Research Article

GC-MS Analysis of Bioactive Compounds in Methanolic Extracts of *Papaver decaisnei* and Determination of Its Antioxidants and Anticancer Activities

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Received 24 February 2022; Revised 10 April 2022; Accepted 12 April 2022; Published 23 April 2022

Academic Editor: Christophe Hano

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The poppy *Papaver* L., Papaveraceae, has more than 820 species distributed into the 43 genera [1]. The Iraqi flora shows 15 *Papaver* geniuses with annual and perennial species, mostly growing in Iraqi Kurdistan (an autonomous region in Iraq) particularly about 80% of them were found in Rawanduz district. They include *P. acrochaetum* Bornm., *P. argemone* L., *P. armeniaca* L., *P. bornmuelleri* Fedde., *P. curviscapum* Nab., *P. cylindricum* Cullen., *P. decaisnei* Hochst., *P. dubium* L., *P. fuga* xPoir., *P. glaucum* Boiss., *P. hybridum* L., *P. rheas* L., *P. persicum* Lindl., *P. macrostomum* Boiss., and *P. somniferum* L. out of these species, and only *P. decaisnei* have not been screened phytochemically and biologically based on the systematic search in Google and SciFinder [2]. The *Papaver* species have different properties with more than 170 various alkaloids in their organs [3]. The alkaloids (thebaine, codeine, and
morphine) of *Papaver* species are industrially used for pharmaceutical products as a treatment for different health problems [4]. Thebaine is a known chemical for the production of pentacyclic morphinan-based drugs. Morphine, noscapine, and codeine were previously presented as analgesia as well as an antiproliferative drug for their significant remedial potency [5]. In more recent decades, the world’s tendency to depend on the *Papaver* alkaloids and their derivatives as a remedy has remodeled the drug production basics of major pharmaceutical companies [6]. Gas chromatography coupled with mass spectrometry is one of the fast and sensitive techniques for the identification of volatile compounds from plant extract. On this occasion in the present work, the GC-MS method was chosen to determination qualitative and quantitative for the complex product [7, 8].

Natural antioxidants and herbal medicine usage as anti-free radicals become popular among health care due to the downsides of chemically synthetic drugs. The antioxidant potentials of *Papaver* species have been reported by numerous research studies [7–10]. This bioactivity of *Papaver* species has been correlated with their moderate hydrophilic secondary metabolites contents, namely, flavonoids, phenolic acids, and glycosides, as well as lipid-soluble compounds, namely, sterols, zeaxanthins, tocopherols, tocochromanols, and carotenoids, which were stated as antioxidants in several diseases involved with the oxidative stress [11, 12]. Alkaloids, namely, berberine, roemerine, amaranthine, thebaine, morphine, and noscapine, of *Papaver* species attracted scientists for further exploration due to their significant antitumor action and antioxidant activity [12–16].

The chemicals of *Papaver* species and their enriched alkaloid contents were always the central attention of plant breeders and investigation on different *Papaver* species and *Papaver* organs, and enlighten the plant breeders to grow the desired poppy genotypes with the most active functional compounds for the food and pharmaceutical industry and with less side effect for the sake of human health. Enlightened by that the present research explores the phytochemistry and bioactivity of MeOH extracts of roots, leaves, and flowers of *P. decaisnei* for the first time.

### 2. Materials and Methods

#### 2.1. Plant Collection.

The flowers, roots, and leaves of *P. decaisnei* were collected from Iraqi Kurdistan, Safeen Mountain (Altitude: 36.609153, Latitude: 44.526220). The identification of the plant was done by botanist Dr. Abdullah Sh. Sarder, and the voucher number (6548) was deposited from the Herbarium of the Salahaddin University Education College (HSUEC) as shown in Figure 1.

#### 2.2. Plant Extract Preparation.

The plant organs (roots, flowers, and leaves) were dried and an amount of 25 g each separately of *P. decaisnei* were taken for the extraction process by using 0.5 L of methanol (99.9%) and microwave (Samsung microwave 20 A3010, 10 power levels, frequency 50 MHz, Australia). The separation of solvents by rotary evaporator was performed in a water bath at 40°C for the crude preparation, further drying of the crude to exclude the solvent completely. The final crude extract for flowers, leaves, and roots was 9.72, 12.4, and 12.92% (w/w), respectively. The plant extracts were kept at +4°C for later analysis [17].

#### 2.3. Phytochemical Profiling.

The *Papaver* crude extracts were qualitatively investigated by using the GC/GC-MS technique to determine their phytochemical and alkaloid constituents. The methanol extract examined by Shimadzu Model QP-2010 GC coupled with MS. GC equipped with a capillary column (30 m × 0.25 mm i.d., film thickness 0.25 μm) and HP-5 MS (5% phenylmethyl siloxane) at a helium flow rate of 1.61 mL/minute with the temperature 60°C (2') to 250°C for 10 minutes at a rate of 20°C/min. The ion source was maintained at 250°C and 70 eV electron energy. The methanol was added to the extracts before injecting 1 μl into the column. The exact name and molecular weight of unknown compounds were found by comparing their mass spectrum with the reference spectrum available in the Wiley GC/MS Library, Mass Finder Library, and Adams Library [16–19].

#### 2.4. Antioxidant Activity.

The antioxidant activity of *Papaver* organs was measured based on two different methods: firstly, by using free radical scavenging activity in 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assays, and secondly, by measuring reducing power activity in Cupric reducing antioxidant capacity (CUPRAC) and ferric reducing antioxidant power (FRAP) assays. The antiradical action was expressed as a microgram of Trolox equivalents (TE) per millilitre as explained previously [20].

#### 2.5. Anticancer Activity.

The extracts of *Papaver* organs (flowers, leaves, and roots) were examined for anticancer efficacy based on their minimal inhibitory concentration (IC50) to reduce the growth of MCF-7 (human breast adenocarcinoma), HeLa (human cervical cancer), and Caco-2 (human colorectal adenocarcinoma) cell lines by the MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyltetrazolium bromide) assay [21–25]. The live-cell count was done at 580 nm by using an ELISA plate reader as an equal number to the intensity of light absorbance as described previously [21–25].

#### 2.6. Statistical Analysis.

Statistical analysis of multivariate GC-MS experimental analysis by GC Shimadzu software was applied. The IC50 numbers were found as drug concentrations causing a 50% decrease in the viability or slowing the bioactivity. The IC50 numbers were calculated by a logistic curve of the four-parametric form (Sigma Plot 11.0) [26, 27]. The biological activity data were calculated by Student’s t-test (α = 0.05) and one-way analysis (ANOVA) from the SPSS v. 14.0 program version 24.0 for Windows. The values considered significant if p < 0.05 [28].
3. Results and Discussion

3.1. GC-MS Profile. The phytochemical qualitative study of extracts of *Papaver* organs (flowers, leaves, and roots) resulted in finding various alkaloids and chemicals as shown in Table 1, belonging to different organic classes as shown in Table 2. The chemical profiling of *P. decaisnei* plant organs, namely, roots, leaves, and flowers, showed 22, 19, and 17 chemicals, respectively, constituting 100% of their volatile contents as shown in Figures 2–4.

The chemical profiling of MeOH root extracts found roemerine (70.44%) as the main compound in this organ, while some compounds were detected in a minor amount, including 3′-methyl-1′-phenylspiro (indoline-2,4′-2) pyrazoline)-5′-one (5.16%), and hexadecanoic acid (2.66%) as shown in Table 1 and Figure 2. The biological and medicinal efficiency (alleviation symptoms of neurodegenerative diseases) of roemerine as a natural alkaloid has been reported by previous research studies [29]. A previous study by Hijazi et al. (2017) had reported roemerine as the main component of *P. libanoticum* with significant anticancer activity of its extract and alkaloid contents against human breast cancer and human colon cancer cells [30].

Similar to our high amount detection of roemerine in *P. decaisnei*, the previous study has reported an increased amount of alkaloid roemerine in *P. lacerum*, *P. syriacum*, *P. glaucum*, and *P. rhoeas* and considered it as a potential antidepressant drug [31]. The current phytochemical analysis of *P. decaisnei* also unrevealed alkaloids and chemicals in their organ extract as shown in Table 1 that were not discussed in the current article.

The prevalent chemical compounds of MeOH leave extracts were 9,12,15-octadecatrien-1-ol (25.45%), hexadecanoic acid (14.66%), 8, β,13 : 8, α,14(8.81%), γ-sitosterol (5.31%), neophytadiene (4.79), 2-methoxy-4-vinylphenol (4.14%), phytol (3.10%), and 6,8-dioxa-3-thiabicyclo (3,2,1) octane (3,3-dioxide (8.07%) as shown in Table 1 and Figure 3. Most of these chemicals have been linked with antioxidant and anticancer activity; for example, 9,12,15-octadecatrien-1-ol and hexadecanoic acids were previously shown as great antiradical and antitumor agents [32]. The same biological activity for γ-sitosterol has been shown by a recent study [33]. The chemical profiling of MeOH leave extracts of *P. decaisnei* also revealed some phytochemicals in minor amounts including octadecanoic acid (2.98%), 2,3-dihydrobenzofuran (2.68%), gibberellin a3 (2.55%), 2,4-di-tert-butylphenol (2.80%), and a few others, which were not explained in this report.

The GC-MS investigation of flower extracts showed 17 compounds (shown in Table 1 and Figure 4), which mainly includes decarbomethoxytabersonine (24.49%), hexadecanoic acid (16.40%), 9,12,15-octadecatrien-1-ol, (Z,Z,Z) (12%), glycerin (6.41%), γ-sitosterol (4.31%), benzyl benzoate (3.60%), amitriptyline oxide (3.59%), 3,4-dihydro-6,7-dimethoxyisoquinoline 2-oxide (5.62%), and 2H-Pyran-2-one, tetrahydro-4-hydroxy-4-methyl- (4.85%). Most of which have been found to act as antioxidant and anticancer agents; for example, decarbomethoxytabersonine has stated as a strong alkaloids showing significant antitumor and antiradical activity [34].

The major organic chemicals detected in 3 *Papaver* organs were belonging 5 classes, including alkaloids, phenolics, esters, terpenoids, and fatty acids, while the minor organic chemicals of three plant parts were related to coumaranes, fatty alcohols, organosulfur, and phytosterols as shown in Table 2. The present report about the chemical profile of *P. decaisnei* is found to be similar to a more recent chemical analysis of *P. decaisnei* by thin-layer chromatography (TLC), which concluded alkaloids as the most abundant organic class in *P. decaisnei*, namely, proaporphine-type mecambrine (PD2) and aporphine-type roemerine [35]. Furthermore, phytochemical profiling of *P. glaucum* has reported similar alkaloid compounds, namely, roemerine, roemerine N-oxide, rhoeagenine, and dehydroemetine [35]. Similar alkaloid constituents were detected from chemical profiling of *P. bracteatum* [36], *P. rhoeas* [37], and *P. somniferum* [14]. The chemical structures of the major detected phytochemicals in *P. decaisnei* are presented in Figure 5.

The systematic Google search and SciFinder did not find any previous research on the GC-MS profile of *P. decaisnei*. Therefore, the present work considered the first article on the phytochemistry of *P. decaisnei* organs (flowers, leaves, and roots).
3.2. Antioxidant Activity. The investigation of antioxidant activity of *P. decaisnei* organs revealed the significant potentiality of this species as a strong antioxidant agent. This bioactivity of *P. decaisnei* could be linked with its phytochemicals, mainly alkaloid and polyphenolic compounds. The antioxidant activity was evaluated by two different methods, radical scavenging activity by DPPH and ABTS assays, and reducing power activity by FRAP and CUPRAC assays, as presented in Table 3. The antioxidant activity presented as IC50, represents the plant’s ability to 50% of free radicals in essay reagents. The lesser the IC50 number of a plant extract is the higher the antioxidant efficacy is. Antioxidant activity evaluation by DPPH and ABTS assays showed higher values (39.1 and 135.4 μg/mL Trolox) for flowers than that (81.35, 245.6 μg/mL trolox and 143.5, 276.4 μg/mL trolox) for leaves and roots, respectively. Antioxidant measurement by FRAP and CUPRAC assays revealed the highest values (12.4 and 42.6 μg/mL trolox) for leaves than that (18.3, 68.1 μg/mL trolox and 34.3, 75.8 μg/mL trolox) for roots and flowers, respectively.

The antiradical actions of different organs of *P. decaisnei* can be correlated with their different chemical constituents, namely, alkaloids, polyphenols, and phytosterols. The antioxidant activity of this compound has been also clarified by several research studies [33–37].

| NO. | RT | Components name | Similarity | PF | PL | Pr |
|-----|----|-----------------|------------|----|----|----|
| 1   | 7.55 | Glycerin | 9 | 6.41 | – | – |
| 2   | 8.666 | Uracil, 1-N-Methyl- | 59 | – | 1.76 | – |
| 3   | 8.686 | Thymine | 72 | – | – | 0.96 |
| 4   | 9.003 | Guaiacol | 94 | 1.85 | – | 0.99 |
| 5   | 10.259 | 4H-Pyrane-4-one, 2,3-dihydro-3,5-Dihydroxy-6-Methyl- | 72 | – | – | 1.19 |
| 6   | 10.58 | Silane, triethylmethoxy- | 72 | 1.99 | – | – |
| 7   | 11.021 | 2-Methyl[1,3,4]Oxadiazole | 59 | – | – | 0.72 |
| 8   | 11.659 | 1,2-Benzenediol | 81 | – | – | 0.54 |
| 9   | 12.038 | 2,3-Dihydro-Benzofuran | 90 | 2.68 | – | 0.77 |
| 10  | 13.029 | 2H-Pyrane-2-one, tetrahydro-4-hydroxy-4-methyl- | 91 | 4.85 | – | – |
| 11  | 13.642 | Trans-anethole | 98 | – | – | 2.55 |
| 12  | 14.269 | 2-Methoxy-4-vinylphenol | 96 | 2.18 | 4.14 | 1.63 |
| 13  | 15.079 | 2,6-Dimethoxyphenol | 95 | – | – | 0.61 |
| 14  | 15.592 | DL-Proline, 5-oxo-, methyl ester | 78 | 2.80 | – | 0.44 |
| 15  | 16.127 | Vanillin | 96 | – | – | 0.52 |
| 16  | 17.201 | 6,8-Tioca-3-thiabicyclo(3,2,1)octane, 3,3-dioxide | 47 | – | 8.07 | 2.49 |
| 17  | 17.958 | 1,6-Anhydro-beta-D-Glucopyranose (levoglucosan) | 47 | 2.67 | – | – |
| 18  | 18.457 | 2,4-Di-Tert-Butylphenol | 96 | – | 2.80 | – |
| 19  | 18.462 | Phenol, 2,4-bis(1,1-dimethylthyl)- | 96 | 0.60 | – | 0.84 |
| 20  | 20.376 | Alpha-cedrol | 99 | – | – | 1.40 |
| 21  | 21.907 | 3a-Hydroxy-1,2,3,3a,8,8a-Hexahydroxyprolo (2,3b)Indole | 90 | – | – | 0.45 |
| 22  | 22.763 | 4-Methoxy-6-methyl-2-Proplypyridine | 50 | – | – | 1.27 |
| 23  | 23.297 | Benzyl benzoate | 98 | 3.59 | – | 2.52 |
| 24  | 24.496 | Neophytiadiene | 96 | – | 4.79 | – |
| 25  | 25.944 | Hexadecanoic acid, methyl ester | 99 | – | 1.70 | – |
| 26  | 26.52 | Hexadecanoic acid | 99 | 16.40 | 14.66 | 2.66 |
| 27  | 28.725 | Methyl 9,12,15-octadecatrienoate | 99 | – | 2.19 | – |
| 28  | 28.901 | Phytol | 91 | – | 3.10 | – |
| 29  | 29.187 | 9,12-Octadecadienoic acid (Z,Z)- | 96 | 3.47 | – | 1.45 |
| 30  | 29.197 | Linoleic acid | 97 | – | 2.18 | – |
| 31  | 29.29 | 9,12,15-Octadecatrien-1-Ol, (Z,Z,Z)- | 94 | 12.00 | 25.45 | – |
| 32  | 29.607 | Octadecanoic acid | 98 | – | 2.98 | – |
| 33  | 35.32 | 8β,13:8α,diepoxy-14,15-bisnorlabdane | 86 | – | 8.81 | – |
| 34  | 35.325 | Decarbomethoxytabersonine | 56 | 24.49 | – | – |
| 35  | 35.382 | Roemerine | 58 | – | – | 70.44 |
| 36  | 36.145 | 3-(3Methoxyphenyl)Propenemitrite, 2-(3Methoxyphosphinyl)- | 95 | – | – | 1.23 |
| 37  | 36.98 | Butyrylamine | 72 | – | 2.25 | – |
| 38  | 36.98 | Amitriptyline | 59 | 3.60 | – | – |
| 39  | 39.279 | 4-Methoxybenzene, 1-(2-hydroxynaphthylmethyleneamino)- | 95 | – | 2.08 | – |
| 40  | 39.284 | 3′-methyl-1′-Phenylspiro[indoline-2,4′-(2′)Pyrazoline]-5′-one | 72 | 3.18 | – | – |
| 41  | 39.289 | 3′-methyl-1′-Phenylspiro[indoline-2,4′-(2′)Pyrazoline]-5′-one | 72 | – | – | 5.16 |
| 42  | 43.139 | 3,4-Dihydro-6,7-Dimethoxyisquinoline 2-oxide | 43 | 5.62 | – | – |
| 43  | 43.238 | Gibberellin A3 | 58 | – | 2.55 | – |
| 44  | 44.695 | γ-Sitosterol | 95 | 4.31 | 5.31 | 1.69 |

Retention time (RT [min]) on a Restek RTX-5 column. Peak area percentage calculated from the GC-FID chromatogram. PF: *Papaver* flower, PL: *Papaver* leaves, Pr: *Papaver* roots.
The present research found flower extracts as the highest bioactive part in the antioxidant tests by DPPH and ABTS assays, which may be due to its phytochemical constituents, mainly terpenoids, fatty acids, and ester, namely, hexadecanoic acid, decarbomethoxytabersonine, and anthocyanins. The given data results are following the previous findings regarding the antioxidant activity of the mentioned phytochemicals [34, 38–46].

The reducing power estimation by FRAP and CUPRAC assays revealed the part of leaves as the most active part in the antioxidant activity. This bioactivity of leaves can be linked with its high alkaloid, fatty acids, and polyphenolic contents, namely, 9,12,15-octadecatrien-1-ol (25.45%), 8-α,14-diepoxy-14,15-bisnorlabdane and hexadecanoic acid. A similar study showed significant antioxidant activity of Papaver rhoeas L. leaves extracts and linked this action with its increased phenolic contents [47, 48]. Furthermore, the another study by Trichopoulou et al. revealed significant antioxidant activity of Papaver leaves and linked this action with their efficient flavonoid contents, namely, quercetin, isorhamnetin, kaempferol, and myricetin [49].

The present investigation of P. decaisnei root extract revealed a significant amount of roemerine, a known aporphine alkaloid, which is regarded as an efficient antioxidant and anticancer agent [50]. Furthermore, the antioxidant and anticancer potentials of aporphine compounds like roemerine have also been confirmed by D. Muthna and his colleagues [51]. Similarly, the antioxidant and antitumor capacity of alkaloids from plant species were used for medicinal and pharmaceutical purposes [52–55].

The Papaver alkaloids, namely, narcotine, morphine, codeine, narceine, and thebaine, from P. somniferum, and P. libanoticum are considered nitrogenous waste-producing chemicals with several pharmaceutical and biological activities including antidepressant, analgesia, and anticancer activity [15, 30, 39]. The antitumor action of herbal alkaloids brings more hope to the scientists in handling severe diseases due to the lower side effects of natural-based cures than chemically synthetic therapy. Thus, in the past few years, scientists have raced against the time to find an alkaloid with the highest indole ring activity and hydrocarbon chains against different cancer cell lines, because those properties have significant roles in drug delivery process [54, 56–58]. Enlightened by that the current study explores the cytotoxicity of methanolic extracts of P. decaisnei organs (flowers, leaves, and roots) against the viability of HeLa, Caco-2, and MCF-7 cancer cells. The present data revealed significant anticancer activity of extracts of MeOH leaves (176.2, 268.2 μg/mL) against Caco-2 and MCF-7 cell lines, which were higher than that (194.7, 388.4 μg/mL and 223.4, 306.5 μg/mL) for roots and flower extracts, respectively. This increased anticancer action of leave extracts can be correlated with its higher alkaloids, fatty acids, and phytosterols contents, namely, 9,12,15-octadecatetraen-1-ol (25.45%), 8, β,13; 8, α,14(8.81%), and γ-sitosterol (5.31%), and hexadecanoic acid (14.66%). The anticancer activity of the mentioned chemical compounds has been confirmed by multiple research studies [37, 53–60].

The anticancer action of MeOH root extracts of P. decaisnei against HeLa cell lines was higher (125.3 μg/mL) than that (165.3 μg/mL and 228.4 μg/mL) for leaves and flowers, respectively. This anticancer superiority of root

### Table 2: Compound type of roots, leaves, and flowers of P. decaisnei.

| No. | Compound type (total number in 3 plant organs) | % and (number) in PF | % and (number) in PL | % and (number) in PR |
|-----|-----------------------------------------------|---------------------|---------------------|---------------------|
| 1   | Alkaloids (12)                                 | 15.78 (3)           | 23.52 (4)           | 22.72 (5)           |
| 2   | Phenolics (11)                                 | 10.52 (2)           | 17.64 (3)           | 27.27 (6)           |
| 3   | Fatty acids (8)                                | 15.78 (3)           | 17.64 (3)           | 9.09 (2)            |
| 4   | Esters (6)                                     | 15.78 (3)           | 11.76 (2)           | 4.54 (1)            |
| 5   | Terpenoids (5)                                 | 21.05 (4)           | 0 (0)               | 4.54 (1)            |
| 6   | Phytosterol (3)                                | 5.26 (1)            | 5.88 (1)            | 4.54 (1)            |
| 7   | Coumaranes (2)                                 | 5.26 (1)            | 0 (0)               | 4.54 (1)            |
| 8   | Organosulfur (2)                               | 5.26 (1)            | 0 (0)               | 4.54 (1)            |
| 9   | Alcohols (2)                                   | 5.26 (1)            | 5.88 (1)            | 0 (0)               |
| 10  | Oxapanes (1)                                   | 0 (0)               | 5.88 (1)            | 0 (0)               |
| 11  | Aromatics (1)                                  | 0 (0)               | 0 (0)               | 4.54 (1)            |
| 12  | Others (5)                                     | 0 (0)               | 11.76 (2)           | 13.63 (3)           |
| Total|                                            | 100%                | 100%                | 100%                |

In recent years, herbal medicine and plant-derived compounds become a strong alternative source of synthetic drugs for the treatment of several tumor diseases such as hepatocellular carcinoma, human colorectal adenocarcinoma, and breast cancer. The main reason is because of fewer side effects of these natural compounds than chemical drugs. For that, multiple flowering herbs including Papaver species were used for medicinal and pharmaceutical purposes due to its increased alkaloids and aromatic hydrocarbon contents [52–55].
extract against HeLa cell lines can be linked with its higher alkaloid and phenolic constituents, namely, roemerine (70.44%) and 3′-methyl-1′-phenylspiro(indoline-2,4′-(2) pyrazoline)-5′-one (5.16%).

Our data regarding highlighting the two mentioned compounds as anticancer agents are following the previous herbal bioactive studies [30, 61–63]. Furthermore, the cytotoxic mechanism of roemerine as the main alkaloid component of *P. libanoticum* and *Nelumbo nucifera* against several cancer cells has been linked to its ability to stimulate apoptosis, increase membrane permeability, and facilitate in cleavage of caspase-3, caspase-7, and caspase-9 in human cancer cells as clarified previously [30, 50, 64]. Similarly, to our results, researchers have also shown the superiority of MeOH root extracts of *P. somniferum* in reducing the growth of HeLa cell lines [15, 58, 65]. Moreover, based on several previous studies, the Papaveraceae members can be emphasized as a strong candidate for anticancer pharmaceutical production because of their high alkaloid contents [3, 9, 16, 40, 44, 50, 52]. The systematic Google search and
Figure 3: Chromatogram of MeOH leave extracts of *P. decaisnei*.
Figure 4: Chromatogram of MeOH flower extracts of *P. decaisnei*. 

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SciFinder did not find any previous anticancer record for *P. decaisnei*; therefore, the present work is considered as the first project studying the anticancer of *P. decaisnei*.

### 4. Conclusion

The present article showed GC-MS analysis, antiradical, and antitumor of roots, flowers, and leaves of *P. decaisnei* as the first report. The prevalent detected alkaloids of flowers were decarbomethoxytabersonine, hexadecanoic acid, and anthocyanin. Moreover, the analysis of MeOH leaves extract showed 9,12,15-octadecadien-1-ol, hexadecanoic acid, and γ-sitostanol as their prevalent alkaloids. The prevalent alkaloid content of methanolic root extract was roemerine (70.44%), an alkaloid commonly used due to its antidepressant and antianxiety action. The antioxidant assays revealed the *Papaver* flower as the most active organ in DPPH and ABTS assays, while root extracts had the highest activity in reducing power activity by FRAP and CUPRAC assays. The antiproliferative analysis of roots, flowers, and leaves of *P. decaisnei* revealed significant potentials of *Papaver* organs against the proliferation of HeLa, Caco-2, and MCF-7 cell lines. The current research presents a ground knowledge on the phytochemical profile and bioactivity of *P. decaisnei* that could be used for future biomedical analysis and cancer study programs; however, a more detailed study

### Table 3: Antioxidant activity of MeOH extracts of roots, leaves, and flowers of *P. decaisnei*.

| Plant extracts | DPPH scavenging | ABTS scavenging | FRAP reducing | CUPRAC reducing |
|---------------|-----------------|-----------------|---------------|-----------------|
| Flowers       | 39.1 ± 0.53b    | 135.4 ± 0.78b   | 34.3 ± 0.05b   | 75.8 ± 0.9b     |
| Leaves        | 81.35 ± 0.111a  | 245.61 ± 0.23a  | 12.4 ± 0.08d   | 42.6 ± 0.3a     |
| Roots         | 143.5 ± 3.06a   | 276.4 ± 0.045e  | 18.3 ± 1.023c  | 68.1 ± 0.9c     |
| Trolox        | 1.4 ± 0.02c     | 2.29 ± 0.02c    | 2435.1 ± 0.01d | 2255.2 ± 0.02d  |
| EDTA          | ND              | ND              | ND             | ND              |

1The values indicated by different superscripts within the same column are different according to Tukey’s honestly significant difference test at 5% significance level (value as mean ± standard deviation). IC50 (μg/mL), inhibition concentration at which 50% of the DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS (2,2′-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) radicals were scavenged and the ferrous ion-ferrozine complex was inhibited. EC50 (μg/mL) is effective concentration at which the absorbance was 0.5 for CUPRAC (cupric ion reducing antioxidant capacity) and FRAP (ferric reducing antioxidant power) assays. EDTA: ethylenediaminetetraacetic acid (disodium salt). ND: not detected.

### Table 4: The anti-proliferative activity IC50 (μg/mL) of extract on human cell lines after 24 hr of treatment.

| Cell line | Flowers MeOH extract | Leaves MeOH extract | Roots MeOH extract | DOX |
|-----------|----------------------|---------------------|-------------------|------|
| Caco-2    | 223.4 ± 2.1c         | 176.2 ± 3.8b        | 194.7 ± 6.5d      | 6.7 ± 0.4a |
| MCF-7     | 306.5 ± 9.8b         | 268.2 ± 12.3b       | 388.4 ± 11.2c     | 18.8 ± 0.3a |
| HeLa      | 228.4 ± 3.1c         | 165.3 ± 2.3b        | 125.3 ± 4.2b      | 14.0 ± 0.1a |

1Mean value ± standard deviation (n = 3) of IC50 (μg/mL), inhibition concentration at which 50% of the DPPH (2,2-diphenyl-1-picrylhydrazyl) radicals were scavenged and the ferrous ion-ferrozine complex was inhibited. EC50 (μg/mL) is effective concentration at which the absorbance was 0.5 for CUPRAC (cupric ion reducing antioxidant capacity) and FRAP (ferric reducing antioxidant power) assays. EDTA: ethylenediaminetetraacetic acid (disodium salt). ND: not detected.

The present article showed GC-MS analysis, antiradical, and antitumor of roots, flowers, and leaves of *P. decaisnei* as the first report. The prevalent detected alkaloids of flowers were decarbomethoxytabersonine, hexadecanoic acid, and anthocyanin. Moreover, the analysis of MeOH leaves extract showed 9,12,15-octadecadien-1-ol, hexadecanoic acid, and γ-sitostanol as their prevalent alkaloids. The prevalent...
is required to investigate the toxicity and drawbacks of *P. decaisnei* as a potential remedy for different human diseases.

**Data Availability**

The data used to support the findings of this study are included within the article.

**Conflicts of Interest**

The authors declare that they have no conflicts of interest.

**Authors’ Contributions**

Ahmed Aj. Jabbar and Fuad O. Abdullah have structured, designed, and done the methodology. Kamaran K. Abdulrahman analyzed the results, and A. A Jabbar wrote the article with the guidance of all authors. All authors participated equally in reviewing and the finalizing manuscript.

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