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ANTIOXIDANT AND CYTOTOXIC POTENTIAL OF *CHRYSANTHEMUM MORIFOLIUM* AND *CONVOLVULUS ARVENSIS* EXTRACTS: A PROMISING SOURCE OF BIOACTIVE COMPOUNDS FOR MEDICINAL APPLICATIONS

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ABSTRACT

In this research, acetone extracts from the plants *Chrysanthemum morifolium* (*C. morifolium*) and *Convolvulus arvensis* (*C. arvensis*) were tested for their antioxidant and cytotoxic properties. Total phenolic content (TPC) and total flavonoid content (TFC) analyses of these extracts revealed considerable phenolic and flavonoid component concentrations. Both extracts demonstrated significant antioxidant activity as determined by the DPPH and FRAP tests, and their low IC_{50} values suggested that they were capable of effectively scavenging free radicals. Numerous bioactive substances, including n-hexadecanoic acid and ç-Sitosterol in *C. arvensis* and Lupeol and α-Amyrin in *C. morifolium*, were discovered in each extract by gas chromatography-mass spectrometry (GC-MS) analysis. These results point to the medicinal benefits associated with these plant extracts. Furthermore, cytotoxicity assessments were performed on breast cancer (MCF-7) cell lines, lung cancer (A549), and hepatocellular carcinoma (HepG2). *C. arvensis* extract demonstrated strong cytotoxicity versus all three cell-lines, alongside IC_{50} values varying from 7.10 µg/mL to 12.63 µg/mL. *C. morifolium* extract also displayed cytotoxic effects, with IC values of 51.57 µg/mL, > 100 µg/mL, and 107.10 µg/mL for the respective cell lines. These results highlight the potential of C. morifolium and C. arvensis extracts as sources of bioactive substances with cytotoxic and antioxidant activities. Suggesting their utility in the development of novel pharmaceuticals, particularly in the context of cancer treatment. This research highlights the importance of medicinal plants in the quest for new therapeutic agents.

Key words. *C. arvensis, C. morifolium*, GC-MS, HepG2, A549, MCF-7

INTRODUCTION

Natural products, particularly those derived from plants, represent a promising reservoir of novel biologically active compounds (Rodrigues et al., 2016). Herbal products have gained significant popularity, particularly in light of the adverse effects associated with synthetic drugs (Bahadori et al., 2019). Natural resources, with their abundant polyphenolic contents and diverse secondary metabolites, hold potential as antioxidants and anticancer agents. Antioxidants can effectively delay or prevent oxidative damage, a root cause of several diseases, by intercepting the formation of free radicals or neutralizing them post-production. In most instances, natural compounds prove to be more efficacious and dependable than synthetic antioxidants, thereby driving increased interest in identifying beneficial natural components for human use (Al-Snafi, 2016).

The emphasis has been on using medicinal plants to provide natural antioxidants (Prathapan et al., 2011). The important medicinal plant is *Chrysanthemum morifolium Ramat*, a member of the Asteraceae family (Park et al., 2015). Due to its extensive biological properties, which include antioxidant, anticancer, antimutagenic, anti-inflammatory, antibacterial, and antiviral properties, this medicinal herb's flower extract has been used for centuries in various Asian countries as a source of healthy food, beverages, and traditional Chinese medicine (Hodaei et al., 2021). Tea, a popular beverage in China and Korea, is made using chrysanthemum flower extract as a basic material. Before being used as a vegetable in Chinese cuisine, chrysanthemum leaves are also cooked or steamed (Khaing et al., 2013). Numerous studies have proven that C. morifolium has strong antioxidant and antibacterial properties (Yeasmin et al., 2016). Rezaei et al. (2017) observed that polyphenols, which comprise phenolic acids, flavonoids, and anthocyanins, are among the bioactive elements present in *C. morifolium* flowers and that these components are closely connected to the health advantages of the plant blooms.

The Convolvulaceae family comprises a number of noteworthy plants that contain a variety of chemical compounds used to treat a variety of ailments, according to Jacobs and NRCS (2007). *Convolvulus arvensis* (Family: Convolvulaceae), a common wild plant in Egypt, is native to Europe and Asia. A perennial herbaceous climbing or creeping plant, it can grow anywhere between 0.5 and 2 meters tall. Because of its powerful healing properties, *C. arvensis* is the ideal illustration of a medicinal plant. This plant has been investigated as a potential source of antioxidant activity, according to Mohammed et al. (2011). According to Awaad and Jaber (2010) and Thakral et al. (2010), the phenolic components of *C. arvensis* extracts flavonoids, phenolic acids, tannins, and phenolic diterpenes are principally responsible for the plant antioxidant action. According to Thane et al. (2000), *C. arvensis* shows potential as a source of anticancer drugs. Different *C. arvensis* extracts have shown impacts on immune cell activity and tumor angiogenesis, boosting immune cells (Kidd, 2000). This study's objective was to investigate the antioxidant and

cytotoxic properties of acetone extracts from the plants *Chrysanthemum morifolium* (*C. morifolium*) and *Convolvulus arvensis* (*C. arvensis*).

MATERIALS AND METHODS

Convolvulus arvensis and *Chrysanthemum morifolium* plants were taken from the nursery at faculty of Agriculture, Minia University. Fresh, healthy leaves were meticulously cleaned, properly rinsed under running water, and allowed to air dry for four weeks without exposure to sunlight. They were then stored in a sealed container after being processed into a fine powder using an electric grinder. One hundred grams of the powdered material were added to a 1000 mL round-bottom flask with a magnetic stirrer to make the extracts. Following the addition of 700 milliliters of acetone, the mixture was constantly swirled for six hours. Whatman No. 1 filter paper was then used to collect and filter the extracted material.

Total phenolic and total flavonoid contents (TPC and TFC)

The Folin-Ciocalteu method was used to calculate the total phenolic content (TPC) of each extract [Velioglu et al., 1998; Singleton et al., 1991]. The amount of phenolics in the sample was measured and represented as milligrams of gallic acid equivalent (mg GAE) per gram. The total flavonoid content in the extracts was calculated utilizing the approach described by Ebrahimzadeh et al. in 2008. For every gram of the sample, the quantity of flavonoids was calculated as milligrams of quercetin equivalents (mg QE).

Antioxidant activity determination:

Antioxidant activity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging method. The scavenging activity against free radicals in extracts from several plant species was evaluated using the method described by Brand-Williams et al. (1995). The FRAP (Ferric reducing ability of plasma) assay was carried out in accordance with the steps described by Benzie and Strain in (1996).

GC-MS Analysis:

The National Research Center's Mass Spectrum Lab in Dokki, Giza, conducted the GC/MS analysis. Thermo Scientific Trace GC Ultra/ISQ Single Quadrupole MS and TG-5MS fused silica capillary column (30 m, 0.25 mm, 0.1 mm film thickness) were utilized for the analysis. Helium was used as the carrier gas with a flow rate of 1 mL/min and an electron ionization device with an ionization energy of 70 eV for GC/MS detection. A consistent temperature of 280°C was maintained for the MS transfer line and injector. All the components were assessed using % relative peak area.

Cell culture and reagents

The hepatocellular carcinoma (HepG2), lung carcinoma (A549), and breast cancer (MCF-7) cells were donated by Nawah Scientific Inc. in Mokattam, Cairo, Egypt. In addition to 10% heat-inactivated fetal bovine serum, 100 mg/mL streptomycin, and 100 units/mL penicillin, these cells were maintained in DMEM media. Maintenance was carried out in a humid environment with 5% (v/v) CO_2 at 37 degrees Celsius.

Test for cytotoxicity

The SRB test was used to gauge cell viability. First, 96-well plates were seeded with 100 L of a cell suspension containing $5x10^3$ cells. After that, the plates were incubated in full medium for 24 hours. The cells were then exposed to 100 µL of medium with various concentrations of plant extracts. After being exposed to the extracts for 72 hours, the cells were fixed by removing the medium and replacing it with 150 µL of 10% TCA, followed by an hour-long incubation at 4°C. The cells received five washings with distilled water after TCA elimination**.** For viability testing, 70 L of SRB solution (0.4% w/v) was added, and it was incubated at room temperature for 10 minutes in a dark setting. After three 1% acetic acid washes, the plates were air dried overnight. A BMG LABTECH® FLUOstar Omega microplate reader (Ortenberg, Germany) was used to detect the absorbance at 540 nm after 150 L of TRIS (10 mM) had been added to dissolve the protein-bound SRB dye (Allam et al., 2018; Skehan et al., 1990).

Statistical Analyses:

All experiments and analytical data were conducted in triplicate and are provided as mean standard deviation. The significance of the treatment effect was determined using the F-test (P 0.05). Differences between individual means were analyzed using the Duncan test (1957), and significance was established at P 0.05.

RESULTS AND DISCUSSION

Phytochemical analysis and antioxidant activity

Phenolics or polyphenols, which are secondary plant chemicals, are very important because they can serve as antioxidants. To do this, deactivate lipid free radical chains and prevent hydroperoxides from converting to reactive oxyradicals by attaching to redox-active metal ions. The total phenolic and flavonoid contents (TPC and TFC) in the acetone extracts of *Convolvulus arvensis* and *Chrysanthemum morifolium* were examined using spectrophotometric techniques. The outcomes are displayed in Table 1.

Based on the data obtained, the total phenolic content was found to be 39.42±0.21 mg GAEs/g for *C. morifolium* extract and 38.47±0.18 mg GAEs/g for *C. arvensis* extract. Additionally, the total flavonoid content was measured at 24.57±1.02 mg QEs/g for *C. morifolium* extract and 26.97±1.28 mg QEs/g for *C. arvensis* extract. Previous research has identified various compounds in *C. arvensis*. plants, including alkaloids, flavonoids, coumarins, sterols, saponins, and tannins (Todd et al., 1995; Menemen et al., 2002). For instance, *Convolvulus galaticus* was reported to have a total phenolic content of 84.689 mg GAEs/g and a total flavonoid content of 48.760 mg CEs/g (Türker and Yıldırım, 2018). In another study, *C. arvensis* leaves were found to contain 244.6 mg GAE/g of total phenolic content and 174.4 mg RE/g of total flavonoid content (Elzaawely and Tawata, 2012). Despite variations in the amounts of bioactive compounds due to

different plant taxa, solvents, and growth conditions, it is reasonable to conclude that most Convolvulus taxa have the potential to be a significant source of phenolic compounds.

Antioxidants are essential in avoiding or reducing the negative effects of reactive oxygen species by converting them into innocuous molecules. This defense mechanism covers a wide range of illnesses, such as cancer, heart disease, diabetes, infections, and ischemia (Dabbas in 2017). Relying on a single approach may make it difficult to determine the antioxidant capacity of plant extracts due to the complex composition of bioactive secondary metabolites (Du et al., 2009). Therefore, two main techniques were mainly used to evaluate the antioxidant activity of C. morifolium and *C. arvensis* extracts. The outcomes of these techniques, especially the DPPH and FRAP free radical scavenging tests, are shown in Table 1. It's important to note that the differences found are statistically significant (p 0.05).

The capacity of *C. morifolium* and *C. arvensis* extracts to scavenge DPPH free radicals is shown visually in Table 1. For the extracts of *C. morifolium* and *C. arvensis*, the IC_{50} value which denotes the concentration at which 50% of the radicals are neutralized was estimated to be 36.45 g/ml and 36.68 g/ml, respectively. These results concur with those presented by Thrakal et al. (2010). Where they determined IC_{50} values of 131.03 µg/mL in methanolic extracts of *C. arvensis* using the DPPH assay. The researcher also suggested that the presence of phenolic compounds, including phenolic acids and flavonoids, in *C. arvensis* extracts might be accountable for the observed antioxidant activity.

Table 1: Total phenolic content (TPC), total flavonoid content (TFC) and Antioxidant activities of *C. morifolium* and *C. arvensis* extracts

	C. morifolium	***C. arvensis***
Total Flavonoids (mg QE/g extract)	24.57±1.02	26.97±1.28
Total Phenolics (mg GAE/g extract)	39.42±0.21	38.47±0.18
DPPH IC_{50} (µg/ml)	36.45	36.68
FRAP (µM TE /mg)	45.88±2.15	28.86±2.12

Values are mean ± SD (standard deviation).

C. morifolium and *C. arvensis* extracts displayed significant FRAP (ferric reducing ability of plasma) activity, with measured values of 45.88±2.15 mg TEs/g for *C. morifolium* extracts and 28.86±2.12 mg TEs/g for *C. arvensis* extracts.

GC-MS analysis

Medicinal plants undeniably represent invaluable resources for the advancement of novel pharmaceuticals, as they have played a pivotal role in the discovery of active compounds employed in contemporary medicinal treatments. Harnessing plant-based reservoirs has facilitated the identification of diverse bioactive substances that hold a pivotal role in combatting a wide spectrum of diseases and ailments. The critical processes of scrutinizing and isolating these compounds from plant materials constitute essential stages in the modernization and quality assurance of herbal formulations.

The gas chromatography (GC) technique was employed to discern the bioactive compounds within acetone extracts derived from *C. arvensis* and *C. morifolium*. Detailed information concerning the compounds identified in the extracts of *C. arvensis* and *C. morifolium* can be found in Tables 2 and 3. It is pertinent to note that the findings of the GC-MS analysis for the remaining extracts, which exhibited either negligible or no cytotoxic activity, are not included in this analysis.

The outcomes of this investigation, as delineated in Table 2 and Figure 1, substantiate the presence of 14 bioactive phytochemical compounds within the acetone extract of *Convolvulus arvensis*. These compounds are characterized by their retention time (RT), molecular formula, molecular weight (MW), and concentration (peak area %). Moreover, visual representations of the mass spectra for the identified compounds from *C. arvensis* are depicted in Figure 2. Notable constituents detected in the acetone extract of *C. arvensis* encompass n-Hexadecanoic acid (14.15%), ç-Sitosterol (11.82%), 2-Hexadecen-1-ol, 3,7,11,15-Tetramethyl-, [R- [R*, R*-(E)]]- (10.61%), 9,12,15-Octadecatrienoic acid, (Z,Z,Z)- (10.36%), 9,12-Octadecadienoic acid (Z,Z)-, 2,3-bis[(trimethylsilyl) oxy] propyl ester (4.64%).

The GC-MS analysis of the acetone extract derived from *C. morifolium* unveiled the presence of 15 bioactive compounds, as detailed in Table 3 and Figure 2. Notably, the acetone extract exhibited notable concentrations of several major bioactive compounds, including Lupeol (20.64%), α-Amyrin (12.32%), Palmitic acid, TMS derivative (10.31%), Olean-12-en-3-ol, acetate, (3á)- (8.18%), Myristic acid TMS derivative (6.44%), and Heptacosane, (4.40%).

Table 2: Identification of Phytochemical Components in Acetone Extract of *C. arvensis* by GC-MS analysis

NO.	Compound name	MF	Area %	MW	RT
1	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	2.61	278	24.24
2	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	14.15	256	26.49
	Palmitic Acid, TMS derivative	$C_{19}H_{40}O_2Si$	3.55	328	28.22
3	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl-, [r-[r*,r*-(e)]]-	$C_{20}H_{40}O$	10.61	296	29.21
4	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	$C_{18}H_{30}O_2$	10.36	278	29.54
5	Oleic acid	$C_{18}H_{34}O_2$	2.36	282	29.63
6	Octadecanoic Acid	$C_{18}H_{36}O_2$	1.91	284	30.11
7	Olean-12-ene-3,28-diol, (3á)-	$C_{30}H_{50}O_2$	1.19	442	35.87
8	9-Octadecenoic acid (Z)-, 2-hydroxy-1-(hydroxymethyl)ethyl Ester	$C_{21}H_{40}O_4$	1.66	356	37.97
9	Olean-12-ene-3,15,16,21,22,28-hexol, (3á,15à,16à,21á,22à)-	$C_{30}H_{50}O_6$	1.36	506	41.06
10	Stigmastane-3,6-dione, (5à)-	$C_{29}H_{48}O_2$	1.11	428	41.53
11	Tricyclo[20.8.0.0(7,16)]triacontane, 1(22),7(16)-diepoxy-	$C_{30}H_{52}O_2$	2.26	444	41.71
12	9,12-Octadecadienoic acid (z,z)-,	$C_{27}H_{54}O_4Si_2$	1.41	498	42.18
13	1-Heptatriacotanol	$C_{37}H_{76}O$	2.78	536	42.58
14	Vitamin E	$C_{29}H_{50}O_2$	2.20	430	43.01
15	Campesterol	$C_{28}H_{48}O$	3.60	400	43.95
16	Stigmasterol	$C_{29}H_{48}O$	3.58	412	44.25
17	9,12-Octadecadienoic acid (z,z)-, 2,3-bis[(trimethylsilyl)oxy]propyl ester	$C_{27}H_{54}O_4Si_2$	4.64	498	44.57
18	ç-Sitosterol	$C_{29}H_{50}O$	11.82	414	44.77
19	9,12,15-Octadecatrienoic acid, 2,3-bis[(trimethylsilyl)oxy]propyl ester, (z,z,z)-	$C_{27}H_{52}O_4Si_2$	2.52	496	44.97
20	Betulin	$C_{30}H_{50}O_2$	1.05	442	45.11

Table 3: Identification of Phytochemical Components in Acetone Extract of *C. morifolium* by GC-MS analysis.

NO.	Compound name	MF	Area %	MW	RT
1	Ppropiolic acid, 3-(1-hydroxy-2-isopropyl-5-methylcyclohexyl)-	$C_{13}H_{20}O_3$	2.70	224	21.44
2	Myristic acid TMS derivative	$C_{17}H_{36}O_2Si$	6.44	300	24.45
	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	3.45	256	26.59
3	Palmitic acid, TMS derivative	$C_{19}H_{40}O_2Si$	10.31	328	28.26
4	9.12-Octadecadienoic acid	$C_{18}H_{32}O_2$	1.00	280	29.51
5	Heptacosane	$C_{27}H_{56}$	4.40	380	41.09
6	1R.4S.7S.11R-2.2.4.8-Tetramethyl tricycle[5.3.1.0 (4.11)] undec-8-ene	$C_{15}H_{24}$	1.39	204	41.45
7	4.4-Dimethyl-5à-D1-ANDROST AN-3A-OL-7-ONE	$C_{21}H_{33}DO_2$	2.17	319	42.32
8	dl-α-Tocopherol	$C_{29}H_{50}O_2$	2.03	430	43.07
9	Dotriacontane	$C_{32}H_{66}$	3.72	450	43.17
10	Stigmasterol	$C_{29}H_{48}O$	2.90	412	44.54
11	Olean-12-en-3-ol, acetate, (3á)-	$C_{32}H_{52}O_2$	8.18	468	45.73
12	Vitamin E	$C_{29}H_{50}O_2$	2.03	430	45.87
13	α-Amyrin	$C_{30}H_{50}O$	12.32	426	46.22
14	Lup-20(29)-en-3-one	$C_{30}H_{48}O$	1.70	424	46.82
15	Lupeol	$C_{30}H_{50}O$	20.64	426	47.14

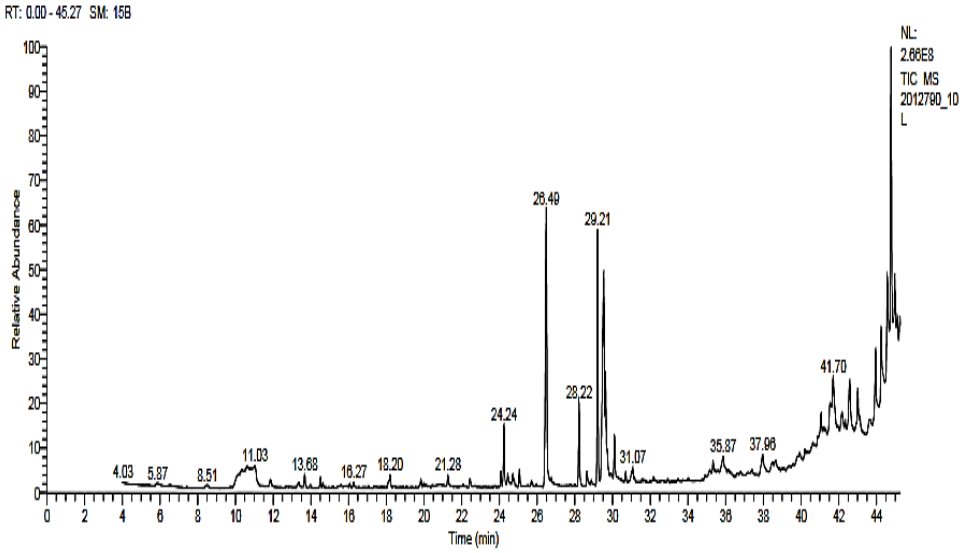

Fig 1: GC-MS chromatogram of Acetone Extract of *C. arvensis*

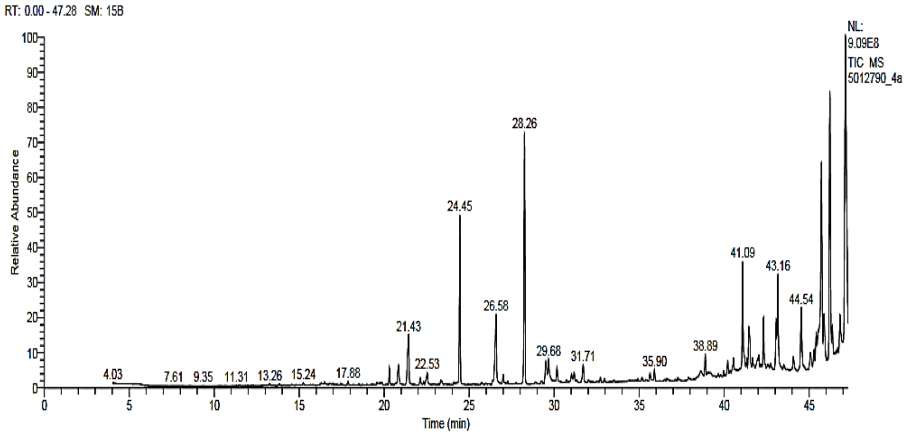

Fig 2: GC-MS chromatogram of Acetone Extract of *C. morifolium*

Cytotoxic activity

To assist in the development of prospective anti-cancer drugs, the cytotoxicity of extracts from *C. arvensis* and *C. morifolium* was examined on three distinct cell lines: lung cancer (A549), hepatocellular carcinoma (HepG2), and breast cancer (MCF-7) cells. As demonstrated in Figures 3-5, cell viability was assessed using the SRB test and contrasted to untreated cells acting as a reference.

A549, MCF-7, and HepG2 cell lines were all significantly cytotoxic to *C. morifolium* extract, with IC_{50} values of 51.57 g/mL, > 100 g/mL, and 107.10 g/mL, respectively. Contrarily, *C. arvensis* extract demonstrated the strongest cytotoxicity, with IC_{50} values for A549, MCF-7, and HepG2 cell lines of 12.23 g/mL, 12.63 g/mL, and 7.10 g/mL, respectively. Against the A549, MCF-7, and HepG-2 cell lines, *C. arvensis* and *C. morifolium* extracts shown strong anticancer effectiveness, showing great cytotoxicity and the potential for tumor management. The effectiveness of these extracts in controlling tumors is attributed to their content of compounds that act as antioxidants, as suggested by Gazwi et al., (2022).

Flavonoids are known to possess anticancer properties because of their ability to influence cell proliferation signaling pathways (Khandan and Piri, 2013). Prior research has indicated that flavonoids extracted from *C. morifolium* demonstrate substantial cytotoxicity against human breast, liver, and colon cancer cells (Feng et al., 2018; Peng et al., 2010). Therefore, the observed anticancer effects of the extract on A549, MCF-7, and HepG2 cell lines can likely be attributed to the presence of these bioactive compounds.

In recent times, the rise of drug resistance has become a significant challenge, underscoring the urgent need for the discovery and development of novel drugs (Qadir and Malik, 2010; Qadir and Malik, 2011). Natural products are increasingly recognized as promising sources for the development of new therapeutic agents (Masood et al., 2011; Javed and Qadir, 2011).

Previous research has demonstrated the cytotoxicity of *C. arvensis* against the human tumor cell line (Hela) using the MTT assay (Sadeghi-aliabadi et al., 2008). Flavonoids and tannins have been established as cytotoxic compounds (Yoshiki et al., 2008), while saponins have been recognized for their potential as anti-cancer agents (Man et al., 2010). Previous studies have indicated the presence of flavonoids, tannins, and saponins in the ethanolic extract of *C. arvensis* (Mojab et al., 2003; Dhole et al., 2012; Abbas et al., 2012). Hence, it is plausible that the cytotoxic properties of the extract of *C. arvensis* may be attributed to the presence of these bioactive compounds.

CONCLUSION

In summary, the research revealed that both *C. morifolium* and *C. arvensis* extracts contain significant amounts of phenolic and flavonoid compounds, showcasing their antioxidant potential. These extracts exhibited notable antioxidant activity in DPPH and FRAP assays, with IC_{50} values indicating their

effectiveness in scavenging free radicals. GC-MS analysis identified multiple bioactive compounds in both extracts, with *C. morifolium* and *C. arvensis* showing potential medicinal value. Additionally, cytotoxicity assays demonstrated the extracts' potency against various cancer cell lines, suggesting their potential in cancer treatment. These findings underscore the value of these plant extracts as sources of bioactive compounds with antioxidant and cytotoxic properties, offering promise for the development of new pharmaceuticals

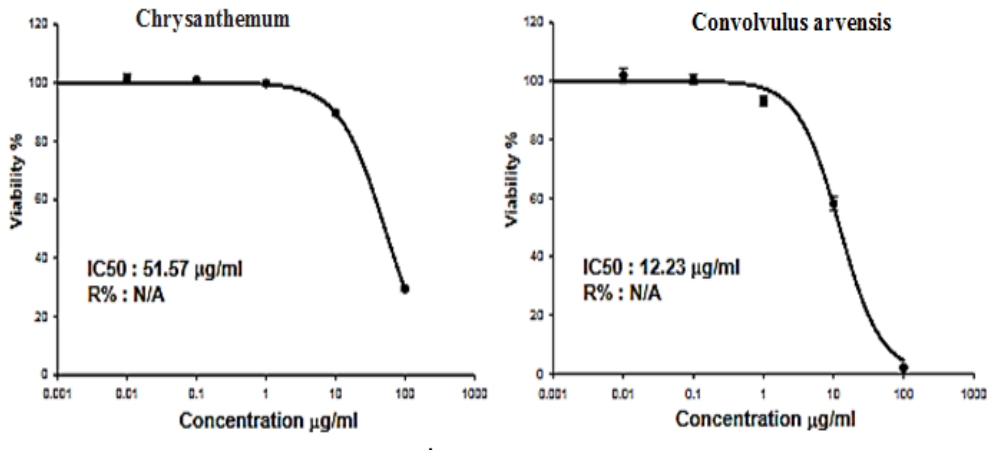

Fig 3. Cytotoxic activity of *C. morifolium* and *C. arvensis* extracts against lung cancer (A549)

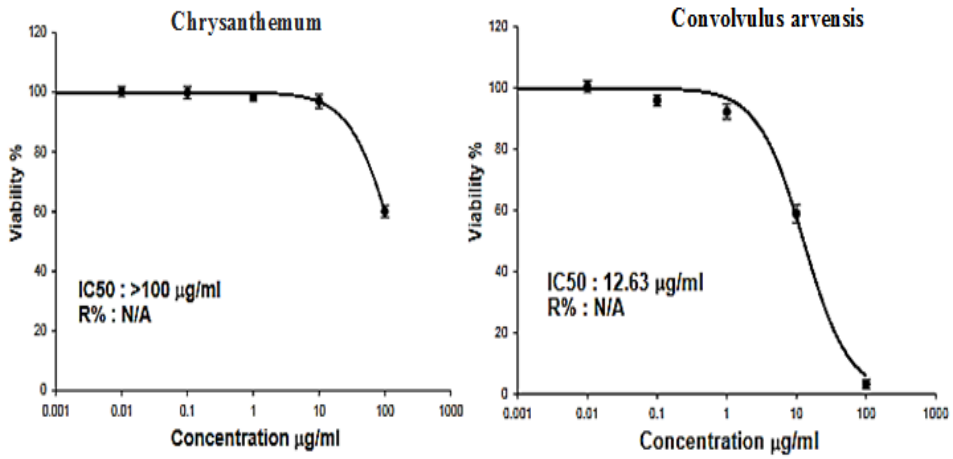

Fig 4 . Cytotoxic activity of *C. morifolium* and *C. arvensis* extracts against (MCF-7)

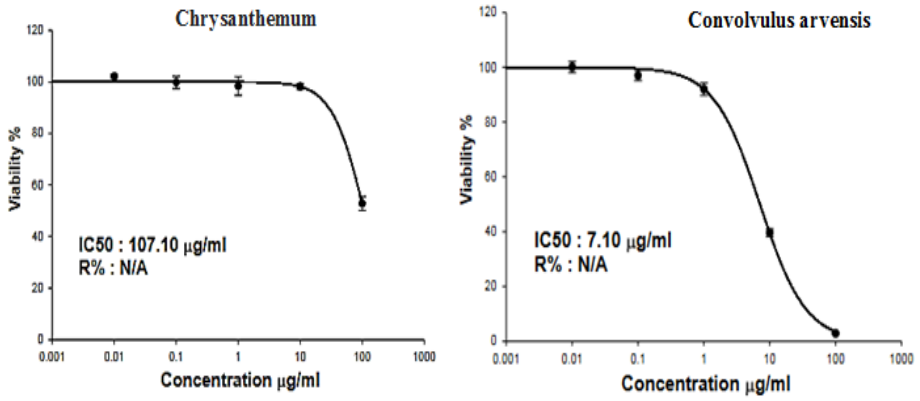

Fig 5. Cytotoxic activity of *C. morifolium* and *C. arvensis* extracts against (HepG2)

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الملخص العربي

النشاط المضاد للأكسدة والسمية الخلوية لمستخلصات الأقحوان ولبلاب الحدائق: مصدر واعد للمركبات النشطة بيولوجيا للتطبيقات الطبية

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في هذه الدراسة، قمنا بدراسة الخصائص المضادة للأكسدة والسمية الخلوية لمستخلصات الأسيتون لكل من الأقحوان ولبلاب الحدائق. تم تقدير محتوى الفينولات الكلية ومحتوى الفلافونويدات الكلية لهذه المستخلصات، مما كشف عن تركيزات مرتفعة من المركبات الفينولية والفلافونويدية. أظهر كلا المستخلصين نشاطًا قويًا مضادًا للأكسدة حيث تم قياسه بواسطة فحوصات DPPH وFRAP، مع انخفاض قيم IC_{50} التي تشير إلى قدرات فعالة في التخلص من الشقوق الحرة. حدد تحليل قياس الطيف الكتلي للغاز (GC-MS) مركبات نشطة بيولوجيًا متعددة في كل مستخلص، مثل Lupeol وα-Amyrin في مستخلص الاقحوان وn-Hexadecanoic acid وç-Sitosterol في مستخلص لبلاب الحدائق. تشير هذه النتائج إلى الإمكانات الطبية لهذه المستخلصات النباتية. علاوة على ذلك، تم إجراء تقييمات السمية الخلوية على خلايا سرطان الرئة (A549)، وسرطان الكبد (HepG2)، وسرطان الثدي (MCF-7). وقد أظهر مستخلص لبلاب الحدائق سمية خلوية قوية ضد جميع الخلايا السرطانية الثلاثة، حيث تتراوح قيم IC_{50} من 7.10 ميكروغرام/مل إلى 12.63 ميكروغرام/مل. أظهر مستخلص الأقحوان أيضًا تأثيرات مضادة للسمية للخلوية، مع قيم IC_{50} تبلغ 51.57 ميكروجرام/مل، > 100 ميكروجرام/مل، و107.10 ميكروجرام/مل ضد الخلايا المعنية. تؤكد هذه النتائج على إمكانات مستخلصات الأقحوان ولبلاب الحدائق كمصادر للمركبات النشطة بيولوجيًا ذات الخصائص المضادة للأكسدة والسمية الخلوية، مما يشير إلى فائدتها في تطوير أدوية جديدة، خاصة في سياق علاج السرطان. يسلط هذا البحث الضوء على أهمية النباتات الطبية في البحث عن مواد ذات مواصفات علاجية جديدة.