis, malarial fever and hydrophobia[7].

The few comprehensive studies investigated thoroughly both the essential oil composition and the anticancer activities for *E. elaterium* grown in Jordan despite the well- known benefits of them encouraged us to evaluate (qualitatively and quantitatively) the complete chemical composition of the essential oil hydro-distilled from aerial parts of wild growing *E. elaterium* collected from Jordan by means of GC-FID and GC-MS systems and to investigate the *in vitro* anticancer activities of the aqueous and alcoholic extracts of the of aerial parts of the plant against selected breast cancer cell line (MCF-7), colon cancer cell line (Caco-2) and pancreatic cancer cell line (Panc-1) using MTT assay.

2. MATERIALS AND METHODS

2.1. Plant collection and identification

Aerial parts (500 g roughly) of *E. elaterium* (L) were collected from north Amman (Jubaiha) in early summer time of 2016. All plants were air dried at room temperature and set aside in a cool place for further study. The collected plants were identified by Prof. Khaled Tawaha (Professor of Pharmacognosy and Phytochemistry, School of Pharmacy, The University of Jordan). Respective voucher samples were reserved in the Department of Pharmaceutical Science, School of Pharmacy, The University of Jordan, and given Voucher-Specimen (Reference) Numbers: (*Ecb*. Am. R. 24/7/16). At the beginning, visual inspection was made for the dried aerial parts for any contamination and then they were powdered to about 0.5 mm in order to enhance the efficiency of extraction.

2.2.Crude plant extraction

Ethanol extracts were prepared from *E. elaterium* by soaking 100 g of dried powdered aerial parts in 1L of ethanol (70%) and kept macerated for 48 h, then the extracts filtered and the solvent evaporated until dryness using rotary evaporator at 40°C. Also water extracts were prepared separately by boiling 250 g and 200 g of dried powdered aerial parts of *E. elaterium* with 2.5 L of tap water for 3 h, and then the boiled material was filtered and evaporated until dryness using rotary evaporator at 75°C. All evaporated extracts were kept in refrigerator for further study.

2.3.Volatile oil isolation

Using Clevenger type apparatus; Volatile oil extraction was conducted by hydrodistillation of 250 g of dried material of *E. elaterium* with 2.5 L of tap water for 3 h. The hydrodistillation was carried out twice for each plant material and the volatile oils obtained for each were pooled, dried over anhydrous sodium sulphate (anh. Na2SO4) and stored in closed in amber vials at 4°C until analysis.

2.4. GC-MS analysis

About 1µL aliquot of the oil sample obtained by hydrodistillation, appropriately diluted in GC grade n-hexane, was injected into Varian Chrompack CP-3800 GC- MS-200 equipped with DB-5 GC capillary column (30 m × 0.25 mm i.d., 0.25 µm film thickness) consisting

of (5% diphenyl 95% dimethyl polysiloxane). Helium was used as a carrier gas at a flow rate of 1.0 ml/min. The GC was coupled to mass detector operating with electron ionization source of 180°C and 70 eV ionization voltage. At the beginning of GC analysis a steady temperature was held at 60°C for 1 min, then a linear temperature programming was applied from 60 °C to 246 °C at 3 °C/min ramping rate, then the temperature was held steady at 246 °C for 3 min. The oil of each individual plant material was analyzed twice. Using the same column, a hydrocarbon mixture of n-alkanes (C8-C20) was separately analyzed under the same chromatographic conditions.

2.5.GC–FID Analysis

Quantitative analysis (% area) was carried out using a Hewlett Packard HP-8590 gas chromatograph equipped with a split-splitless injector (split ratio, 1:50) and a FID detector. The column was an OPTIMA-5 (5% diphenyl 95% dimethyl polysiloxane) fused silica capillary column (30 m × 0.25 mm i.d., 0.25 film thickness). The analysis of the oils was carried out under linear temperature programming applied at 10 °C/min from 60 °C to 250 °C, and then kept steady at 250 °C for 5 min (isothermal). Temperatures of the injector and detector (FID) were maintained at 250 °C and 300 °C, respectively. For each sample, the relative peak areas for individual constituents were averaged (as average % area of all replicates). Assuming a unity response by all oil components, concentrations were calculated as percentage contents (%contents) using their corresponding normalized relative areas obtained by FID. Each oil sample was analyzed twice[8].

2.6.Identification of oil components

The identification of oil components was performed by using their recorded mass spectra matched by library searching with data bank mass spectra (NIST, Wiley and Adams-2007 libraries) and by comparing their calculated retention indices (RI), with literature values measured on columns with identical polarities, mainly using the Adam's library[9]. The identities of α-pinene, β-pinene, limonene, *p*-cymene, γ- terpinene, 1,8-cineole, linalool, α- and β-thujones, camphor, thymol and carvacrol were further confirmed by chromatography of their authentic standards under the same GC-MS conditions[10].

2.7.Cell culture condition

Three solid human tumor cell lines; breast adenocarcinoma (MCF-7), Colorectal adenocarcinoma (Caco-2), pancreatic adenocarcinoma (Panc-1) and normal human skin fibroblast (as control) were purchased ATCC (USA). Malignant and non-malignant cells were cultured in Dulbecco's modified Eagle's medium (DMEM) supplemented with 10% (v/v) fetal bovine serum (FBS), 2 mM L-glutamine, 100 units/ml penicillin and 100 µg/mL streptomycin. Cells were maintained in vented flask at 37 °C in a humidified atmosphere (90%) containing 5% CO_2 and sub-cultured every 3–4 days. All procedures were carried out in a sterile condition using sterile tools, materials, and safety laminar cabinet.

2.8.Extracts preparation for antiproliferative assay

Appropriate weights of previously prepared ethanol extracts of the two plants were initially dissolved in filtered DMSO so that we get concentration of 10mg/ml, and passed through a 0.2 mm filter, then the extracts were diluted in medium to produce concentrations range (0.1-300 µg/mL) of each extract, while in case of previously prepared water extracts of the same two plants appropriate weights of them were dissolved initially in DMEM so that we get concentration of 10 mg/mL, and passed through a 0.2 mm filter, then the extracts were diluted in medium to produce concentrations range (1-1000 µg/mL) of each extract. Doxorubicin and cisplatin were used as positive controls at the concentrations range (0.05 - 50 µg/mL). The final dilution used for treating the cells contained not more than 2% of DMSO, which was shown to be non-cytotoxic

by previous researches, this concentration being used in the solvent control wells.

2.9. Antiproliferative assay

Based on optimization experiments, all procedures followed in screening antiproliferative activity were conducted according to standard protocols verified by the same laboratory research group[11]. The antiproliferative assay was performed using a modified 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyl tetrazolium (MTT) assay. For sake of optimization of outcome, a slight modification of incubation time was performed by increasing it from 48 h to 72 h which was shown to work better for natural and synthetic materials[12-13]. Absorbance measurements were made at 570 nm using a microplate reader (BioteK, USA). Viability was expressed as the fraction of optical density of treated cells that survived relative to the average of optical density of untreated cultures (negative control). The antiproliferative effect was calculated according to the following equation: Toxicity % = $100(A_t/A_C)*100$

Where:

A_t: is the absorbance of the test sample.

A_C: is the absorbance of the control sample.

The IC_{50} value was defined as the concentration at which 50 % of cell viability was inhibited. All experiments were performed in triplicate and repeated at least twice.

2.10.Determination of IC_{50} values

The toxicity % of each treated well was calculated and since the experiments were performed in triplicate the average of toxicity % was also calculated for every treatment concentration, and the standard deviation (SD) was calculated for reading that expresses the same concentration, then a curve of % cytotoxicity against logarithm of concentration was drawn and the IC_{50} value was calculated from the equation of logarithmic line. Optimally crude herbal extracts are considered effective antineoplastic if their IC_{50}s < 30 µg/mL[14-16].

3. RESULTS AND DISCUSSION

3.1.Essential Oil analysis

The quantitative and qualitative composition of essential oil hydrodistilled from aerial parts of *E. elaterium* is summarized in Table 1. All components with their percentage contents are listed in ascending order based on their linear retention indices (Kovats indices) calculated on DB-5 equivalent column as according to Van Den Dool and Kratz relationship in Table 1. In addition, representative total ion current (TIC) chromatogram of the analyzed oil is shown in Figure 1.

As shown in Table 1, the number of components identified in the oils was 31, corresponding to an average of 76.3% of the total oils hydrodistilled from the plant. The dominant fraction was the non-terpenoidal hydrocarbons and miscellaneous (30.1%), the sesquiterpene fraction was accounting for 26.7%, the monoterpene fraction was 17.0%, while, diterpenes accounted for not more than 2.5% of the total oil. Most notably, four compounds were major component of the oil: hinesol (17.2%), an unknown compound has the same content (17.2%) like hinesol but eluted after, followed by benzaldehyde (12.3%), and lastly E-β-ionone (7.8%).

Generally speaking, the diversity in squirting cucumber of *Ecballium* composition was obvious and some commonality exists. Of that, aliphatic esters were present like palmitic and phthalic acid esters; also aromatic aldehydes such as benzyldehyde, benzene acetyldehyde, *o*-tolualdehyde and safranal, characteristic to the oil in addition to aliphatic aldehydes such as decanal and β- cyclocitral. The majority of these aldehydes are flavoring compounds. Aliphatic acetones were also found to present in the oil such as rose ketones (e.g. β-damascone and β-ionone), neryl acetone, and vistitenone. According to our intensive literature survey and to the best of our knowledge; our study is unprecedented in evaluating the EOs of this plant in Jordan. In one similar study conducted in Iran, leaves and fruits were analyzed separately.

Unlike our tested plant oil which was dominated by terpenoidal compounds, the fruits of Iranian plants was dominated by aromatic compounds followed by aliphatic hydrocarbons, while, the aliphatic esters were dominating in leaves[18]. Moreover there were substantial variations in the principal and major constituents. Tables 2 and 3 summarize chemical class distribution of the EO composition and the main identified components in the oils obtained from Iranian *E. elaterium* compared to our tested Jordanian plant.

These differences may be attributed to: 1) the difference in parts that the oil was obtained from; our sample oil was obtained from the whole aerial parts, while in Iranian specimens oils were from leaves and fruits; 2) the difference in geographical locations (source), which stands as one of the main variability factors as shown above; 3) the difference in time of collection, the Iranian plant specimens were collected in September, while our samples in July; and 4) cultivation conditions and drying methods can also affect the chemical constituent of EOs.

3.2.Antiproliferative activity

Table 4 displays the IC_{50} values antiproliferative activity using MTT assay in a panel of cancer cell lines, namely breast adenocarcinoma (MCF-7), Colorectal adenocarcinoma (Caco-2), and pancreatic adenocarcinoma (Panc-1). Normal human skin fibroblast cell line was recruited to verify selective cytotoxicity. All IC_{50} values listed are mean ± SD (standard error of mean) (µg/mL). Antineoplastic agents' cisplatin and doxorubicin were the reference controls.

Importantly; significant antiproliferative effectiveness of ethanol extracts for *E. elaterium* (mainly displayed in both MCF-7 and Caco-2) was demonstrated with IC_{50}s < 30 µg/mL. Water extract was found to be non cytotoxic against any cancer cell line; furthermore all extracts examined in the study had a high safety profile exhibited in normal human fibroblasts. Figures 2-5 express the effect of each crude extracts on the four cell lines used in the study.

The evaluation of antiproliferative activity of aerial parts of *E. elaterium* using two solvents with different polarities (water and ethanol) against MCF-7, Caco-2 and Panc-1 cancer cell lines was conducted. Moreover the safety of the extracts of plants was determined by studying their activities against normal fibroblasts.

According to the American National Cancer Institute guidelines (NCI), crude extract is considered cytotoxic of promising anticancer product for future bio-guided studies only if it exerts an IC_{50} value < 30 µg/mL[19]. The ethanol extract from *E. elaterium* showed good cytotoxic activity on MCF-7 and Caco-2 cells with IC_{50} values of 29.67 µg/mL and 17.64 µg/mL respectively. Water extract was not found to be cytotoxic against any cell line; this lack of activity can be attributed to low water solubility for the organic compounds. Furthermore all extracts used in the study are considered safe against normal human cells because IC_{50} values determined for all extracts against normal fibroblast cell line was far away from that recorded against cancer cell lines under our study.

Generally, *E. elaterium* is known for its anticancer effect, thus the cytotoxic activity of the screened plant ethanol extracts on MCF-7 and Caco-2 was not surprising, for MCF-7 the result of this study is in accordance with previous finding for Egyptian crude cucurbitacins extract from the plant since IC_{50} value of 19.70 µg/ mL previously reported by Saker[20] was comparable to ours. Against Caco-2 cells, *E. elaterium* showed more potent cytotoxic effect. This cytotoxic effect could be due to the presence of active phyto-constituents in the extracts that have been reported previously with highly cytotoxic activities on other cell lines such as curcubitacins compounds which were isolated and characterized from *E. elaterium*. Appreciably the isolated cucurbitacins from other genus of the same family were specifically and strongly cytotoxic for Caco-2 cells[21]. Profoundly combination of

cucurbitacin B and gemcitabine synergistically potentiated the antiproliferative effects of gemcitabine on pancreatic cancer cells other than Panc-1 cells[22]. Notably studying cytotoxicity against Panc-1 cells was for the first time with this plant, to the best of our knowledge.

3.3. Conclusions

Squirting cucumber of *E. elaterium* oil composition was characterized by the presence of high contents of non-terpenoidal compounds (hydrocarbons, ketones, aldehydes, etc.), sesquiterpenes, and very lower contents of monoterpenes and diterpenes. Hinesol, benzaldehyde, and E-β-ionone were among the major components with the highest contents. With regard to cytotoxicity results, the ethanol extract from *E. elaterium* showed good cytotoxic activity on MCF-7 and Caco-2. Notably the tested extracts under the present study were found to be safe on normal human cells.

Acknowledgment

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Table 1. Chemical composition of the essential oil hydrodistilled from aerial parts of *E. elaterium* from Jordan

No.	Rt	RI^{cal}	RI^{lit}	compound	%Content
1	**7.0**	**960**	**960**	**Benzaldehyde**	**12.3%**
2	7.7	1033	1035	Mixed peak, identified 2-isobutyl thiazole	1.6%
3	8.6	1042	1042	Benzeneacetyldehyde	0.9%
4	10.7	1068	1068	*o*-Tolualdehyde	0.8%
5	11.7	1093	1093	Ethyl sorbate	0.8%
6	12.2	1105	1106	α-Fenchocamphorone	2.0%
7	13.4	1134	–	Unknown	2.6%
8	15.4	1198	1197	Safranal	1.4%
9	16.1	1206	1202	n-Decanal	1.5%
10	17.0	1218	1217	β-Cyclocitral	0.8%
11	20.7	1303	NA	4,6-dimethyl-3,5,7-trioxatetracyclo[7.2.1.0(4,11).0(6,10)]Dodecane^{ms}	1.1%
12	20.9	1307	1309	p-vinyl-Guaiacol	2.1%
13	24.4	1389	1390	Isolongifolene (tobeshifted 6 m/zvalues)	1.9%
14	25.0	1405	1414	β-Damascone	1.1%
15	26.8	1446	1436	Neryl acetone	2.5%
16	27.2	1457	1447	Vestitenone	1.4%
17	**28.0**	**1476**	**1489**	**E-β-Ionone**	**7.8%**
18	28.1	1491	1490	cis-Eudesma, 6, 11 diene	0.9%
19	28.6	1510	1509	Germacrene A	0.7%
20	29.5	1513	–	Unknown	1.2%
21	31.4	1561	1563	E-Nerolidol	1.5%
22	33.6	1619	1624	10-epi-γ-Eudesmol	2.1%

No.	Rt	RI^{cal}	RI^{lit}	compound	%Content
23	**34.3**	**1639**	**1642**	**Hinesol**	**17.2%**
24	35.0	1656	1653	Eudesmol	1.0%
25	35.5	1670	1675	β-Bisabolol	0.7%
26	36.6	1713	1715	Longifolol	0.7%
27	41.3	1834	NA	2-methyl-7-octadecyne^{ms}	2.6%
28	**41.5**	**1839**	**–**	**Unknown**	**17.2%**
29	42.0	1853	NA	Phthalic acid, 6-ethyl-3-octyl isobutylester^{ms}	0.8%
30	42.2	1858	–	Unknown	0.8%
31	43.5	1876	1878	Cubitene	1.2%
32	43.7	1898	1900	n-Nonadecane	1.5%
33	43.9	1905	1902	epi-Laurenene	1.3%
34	44.3	1923	1921*	Hexadecanoicacid, methyl ester	2.8%
35	45.1	1947	NA	Butylcyclohexyl phthalate^{ms}	1.3%
36	46.3	1991	NA	Unknown	0.7%
Terpenoids:					**46.2**
Monoterpenes					**17.0**
HydrocarbonMonoterpenes					–
Oxygenated Monoterpenes - No.: 6,8,10,15,16 - No.: 14,17 (Rose ketones, carotenes degradation)					**17.0**
Sesquiterpenes					**26.7**
HydrocarbonSesquiterpenes - No.: 13,18,19					**3.5**
Oxygenated Sesquiterpenes - No.: 21-26					**23.2**
Diterpenes - No.: 31,33					**2.5**
Miscellaneous (all other compounds)					**30.1**
Total identified					**76.3**
Unidentified and Traces					**23.7**

*Rt: Retention time; RI^{cal}: linear (arithmetic) retention index calculated on a DB-5 equivalent column; RI^{lit}: retention index from literature[9];NA: data not available in literature; Compounds in bold are the major oil components (%content>5.0%);^{ms}:compound is identified according to MS only; *: RI^{lit}retention index is according to Santos et al.[17].*

Table 2. **Chemical class distribution of the essential oil components hydrodistilled from three samples of *E. elaterium***

Country Part used Collection time	Aliphatic hydrocarbons (%)	Aliphatic esters (%)	Aromatic compounds (%)	Alicyclic hydrocarbons (%)	Terpenoides (%)
Jordan Aerial parts July Our study sample	5.6%	0.8%	19.0%	4.7%	46.2%
[18]Iran Leaves					
Fruits	16.7%	30.8%	6.4%	20.4%	20.4%
September	33.0%	3.5%	45.3%	7.8%	7.8%

Table 3. Main, major and some components identified in the essential oils hydrodistilled from fruits, leaves and aerial parts of *E. elaterium* collected from Iran and Jordan.

Country Part used	**Main principal**	**Majors (<5% of the identified portion)**	**Components (≥ 2% of the identified portion)**
Jordan Aerial parts Our study sample	Hinesol (17.2%) Unknown (17.2%) Benzaldehyde (12.3%)	E-β-Ionone (7.8%)	p-vinyl–Guaiacol (2.1%) Neryl actone (2.5%) 10-epi-γ-Eudosmol (2.1%) 2-methyl- 7-octadecyne (2.6%) 14-methyl-petadecanoic acid (2.8%)
[18]Iran Fruit	E-anethol (31.6%)	3-(6,6-Dimethyl-5-oxohept- 2-enyl)- cyclohexanone (8.8%) Tetracosane (7.4%) Hexadecane (5.2%) Octadecane (5.7%)	β-Thujone (3.0%) Heptadecane (2.1%) Octyl octanoate (3.5%) Hexahydrofarnesyl acetone (2.1%) Dibuthyl phtalate (3.2%) Eicosane (2.7%) Henicosane (2.8%) Tricosane (4.9%)
[18]Iran Leaves	Octyl octanoate (30.0%) 3-(6, 6-Dimethyl-5- oxohept- 2-enyl)- cyclohexanone (20.4%) Hexahydrofarnesyl acetone (19.1%)		Hexadecane (2.5%) Octadecane (2.9%) Tricosane (2.0%) Tetracosane (3.7%)

Table 4. *In vitro* Antiproliferative activity of *E. elaterium* crude extracts on three cancer cell lines and normal human fibroblast cell line.

Treatment	Cytotoxicity (as of % control) (IC_{50} value: mean ± SD (µg/ ml)			
	MCF-7	**Caco-2**	**Panc-1**	**Fibroblasts**
E. elaterium AE	132.95 ± 5.9	972.63 ± 142.3	1141.39 ± 57.0	1236.45 ± 24.7
E. elaterium EE	**29.67 ± 2.9**	**17.64 ± 2.2**	107.77 ± 7.0	159.97 ± 1.3
Doxorubicin	0.35 ± 0.03	0.59 ± 0.1	1.38 ± 0.1	1.12 ± 0.1
Cisplatin	1.65 ± 0.2	1.44 ± 0.2	6.11 ± 0.1	9.91 ± 0.3

AE: aqueous extract. EE: ethanol extract. Results, representing IC_{50} (µg/ mL), are mean ± SD (n= 3 independent replicates). IC_{50}values (concentration at which 50% inhibition of cell proliferation took place in comparison to non- induced basal 72 h incubations) were calculated within treatment concentration range 0.05-1000 µg/ mL for all extracts and controls.

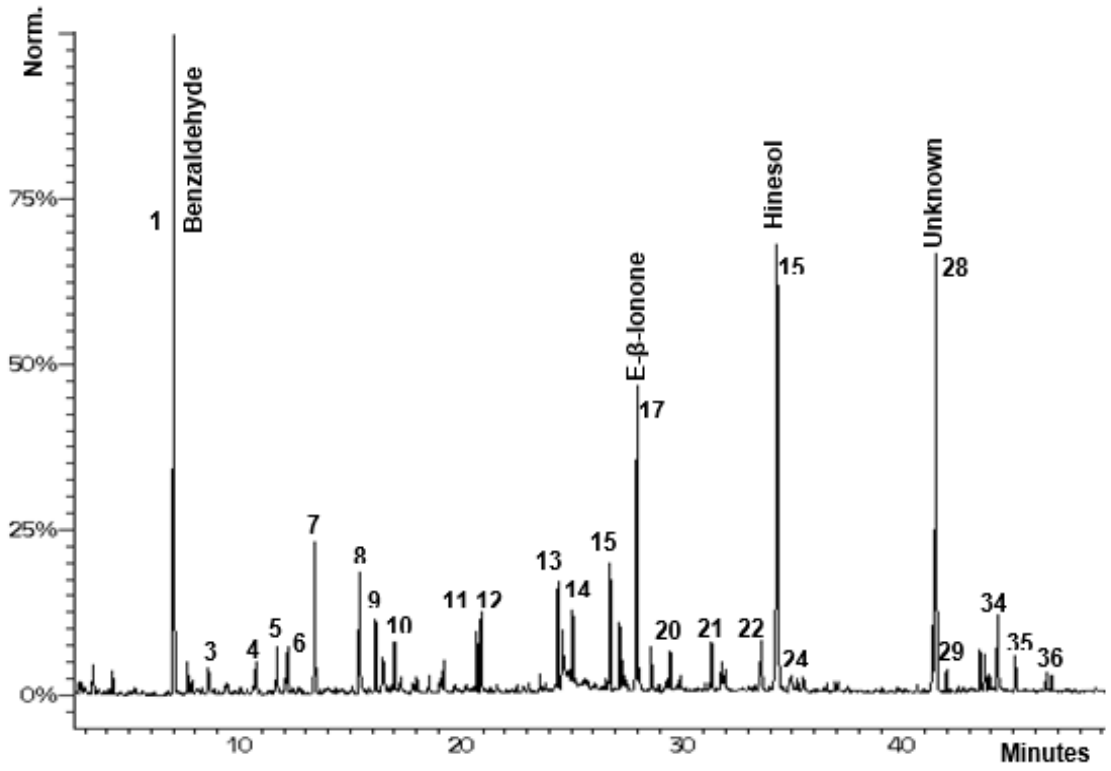

Figure 1. GC-MS TIC chromatogram of the essential oil hydrodistilled from aerial parts of *E. elaterium* grown in Jordan eluted on DB-5 column.

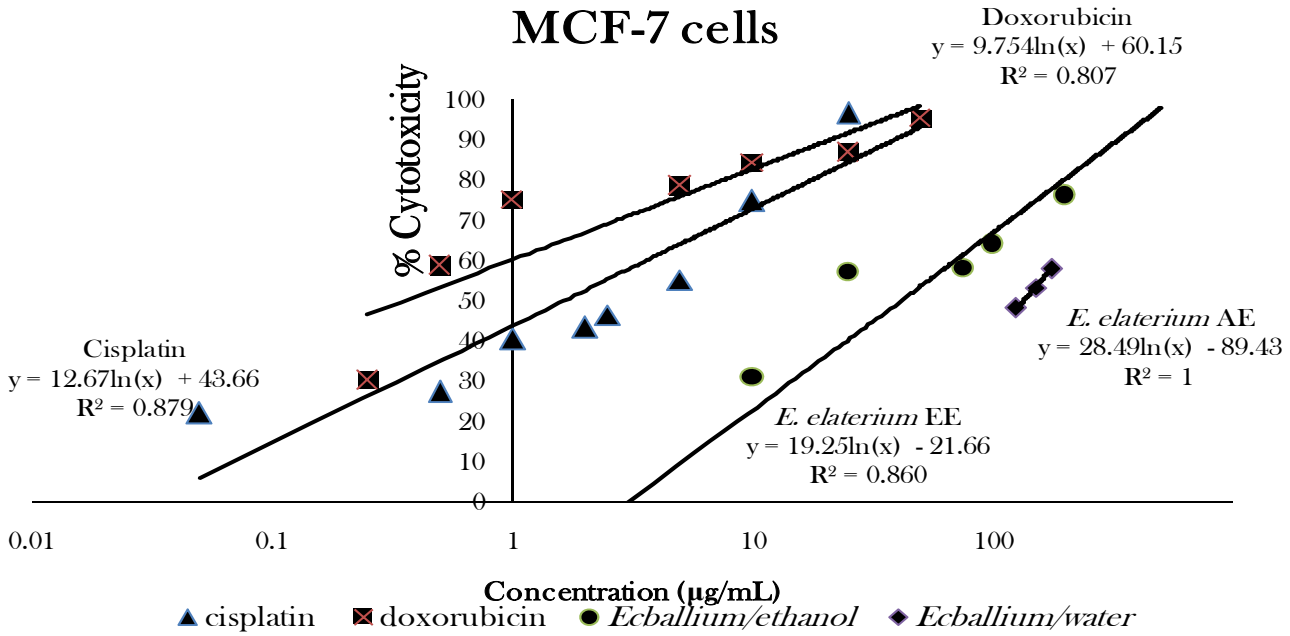

Figure 2. ***In vitro*** **antiproliferative activity of** ***E. elaterium*** **crude extracts, doxorubicin and cisplatin on MCF-7 breast cancer cells.**

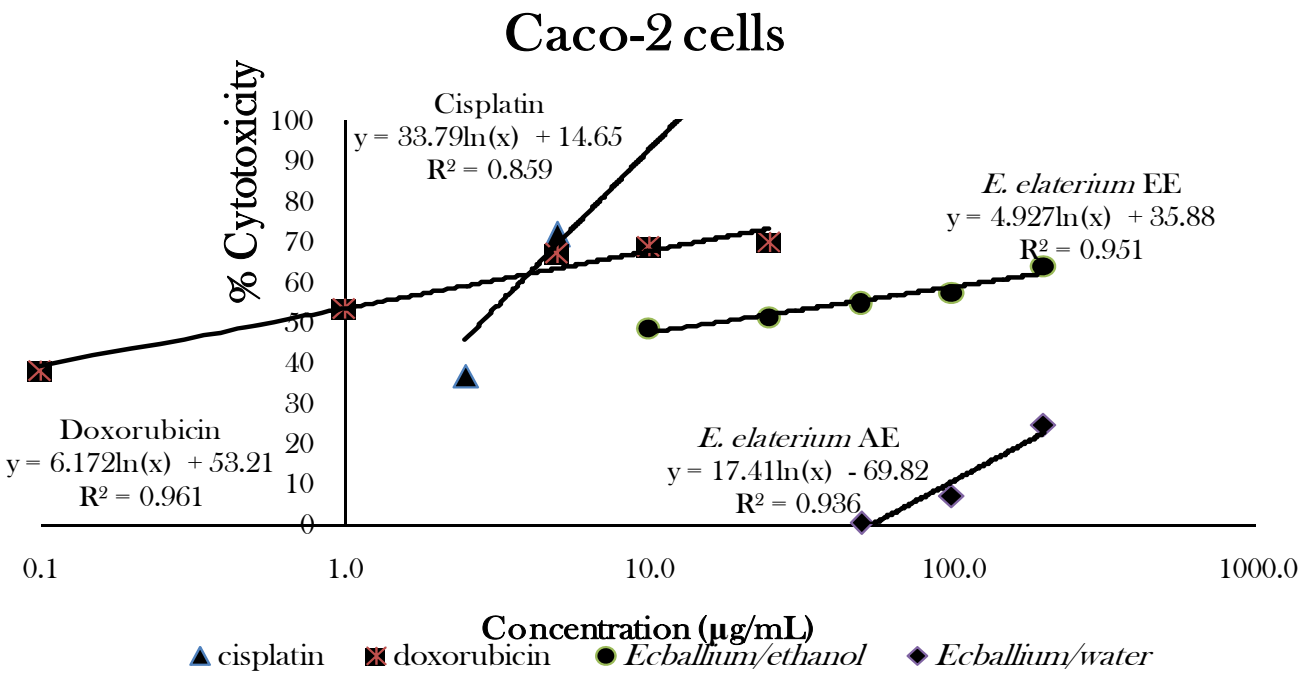

Figure 3. ***In vitro*** **antiproliferative activity of** ***E. elaterium*** **crude extracts, doxorubicin and cisplatin on Caco-2 colorectal cancer cells**

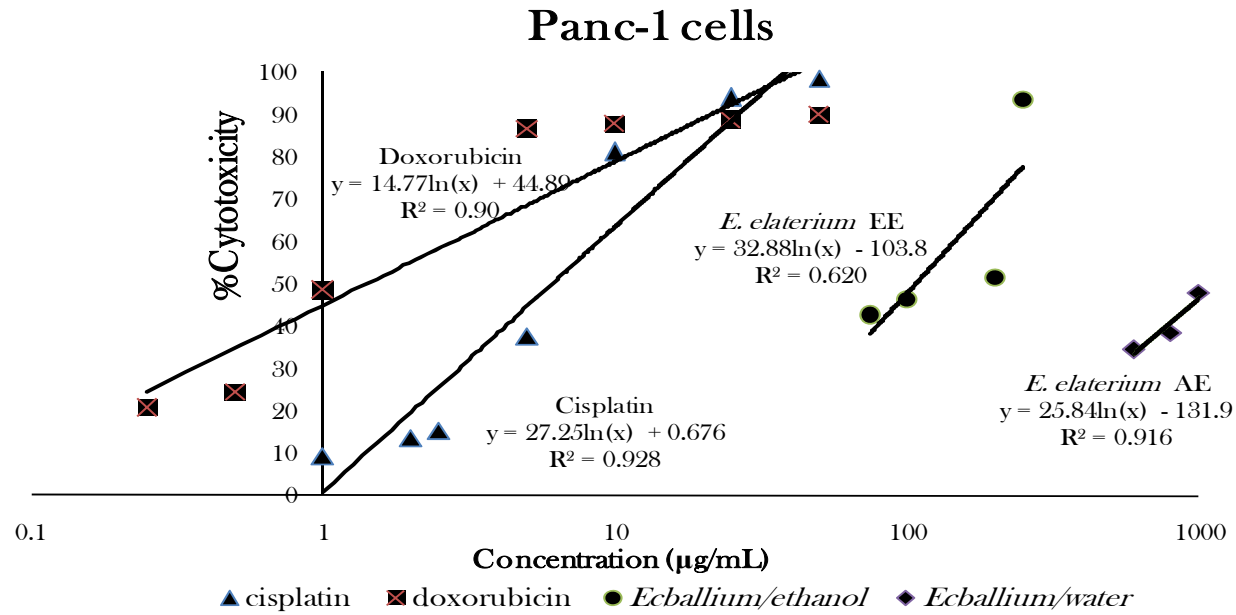

Figure 4. ***In vitro*** **antiproliferative activity of** ***E. elaterium*** **crude extracts, doxorubicin and cisplatin on Panc-1 pancreatic cancer cells**

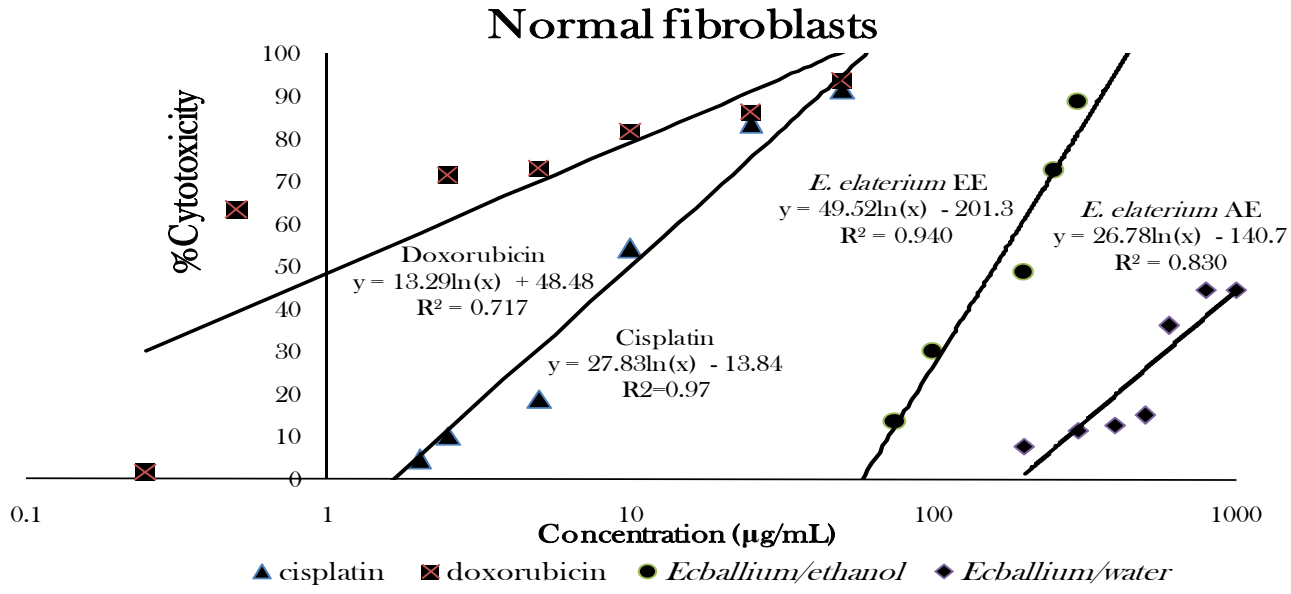

Figure 5. ***In vitro*** **antiproliferative activity of** ***E. elaterium*** **crude extracts, doxorubicin and cisplatin on normal fibroblast cells**

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دراسة مكونات الزيت العطري والنشاط المضاد لتكاثر الخلايا السرطانية للأجزاء الهوائية لنبات قثاء الحمار *Ecballium elaterium* (L) نبتة حاملة للزيوت العطرية الطبية من الأردن

ريم رايق جبارة[1] ، محمد م.د هديب [1،2] ، ياسر ك. بستنجي [1] ، نور ط الحوراني [1] ،ريم العباسي [1] وفيوليت كسابري

[1] كلية الصيدلة ، الجامعة الأردنية ، عمان ، الأردن

[2] كلية الصيدلة ، جامعة العين للعلوم والتكنولوجيا ، أبوظبي ، الإمارات العربية المتحدة .

ملخص

الخلفية والأهداف: هدفت هذه الدراسة إلى توفير تحليلات GC-FID و GC-MS للزيت العطري للأجزاء الهوائية المجففة من .Ecballium elaterium L في الأردن ودراسة قدرتها على السمية الخلوية .

الطريقة: تم الحصول على الزيت العطري بالتقطير المائي باستخدام جهاز .Clevenger تم استخدام طريقة MTT للتحقيق في النشاط المضاد لتكاثرالخلاياالسرطانية في المختبر للنبات ضد سلالات الخلايا السرطانية MCF-7 و Caco-2 و Panc-1 بالإضافة إلى خلايا الخلايا الليفية الطبيعية .

النتائج: أنتج زيت E. elaterium المقطر بالماء واحد وثلاثين مكوناً ، وهو ما يمثل 76.3٪ من إجمالي محتوى الزيت. محتويات عالية من nonterpenoidal لمركبات ، سيسكيتيربين ، ومونوتربين ميزت الكسور المتطايرة مع الهينيسول (17.2٪) ، المركب الرئيسي ، البنزالديهايد (12.3٪) و E-β-ionone (7.8٪) (كمكونات رئيسية. أظهر المستخلص الإيثانولي لنبتة E. elaterium نشاطًا جيدًا ضد خلايا MCF-7 و) Caco-2 قيم IC50 = 29.67 ميكروغرام / مل و 17.64 ميكروغرام / مل ، على التوالي). علاوة على ذلك ، كانت جميع المستخلصات آمنة على الخلايا البشرية الطبيعية. وبالمحصلة: تم إجراء تقييم لزيت E. elaterium المتطاير لأول مرة في الأردن. كما تم اختبار مستخلصات مختلفة لأول مرة ضد خلايا .Panc-1 علاوة على ذلك ، بناءً على النتائج التي تم الحصول عليها ، يمكن تقديمالمستخلص الإيثانولي من E. elaterium كمرشح لمعالجة سرطان الثدي والقولون والمستقيم.

الكلمات المفتاحية: Ecballium elaterium L. ، زيت عطري ، الأردن ، نشاط مضاد لتكاثرالخلايا السرطانية ، MCF-7، Caco-2، Panc-1.

الاختصارات

EOsالزيوت الأساسية

RIمؤشرالاحتفاظ

DMSO ثنائي ميثيل سلفوكسيد

DMEMوسيط Dulbecco’s modified Eagle’s

GC-MSكروماتوغرافيا الغاز – التحليل الطيفي الشامل

GC-FIDكروماتوغرافيا الغاز – كاشف التأين باللهب

تاريخ استلام البحث 2020/7/20 وتاريخ قبوله للنشر 2021/5/31.