The differences between *Froriepia subpinnata* (Ledeb.) Baill. and *Pimpinella anisum* L. commonly named as anarijeh based on major components of the essential oil; a marker for resolve ambiguities

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**ABSTRACT**

**Background:** *Froriepia subpinnata* (Ledeb.) Baill. and *Pimpinella anisum* L. are two important medicinal plants belong to the Apiaceae family. Due to the similar Persian name in ethnobotanical studies, namely “anarijeh”, these two medicinal plants are mistakenly used instead of each other in the Iranian medicinal plants market and even in scientific reports. **Objective:** In this study, the correct morphological description of studied species were introduced and the chemical composition of their essential oils and their antioxidant activities were determined. **Methods:** The aerial parts of *F. subpinnata* and the seeds of *P. anisum* were crushed separately followed by hydro-distillation method for 3 h using a Clevenger apparatus to obtain essential oils (EOs) and their constituents were analyzed by GC/MS. Also, the potential of antioxidant inhibitory of essential oils were determined using DPPH and FRAP methods. **Results:** p-Cymen-8-ol (51.13 %), α-terpinolene (7.69 %) and limonene (6.83 %) were the major components of *F. subpinnata* EO while trans-anethole (85.65 %) and carvone (5.31 %) were the major components in *P. anisum* EO. The results of antioxidant activities in DPPH and FRAP assays at the concentration of 250 μg/ml were 53.03 and 62.72 % for *F. subpinnata* and 50.27 and 59.91 % for *P. anisum*, respectively. The results of antioxidant activity by DPPH and FRAP methods indicated both essential oils had almost similar potential. **Conclusion:** Type and the amounts of the major components of the essential oils of *F. subpinnata* and *P. anisum* can be regarded as an accurate basis for differential diagnosing the plants. These differences can be used as a good phytochemical marker in correct identification and prevention of mistakes and deceptions in herbal products.

**Abbreviations:** GC/MS, Gas Chromatography/Mass Spectroscopy; EOs, Essential Oils

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1. Introduction

Nowadays, medicinal plants have a vital role in health and economy. Millions of people around the world are working on different aspects of medicinal plants such as planting, harvesting and processing [1]. Many problems due to misuse of medicinal plants like lacking of proper evaluation and monitoring system for activists in this field have been generated, as a result, we see many mistakes or deceptions in preparation of medicinal plants for public use [2]. Use of unknown or doubtfull plant species in the market of dried herbs and production of herbal drugs is the most important challenges in this issue. Hence, shortage of essential knowledge has caused many mistakes and deceptions in pharmaceutical research and their products [3, 4].

Exact identification of plants begins with direct observation of the morphological characteristics of plants body or with microscopic descriptions of powder of plant tissues and organs. After taxonomic verification, the type and content of specific phytochemical compounds of the plant are evaluated and approved with comparison by the plant’s literature review. Essential oil compositions and antioxidant properties of the plant as a suitable marker can be used for phytochemical verification of plants [5-7].

The widespread presence of plants in different societies has led to the formation of different local names for plants. This significantly leads to similarities and differences in the naming of plants. So that there may be different names for one species in different cultures and languages, or the same names may be used for different plant species in different languages [8, 9]. For this reason, the scientific explanation of medicinal plants samples has a very crucial and fundamental role and also it is considered as the first step for use of traditional medicinal plants [2].

One of the mistakes in naming plants, which is unfortunately common in Iran herbal stors and scientific societies, is related to Froriepia subpinnata (Ledeb.) Baill. and Pimpinella anisum L. plant species which have been introduced in various sources with the same local name of anarijeh. While this common persian name is used for both plants that different parts of them are used in medicinal plants market. The aerial part of F. subpinnata has been used as a carminative, appetizer, antispasmodic, diuretic antiseptic and sedative. This species contains antioxidant and antibacterial properties [10]. P. anisum seeds are the used part of plant which heals, stimulates and improves the function of the digestive system and is also beneficial for liver and circulatory system. Essential oil of P. anisum seeds has antimicrobial, antifungal, antiviral, antioxidant, analgesic and antispasmodic, anti-epileptic effects and is effective in healing stomach ulcers. Also, in traditional medicine has been used to treat some diseases such as epilepsy [11, 12].

Based on our field and herbarium observations and reports of other researchers, it certainly seems that the vernacular name of anarijeh is related to F. subpinnata [9, 10, 13-16], However, there are several researches in the scientific sources that shows the name of anarijeh has been used for the Pimpinella genus [17-23].

Due to the mistakes in identification and thus the use of Froriepia subpinnata and Pimpinella anisum and also the lack of accurate illustrative studies, the present research specificly aimed to correct introduction and identification of these plants and also provide their essential oil composition and antioxidant capacity.
2. Materials and Methods

2.1. Plant material, extraction of essential oils and analysis by GC/MS

The samples of *F. subpinnata* and *P. anisum* were collected in 2018 from Behshahr and Isfahan cities (Mazandaran and Isfahan provinces respectively) in Iran. Voucher specimens (No. 580-SANRU for *F. subpinnata* and No. 601-SANRU for *P. anisum*) were determined by expert authors and deposited in herbarium of the Sari Agricultural Sciences and Natural Resources University, Sari, Iran.

The aerial parts of *F. subpinnata* and seeds of *P. anisum* were air-dried at ambient temperature (25 °C) during a week and then they were powdered separately and essential oils were isolated using Hydrodistillation method for 3 h [24]. 300 g of powdered samples were heated with one liter of distilled water in Clevenger apparatus and finally the obtained essential oils were collected. After dehumidification with anhydrous sodium, the essential oils were stored in glass containers at 4 °C in the refrigerator and away from light.

The essential oils were analysed by gas chromatography/mass spectroscopy. 1 μl of the oil sample was injected into the GC/MS apparatus. The essential oils were also analyzed by an Agilent 6890 apparatus on capillary column. Mass spectrometry (Agilent 5973N, USA) equipped with a BPX5 fused silica column of (30 m × 0.25 mm i.d. × 0.25 μm film thickness) were done in electronic impact mode (70 eV), split injection ratio (1: 35), Carrier gas helium with 0.5 ml/min flu rate and mass range of 40 to 500 amu. The temperature program of the column was adjusted as follows: The initial temperature of the oven was 50 °C for 5 min, the temperature gradient of 3 °C per min and rises to 240 °C and then at a speed of 15 °C per min, the temperature rises to 300 °C for 3 min. Stopping at this temperature and response time was 75 min. Compounds were identified by comparing retention time (RT) with those reported in the literature and their mass spectrum with Wiley library [25, 26].

2.2. Antioxidant capacity of essential oils

Two common methods of DPPH and FRAP were used to measure the antioxidant activity of essential oils of *F. subpinnata* and *P. anisum* plants at the concentration of 250 μg/mL. In the DPPH method, the potential of the essential oils for free radical scavenging activities were evaluated based on percentage inhibition of 2,2-diphenyl-1-picrylhydrazyl (DPPH) activity as calculated using previously introduced methods [27, 28]. Then it was expressed as a percentage of inhibition of DPPH which was calculated according to the following Equation:

\[
\text{Percent (\%)} \text{ inhibition of DPPH} = \left( \frac{A_0 - A_1}{A_0} \right) \times 100
\]

The A₀ was the absorbance value of the blank sample or control reaction and A₁ was the absorbance value of the test sample. All measurements were performed in triplicates. vitamin C and E were separately used as control due to their potential for inhibition of free radicals effect.

In the second method, the ferric reducing antioxidant power (FRAP) of the essential oil from the samples of *F. subpinnata* and *P. anisum* were assayed according to described assay [29]. The percent of free radical inhibition in FRAP assay of the samples was calculated according to the below formula:

\[
\text{Antioxidant Activity (\%)} = \frac{A_1}{A_0} \times 100
\]

A₀ is the absorbance of the control (potassium phosphate buffer + FRAP reagent), A₁ is the Absorbance of sample. The vitamin C and E were separately used as the reference antioxidants.
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2.3. Botanical illustrations

For full confidence of correct identification of plant species, they were studied and compared with related references in aspects of taxonomy, morphological description and geographical distribution [9, 30-32].

2.4. Statistical analysis

Statistical analysis of antioxidant activities of essential oils were conducted using SAS version 9.1. All assays were performed in at least three replications. Differences between means were distinguished using F-test and the confidence limits was based on 95% (P < 0.05).

3. Results

3.1. Taxonomy, Geographical distribution and morphological description of plants samples

Distribution of *F. subpinnata*: Froriepia is a fragrant plant belongs to the Apiaceae family, native to the Caucasus region which has only one species (*F. subpinnata*) in Iran and has been reported from the provinces of Gilan, Mazandaran and Golestan. The species grows on the roadsides and mountainous areas. This plant is known as anarish or in the northern regions of the country and its fresh and dried leaves are commonly used in local foods.

Morphological description of *F. subpinnata*: Slender glabrous biennial. Stems up to 10 cm, divaricately branched, purple-striped below, glaucous-green above. Basal leaves unknown. Cauline leaves with a white, membranous, petiolar subauriculate sheath; median leaves with few, filiform, mucronulate segments up to 5 mm long; upper leaves reduced to one segment. Umbels 2-4-rayed, up to 1.5 cm long. Bracts absent. Bracteoles 1-3, narrowly lanceolate, longer than pedicels, with a white margin and long awn, somewhat rigid. Central umbellule subsessile. Central fruit 2-2.5 mm long, outer fruits 1.5-2 mm long, often with rudimentary mericarps. Mericarps subterete, primary ridges 5-6, secondary ridges 4-5. Dorsal vittae 4-5, commissural vittae 2, all small (Fig. 1).

Distribution of *P. anisum*: The genus *Pimpinella* L. from the Apiaceae family have about 21 species of annual or perennial species in Iran. They are generally fragrant plants in Europe, Turkey, Iran, Caucasus, Armenia, Central Asia, Syria and Egypt. *P. anisum* with common name of Anise or Roman anise and only its seeds have medicinal use. This species is widely cultivated in different parts of the Iran and has been reported from the Azerbaijan, Isfahan and Tehran provinces and probably does not originate from Iran while *P. affinis* Ledeb. is widespread species in Iran and therefore it is mostly used in traditional medicine. Due to similarities between two species of *P. anisum* and *P. affinis* in seed shape, odor and medicinal properties they were used instead of each other in Iran.

Morphological description of *P. anisum*: Strongly aromatic branched annual with puberulent or pubescent stems up to 70 cm. Basal leaves simple, 2-5 cm, petiolate, reniform or ovate, dentate; lower cauline leaves pinnate with ovate or obovate dentate segments; upper cauline leaves 2-3-pinnate, lobes linear-lanceolate, petioles sheathing. Umbels 7-15-rayed; bracts absent or 1; bracteoles absent to few, very narrow. Flowers white, c. 10 per umbellule. Fruit 3-5 mm long, ovoid, shortly adpressed-hairy; stylopodium conical (Fig. 2).
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Fig. 1. Used part (vegetative organs = above) and generative organs (inflorescent = below) of *Froeipia subpinnata*

Fig. 2. Used part of used part (Seeds = left) and generative organs (inflorescent = right) of *Pimpinella anisum*

3.2. Composition and antioxidant properties of essential oils

Based on the results of GC/MS analysis, 36 bioactive compounds were identified in the essential oil of *F. subpinnata* constituting 93.21% of the total oil. The most important of these compounds were *p*-cymen-8-ol, *α*-terpinolene and limonene by about 51.13, 7.96 and 6.83%, respectively (Table 1, Fig. 3).
Table 1. Essential oil compounds in *F. subpinnata*

<table>
<thead>
<tr>
<th>No.</th>
<th>Compounds</th>
<th>RT</th>
<th>KI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hexanal</td>
<td>6.16</td>
<td>809</td>
<td>0.11</td>
</tr>
<tr>
<td>2</td>
<td>Heptanal</td>
<td>10.47</td>
<td>911</td>
<td>0.79</td>
</tr>
<tr>
<td>3</td>
<td>α-Pinene</td>
<td>11.73</td>
<td>936</td>
<td>0.72</td>
</tr>
<tr>
<td>4</td>
<td>Sabinenes</td>
<td>13.81</td>
<td>977</td>
<td>1.99</td>
</tr>
<tr>
<td>5</td>
<td>β-Pinene</td>
<td>14.08</td>
<td>983</td>
<td>0.92</td>
</tr>
<tr>
<td>6</td>
<td>β-Myrcene</td>
<td>14.65</td>
<td>994</td>
<td>0.75</td>
</tr>
<tr>
<td>7</td>
<td>2-Pentylfuran</td>
<td>14.78</td>
<td>997</td>
<td>0.24</td>
</tr>
<tr>
<td>8</td>
<td><em>trans</em>-2-(1-Pentenyl) furan</td>
<td>15.28</td>
<td>1006</td>
<td>0.15</td>
</tr>
<tr>
<td>9</td>
<td>α-Phellandrene</td>
<td>15.61</td>
<td>1013</td>
<td>1.14</td>
</tr>
<tr>
<td>10</td>
<td>α-Terpine</td>
<td>16.15</td>
<td>1023</td>
<td>0.13</td>
</tr>
<tr>
<td>11</td>
<td>α-Cymene</td>
<td>16.66</td>
<td>1033</td>
<td>0.36</td>
</tr>
<tr>
<td>12</td>
<td>Limonene</td>
<td>16.81</td>
<td>1036</td>
<td>6.83</td>
</tr>
<tr>
<td>13</td>
<td>β-Ocimene</td>
<td>17.68</td>
<td>1052</td>
<td>0.27</td>
</tr>
<tr>
<td>14</td>
<td>γ-Terpine</td>
<td>18.35</td>
<td>1065</td>
<td>1.27</td>
</tr>
<tr>
<td>15</td>
<td>α-Terpinolene</td>
<td>19.74</td>
<td>1091</td>
<td>7.69</td>
</tr>
<tr>
<td>16</td>
<td><em>m</em>-Cymen-8-ol</td>
<td>22.18</td>
<td>1140</td>
<td>51.13</td>
</tr>
<tr>
<td>17</td>
<td>Anisole</td>
<td>23.79</td>
<td>1172</td>
<td>1.08</td>
</tr>
<tr>
<td>18</td>
<td>4-Pyridinol</td>
<td>23.96</td>
<td>1176</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Total Identified 93.21

Fig. 3. Chromatogram obtained from GC/MS analysis of *F. subpinnata* essential oil
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The amount of hydrogenated monoterpenes by about 22.07 %, oxygenated monoterpenes by about 58.26 %, hydrogenated sesquiterpene with 4.21 %, hydrogenated diterpenes with 1.3 % and other compounds with 7.25 % of total compounds of essential oil were reported.

Assay of antioxidant activity of F. subpinnata essential oil in the range of 250 μg/ml showed that the percentage of antioxidant inhibitors for F. subpinnata essential oil by DPPH and FRAP methods were about 53.03 and 62.72 %, respectively. Despite, along with rising in essential oil concentration, inhibitory activity was also increased but could not compete with the antioxidant power of vitamins C and E (Table 3).

The most important of these compounds were trans-anethole (85.65 %), carvone (31.5 %) and Limonene (3.25 %) respectively (Table 2, Fig. 4). The content of hydrogenated monoterpenes about 3.35 %, oxygenated monoterpenes about 93.15 %, hydrogenated sesquiterpene 2.69 and oxygenated sesquiterpene 0.12 % of total compounds of essential oil were reported.

Assay of antioxidant activity of P. anisum essential oil in the range of 250 μg/ml showed that the percentage of antioxidant inhibitors for P. anisum essential oil by DPPH and FRAP methods were about 50.27 % and 59.91 %, respectively. Despite, along with rising the essential oil concentration, inhibitory activity was also increased but could not compete with the antioxidant power of vitamins C and E (Table 3).

The results of P. anisum essential oil analysis by GC/MS showed 13 biologically active compounds that constituting 99.3 % of the total oil.

<table>
<thead>
<tr>
<th>No.</th>
<th>Compounds</th>
<th>RT</th>
<th>KI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>α-Phellandrene</td>
<td>15.61</td>
<td>1013</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>Limonene</td>
<td>16.81</td>
<td>1036</td>
<td>3.25</td>
</tr>
<tr>
<td>3</td>
<td>Estragole</td>
<td>25.74</td>
<td>1212</td>
<td>1.38</td>
</tr>
<tr>
<td>4</td>
<td>trans-Dihydro carvone</td>
<td>26.07</td>
<td>1219</td>
<td>0.66</td>
</tr>
<tr>
<td>5</td>
<td>Carvone</td>
<td>28.03</td>
<td>1261</td>
<td>5.31</td>
</tr>
<tr>
<td>6</td>
<td>Anethole</td>
<td>28.39</td>
<td>1268</td>
<td>0.15</td>
</tr>
<tr>
<td>7</td>
<td>trans-Anethole</td>
<td>30.09</td>
<td>1304</td>
<td>85.65</td>
</tr>
<tr>
<td></td>
<td>Total Identified</td>
<td></td>
<td></td>
<td>99.30</td>
</tr>
</tbody>
</table>

Table 3. Evaluation of antioxidant activity in essential oil in F. subpinnata and P. anisum by DPPH and FRAP methods. Vitamins C and E were considered as positive controls.

<table>
<thead>
<tr>
<th>Plant essential oil or Positive control (Concentration)</th>
<th>Inhibition (%)</th>
<th>Inhibition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DPPH method</td>
<td>FRAP method</td>
</tr>
<tr>
<td>F. subpinnata (250 μg/ml)</td>
<td>53.03 ± 0.24(^b)</td>
<td>62.72 ± 0.37(^b)</td>
</tr>
<tr>
<td>P. anisum (250 μg/ml)</td>
<td>50.27 ± 2.15(^b)</td>
<td>59.91 ± 1.52(^c)</td>
</tr>
<tr>
<td>Vitamins C (8 μg/ml)</td>
<td>91.37 ± 3.68(^a)</td>
<td>94.37 ± 1.78(^a)</td>
</tr>
<tr>
<td>Vitamins E (5 μg/ml)</td>
<td>95.58 ± 2.63(^a)</td>
<td>96.23 ± 1.89(^a)</td>
</tr>
</tbody>
</table>

Values are mean ± SD from three replicates (n = 3) at the 0.05 probability levels. \(^{a,b,c}\) Superscript lowercase letters are for significance values.
4. Discussion

It has been observed that two plant species of *F. subpinnata* and *P. anisum* are known as anarijeh in medicinal plants stores and also in some scientific reports of Iran.

Our results indicated 36 bioactive compounds in essential oil in the aerial part of *F. subpinnata* showed that (Table 1, Fig. 3) constituted 93.21% of total oil. Contradictory scientific reports can be found regarding the composition of the essential oil of this plant [32, 33, 34]. The compounds of essential oils *F. subpinnata* reported by [33] are in consistent with the results of the present study and therefore it seems that the plant species has been correctly identified and evaluated. In the another study, 36 compounds were identified from the essential oil extracted from flower of *F. subpinnata* and the major compounds were include *p*-cymen-8-ol (34.7 %), Terpinolene (12.5 %) and Limonene (10.5 %). Due to the similarity of these results with the present study, it confirms the plant correctly introduced [34].

Also in another research study, totally 10 compounds were reported 10 compounds in essential oil of *F. subpinnata*. While the most important compounds were $\beta$-phellandrene (50.3 %) and Sabinene (25.7 %) [35]. However, the data from GC/MS analysis of this present study showed the compounds that have the highest amount in essential oil were including *p*-cymen-8-ol, $\alpha$-Terpinolene and Limonene by about 51.13 %, 7.96 % and 6.83 %, respectively. It is clearly shown that the type of essential oil compounds in this study [35] are very different from our results and therefore may have been mistaken in the exact identification of the plant species in Rustaiyan et al. report.

In another research two scientific name of *F. subpinnata* and *Eryngium bungeii* has been used for anarijeh. Application of two simultaneous scientific names for one plant is
basically incorrect. Also, the compounds reported in this report do not match the compounds reported in the present study probably due to wrong plant identification [19].

In two other reports [35, 36], the plant species of *F. subpinnata* was called as Zolang in Persian, which is according to the Mozaffarian [32]. However, based on previous studies this naming does not agree to the common naming of this plants in the north of Iran and therefore did not approve [9, 15, 16].

Predominant phenolic compounds and their antioxidant effects of *F. subpinnata* were reported previously [38]. Due to similarity of antioxidant activities of this report with present study, it seems that the plant species is probably correctly used.

Also, some controversial reports had found on *P. anisum*. Our results indicated that 13 bioactive compounds identified in essential oil of the essence *P. anisum* (Table 2, Fig. 4) that showed 99.3 % of total oil.

Some studies were reported results of analysis of seeds essential oil of *P. anisum* from different regions of Turkey. The most common identified compounds were trans-Anethole, methyl chavicol and Alpha-terpineol. In the present study, more than 85% of essential oil was trans-Anethole. Also, it has also been reported that the antioxidant activity of essential oil of *P. anisum* extracted from their seeds was higher than alpha-Tocopherol. Therefore, the results of this study are consistent with all the studies mentioned [11, 39].

One report was found antifungal activity of *P. anisum* essential oil on *Fusarium solani* that were introduced by persian name of anarijeh [17]. Also, another report of improper use of local name of anarijeh were observed on the application of essential oil of *P. affinis* [13]. In both of these studies, the exact identification of plant species was not mentioned and the type of compounds was not introduced. Therefore, the results can not be judged scientifically and it is better to evaluate the plant samples due to their incorrect naming.

Some doubtful researches were carried out on *P. affinis* which introduced by the local name of anarijeh. In these reported studies, mentioned that the plant was collected from the north of Iran and also the extraction was done from the aerial part of the plant [20-22]. The used parts of plants are noticable here. only seeds in *P. affinis* have medicinal uses and the aerial part of the plant is not used while the aerial parts of *F. subpinnata* is known due to its therapeutic properties [15, 16]. So it is concluded that the used plants in this studied were *F. subpinnata* and authors have made a great mistake in introducing the plant.

In another research, the antioxidant effects and phenolic and flavonoid content of extracts and essential oils in *P. affinis* which mistakenly introduced as anarijeh were studied [18]. Due to the lack of exact herbarium specimens and mistakes that occurred in the naming of the plant, the results of this study is questionable and need to be examined more carefully.

The studied medicinal plants have different phytochemical compounds with antioxidant properties. The presence of these compounds has been regarded as biologically effective factors. As a result, the antioxidant power of plant essential oils is considered to be directly related to the presence of biological compounds in the essential oils [28].

Antioxidant properties of studied species in both methods were investigated and shown that the essential oil of the aerial part of *F. subpinnata* and seeds of *P. anisum* were not very different
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from each other. Both plants have less antioxidant power than vitamin C and E and therefore, they can be used as a moderately effective agent in the food and pharmaceutical industries.

5. Conclusion

There is a common mistake in Iran in identifying the medicinal plants *F. subpinnata* and *P. anisum*, which they call by the same name of anarijeh. On the other hand in many scientific reports, the plant materials are not correctly identified by an expert botanist. The herbarium samples do not exist and therefore so many mistakes were occured here. In this study, the essential oils of both *F. subpinnata* and *P. anisum* plant species were analyzed and the most prominent compounds and antioxidant potential of each species were introduced. Therefore in order to prevention of mistakes or deception, major compounds and properties of essential oils can be used as a suitable phytochemical indicator to identify plants or derived products of them. Also, due to the antioxidant properties of both plants the consumption of these plants can be useful in everyday human food. As a final conclusion, cooperation or consulting with an expert botanist and presentation of voucher specimen indicating the correct identification of plant is necessary and highly recommended.

Author contributions

P. M. and M. GH N. designed and performed the experiment and participated in writing of manuscript. The analysis of GC/MS were carried out by E. K. and A. A. guided aspects of the research.

Conflict of interest

The authors declare that there is no conflict of interest.

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doi: 10.52547/jmp.20.79.59
مقاله تحقیقاتی

تفاوت بین گیاهان دارویی با توجه به ترکیبات عصاره است اساس: شناختی برای رفع ابهامات

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چکیده

مقدمه: گیاهان Pimpinella anisum (L.) و Froriepia subpinnata (Ledeb.) Baill. در گروه علومی اantarال، دانشکده علوم دانشی به شیلات، دانشگاه علوم کشاورزی و منابع طبیعی ساری، ایران و حتی در گزارشات علمی به اثبات به جای یکدیگر استفاده می‌شوند. هدف: در بخش‌های کیفیت‌شناسی و بذر کیفیات از تشکیل دهنده اساس توسعه کروماتوگرافی گازی FRAP و DPPH در گیاهان فرار ترکیبات FRAP و DPPH با محصولات ناشی از آنها می‌باشد. روش بررسی: یکگانه گیاه F. subpinnata و بذر گیاه P. anisum از ناحیه شیراز، استان فارس به عنوان نمونه انتخاب شده بود و پس از خشک شدن به‌طور تیز تاریخ دریافت اصلاحات: 18 اردیبهشت 1400، روش انتخابی این گیاهان فلز خود، جهت تشخیص افتراقی شناسایی و کلیفیکاسیون از اشتباهات و تقابلات در گیاهان دارویی ایران و محصولات ناشی از آنها می‌باشد.

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