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Phytochemical investigation of *Ajuga iva, Matricaria chamomilla* and *Ruta chalepensis* from Algerian steppe (Djelfa district)

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Abstract

In the present study, three medicinal plants in Djelfa district (Algerian steppe), such as *Ruta chalepensis*, *Ajuga iva* and *Matricaria chamomilla*, were investigated for the presence of phytochemicals (secondary metabolites) i.e. alkaloids, flavonoids, saponins, tannins, coumarins, carbohydrates, terpenoids, anthraquinones, etc. The phytochemical screening was studied by extracting the aerial parts of the plants with different solvents like methanol, acetone, petroleum ether, chloroform and distilled water. The results show the presence of most of the phytochemical components in methanolic extract due to high solubility of active compounds when compared to other solvents. Based on these results, these plants have a great importance as an efficient source of therapeutic agents.

Keywords: Phytochemical screening; *Ajuga iva*; *Matricaria chamomilla*; *Ruta chalepensis*

1. Introduction

Nowadays plants have been recognized as a great source in herbal medicine, complementary pharmaceutical products and leading for new drugs design [1]. Medicinal plants are the indispensible reservoirs of many chemical compounds either primary or secondary metabolites. These compounds include alkaloids, flavonoids, tannins, terpenoids, steroids, carbohydrates, quinones, coumarins, starch and saponins, etc. many studies showed that these compounds possess antitumor, antiviral, antibacterial, anticancer, anti-inflammatory, antioxidant and many other activities [2].

Besides their use as therapeutic agents, medicinal plants could be a potential source of information for many chemical compounds that could be developed as drugs, where the phytochemical analysis or the phytoscreening of these plants attract a great attention of plant researchers in order to contribute in drug research strategies.

Hence this work focused on preliminary phytochemical analysis to screen different phytochemical constituents found in some selected three medicinal plants, *Ajuga iva*, *Matricaria chamomilla*, and *Ruta chalepensis* in Djelfa district (steppe region) in Algeria, where five different solvents (viz. methanol, acetone, petroleum ether, chloroform and distilled water) were used to prepare extracts.

Ajuga iva L. Shrub, a medicinal plant, is widely distributed in the south European and north African countries. In Algeria, *Ajuga iva* has the vernacular name "*Chendgoura*", and it is used traditionnaly in the treatment of many diseases [3], such as digestive disorders, diabetes, cardiovascular disorders, hypertension, and allergy [4-8]. Many studies showed that *Ajuga I* species possess several pharmacological properties such as antioxidant [9], antihypertensive, antidiabetic [10], [11], anti-hypercholesterolemic [12], antibacterial [13], analgesic [14], anticancer and antiviral activities [15], [16].

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Matricaria chamomile L. or German chamomile belongs to the Asteraceae family, is distributed in Eastern Europe, northern Africa, and all the Mediterranean Basin [17], [18]. Chamomile is known in Algeria by its vernacular name of "*Babounj*", used traditionnaly to treat many illnesses such as digestive disorders. Within the species, the essential oil composition of *M. chamomile* was first shown by Schilcher [19].

Due to the presence of many bioactive compounds, chamomile possesses several pharmacological properties, such as anti-inflammatory, antimicrobial, antiseptic, antispasmodic, sedative, antioxidant, antimicrobial, anticancer and anthelmintic [20-24].

Ruta chalepensis L. is a small shrub belonging to the Rutaceae family and native from the Mediterranean region [25]. It is used in Algeria under the vernacular name of "*Fidjel*" to treat different health problems such as: fever, nervous disorders, mental disorders, rheumatism, neuralgia, convulsions, menstrual problems and other bleeding problems. For example the leaf of *R. chalepensis* infused with vinegar are given to children for the treatment of convulsions. Besides these uses *Ruta C*. possesses interesting pharmacological properties [27], such as antimicrobial [26], antibacterial [28], antioxidant [29], anti-inflammatory [30], antiparasitic [31] and amebicidic [32].

2. Material and methods

2.1. Plant material

The plant species were collected in the region of Djelfa (Algerian steppe). They were identified by different local herbalists and authenticated at the department of biology, Ziane Achour University of Djelfa, in Algeria. Voucher specimens have been submitted to the university herbarium.

2.2. Preparation of extracts

The aerial parts of the plant samples were air dried under shade at room temperature for 15 days.

The extracts of selected sample powder were prepared by taking 5g of dried powder in 100 ml of each solvent methanol, acetone chloroform, petroleum ether and distilled water, mixed well under continuous stirring for 24 hours at room temperature, and then filtered. The filtrate of the selected plant samples were taken and used for further phytochemical analysis.

2.3. Phytochemical Analysis

In the preliminary phytochemical analysis of the selected plant species, fifteen different solvents extracts were investigated for the presence of various secondary metabolites such as alkaloids, anthraquinones, glycosides, coumarins, flavonoids, phenols, steroids, saponins, tannins, carbohydrates and terpenoids, using standard procedure [33].

2.3.1. Test of alkaloids

Mayer's test

0.2 ml of dilute hydrochloric acid and 2 ml of the extract were taken in a test tube and then 1 ml of Mayer's reagent was added to it. Formation of yellow coloured precipitate indicates the presence of alkaloids.

Wagner's test

2 ml of the extract was treated with Wagner's reagent. Formation of brown to reddish precipitate indicates the presence of alkaloids.

Dragendorff's test

2 ml of the extract and 0.2 ml of dilute hydrochloric acid were placed in a test tube and then 1 ml Dragendroff's reagent was added. Formation of orange brown precipitate indicates the presence of alkaloids.

2.3.2. Test for flavonoids

Shinoda's test

Few drops of concentrated hydrochloric acid were added to 5 ml of 95% ethanol, small piece of magnesium foil metal and 5 ml of the extract. Pink colour is considered as an indication for the presence of flavonoids.

Lead acetate test

Extract was treated with few drops of lead acetate solution; yellow colour precipitate indicates presence of flavonoids.

2.3.3. Test for anthraquinones

2 ml of extract was mixed with 1ml of benzene and 1 ml of 10% ammonia solution was added. The presence of a pink, red or violet coloration indicates the presence of anthraquinones.

2.3.4. Test for glycosides

Keller Killiani test

0.4 ml of glacial acetic acid was added with 1ml extract and trace amount of $FeCl_3$ and 0.5 ml of concentrated H_2SO_4. Blue colour indicates the presence of glycosides.

Liebermann test

Crude extract was mixed with each of 2 ml of chloroform and 2 ml of acetic acid. The mixture was cooled in ice. Carefully concentrated H_2SO_4 was added. A colour change from violet to blue to green indicated the presence of glycoside.

2.3.5. Test for coumarins

2 ml of extract was treated with 3 ml of 10% sodium hydroxide in a test tube. If the solution turns to yellow colour, then it contains coumarins.

2.3.6. Test for Phenols

Ferric Chloride Test

Extracts were treated with 3-4 drops of ferric chloride solution. Formation of bluish black colour indicates the presence of phenols.

2.3.7. Test for Saponins

5 ml distilled water were added to 2 ml of plant extracts and shaken vigorously for about 30 seconds. If the appearance of foam persists for at least 15 min, it confirms the presence of saponins.

2.3.8. Test for steroids

Salkowski test

2 ml of extract in a test tube was treated with 2ml acetic anhydride acid, 1 ml chloroform followed by 0.5 ml of conc. sulphuric acid (added carefully along the sides of the test tube). If the test solution shows colour change from violet to blue to green, it denotes the presence of steroids.

2.3.9. Test for Tannins

Lead acetate test

2 ml extract was treated with few drops of 1% lead acetate. If yellowish precipitate appears, then it contains tannins.

Braymer's test

2 ml of extract was treated with 10% ferric chloride solution and observed for formation of blue or greenish colour solution.

2.3.10. Test for terpenoids

2 ml of extract was treated with 2 ml of acetic acid followed by 1 ml sulphuric acid which might result in blue green ring formation. This shows the presence of terpenoid.

Salkowki test

2 ml extract was dissolved in 2 ml of $CHCl_3$ in a test tube. 1ml of acetic anhydride was added. Then a few drops of conc. H_2SO_4 were added carefully along the wall of the test tube to form a layer. An interface with a reddish brown coloration confirms the presence of terpenoids.

2.3.11. Test for Carbohydrates

Molisch test

2 ml of exract was taken in a tube and treated with 2 drops of ethanolic solution of α-naphthol (20%). Carefully 1 ml of concentrated sulphuric acid was run down the slides of the tube, without mixing. A Reddish violet coloured ring appeared at the junction of the two liquid in the positive test.

Fehling's Test

Filtrates were hydrolysed with dil. HCl, neutralized with alkali and heated with Fehling's A & B solutions. Formation of red precipitate indicates the presence of reducing sugar.

3. Results and discussion

The results of the phytochemical tests, to reveal secondary metabolites such as alkaloids, saponins, glycosides, tannins, flavonoids, steroids, terpenoids, coumarins, carbohydrates, anthraquinones, phenols in five different solvent extracts of *Ajuga iva*, *Matricaria chamomilla*, and *Ruta chalepensis*, have been reported in tables 1-3 respectively.

Table 1 Phytochemical analysis of different solvent extracts of *Ajuga iva*

Phytochemical	Methanol	Acetone	Chloroform	Petroleum ether	Water
Alkaloids	+	-	+	+	+
Saponins	-	+	+	+	+
Glycosides	+	+	+	-	-
Tannins	+	-	-	+	+
Flavonoids	-	-	+	-	+
Steroids	+	+	+	-	+
Terpenoids	-	+	+	-	+
Coumarins	+	+	+	-	-
Carbohydrates	+	+	+	+	+
Anthraquinones	-	-	-	-	-
Phenols	-	-	-	+	+

+: Present, -: Absent

Table 1 represents the phytochemical screening for five different solvents extracts of *Ajuga iva*. The aereal parts of *Ajuga iva* when treated with methanol revealed the presence of alkaloids, glycosides, tannins, flavonoids, steroids, coumarins, and carbohydrates. The presence of saponins, glycosides, steroids, terpenoids, coumarins, and carbohydrates was also confirmed in acetone extracts. Further, chloroform extract indicated the presence of alkaloids, saponins, glycosides, flavonoids, steroids, terpenoids, coumarins, and carbohydrates. Petroleum ether extract indicated the presence of tannins, phenols, alkaloids, saponins, and carbohydrates. The distilled water extracts showed the presence of all other phytochemicals under study except glycosides, coumarins, and anthraquinones.

The different solvents extracts of *Matricaria chamomilla* (table 2) showed diverse phytoprofiles with reference to the solvents. Out of five extracts distilled water demonstrated the maximum occurrence of phytoconstituents (8/11) such as alkaloids, glycosides, tannins, flavonoids, steroids, terpenoids, carbohydrates, and phenols, and absence of coumarins, and anthraquinones, were observed.

Table 2 Phytochemical analysis of different solvent extracts of *Matricaria chamomilla*

Phytochemical	Methanol	Acetone	Chloroform	Petroleum ether	Water
Alkaloids	+	+	+	+	+
Saponins	-	-	+	+	+
Glycosides	+	+	-	-	+
Tannins	+	+	-	-	+
Flavonoids	+	-	-	+	+
Steroids	-	+	+	+	+
Terpenoids	+	+	+	+	+
Coumarins	-	+	-	-	-
Carbohydrates	+	+	+	+	+
Anthraquinones	-	-	-	-	-
Phenols	+	+	+	+	+

+: Present, -: Absent

In the case of methanol extracts, alkaloids, glycosides, tannins, flavonoids, terpenoids, carbohydrates, and phenols have been found.

Table 3 Phytochemical analysis of different solvent extracts of *Ruta chalepensis*

Phytochemical	Methanol	Acetone	Chloroform	Petroleum ether	Water
Alkaloids	+	+	+	+	+
Saponins	+	-	+	-	+
Glycosides	-	-	+	-	+
Tannins	+	-	-	-	+
Flavonoids	+	+	-	+	+
Steroids	+	+	+	+	-
Terpenoids	+	-	+	+	-
Coumarins	+	+	+	-	-
Carbohydrates	+	+	+	+	+
Anthraquinones	-	-	-	-	-
Phenols	+	-	-	+	+

+: Present, -: Absent

Acetone extract showed the presence of alkaloids, glycosides, tannins, steroids, terpenoids, coumarins, carbohydrates, and phenols. Followed by chloroform extract, which indicated the presence of alkaloids, saponins, steroids, carbohydrates, and phenols, and absence of glycosides, tannins, flavonoids, coumarins, and anthraquinones. Whereas, Petroleum ether extract showed the presence of alkaloids, saponins, flavonoids, steroids, terpenoids, carbohydrates, and phenols.

Table 3 shows the qualitative phytochemical analysis of various solvents extracts of *Ruta chalepensis*. The aereal parts of *R. chalepensis* when treated with methanol revealed the presence of alkaloids, saponins, flavonoids, steroids, terpenoids, coumarins, carbohydrates, tannins and phenols. The presence of alkaloids, flavonoids, steroids, coumarins, and carbohydrates was also confirmed in the acetone extract. The chloroform extract was found to contain alkaloids, saponins, glycosides, steroids, terpenoids, coumarins, and carbohydrates. Further, the petroleum ether extract indicated the presence of alkaloids, flavonoids, steroids, terpenoids, carbohydrates and phenols. The aqueous extract of *R. chalepensis* reveals the presence of alkaloids, saponins, glycosides, tannins, flavonoids, carbohydrates and phenols.

In the present study, the presence of several phytochemicals was investigated in three medicinal plant species. These phytochemicals or secondary metabolites, such as alkaloids, saponnins, tannins, flavonoids, glycosides, steroids, etc. have been reported to possess many pharmacological properties. For example, steroids and tri-terpenoids have analgesic properties. Saponins possess anti-hypocholesterolemic, anti-inflammatory and anti-diabetic properties. Terpenoids have antibacterial activities. Flavonoids and phenols also are evaluated for their anti-carcinogenic, anti-inflammatory antioxidant and antiviral effects. Alkaloids are used as anesthetic agents.

Ajuga iva shrub, a medicinal plant from the Lamiaceae family, is widely distributed in the European and north African countries [34].

In Algeria, *Ajuga iva* has the vernacular name "*Chendgoura*" and it is used traditionally in the treatment of many diseases. Many studies showed that the *Ajuga iva* species possess many pharmacological properties such as analgesic [8], antioxidant [9], antidiabetic and anti-hypocholesterolemic [11], anticancer, anti-bacterial, and antiviral [13-16].

Matricaria chamomilla L. or German chamomile, belonging to the Asteraceae family, is mostly distributed in Eastern Europe, northern Africa and in the entire Mediterranean basin [35].

Chamomile is known in Algeria by its vernacular name of "*Babounj*", a medicinal plant used traditionally to treat many illnesses especially digestive disorders. Its pharmacological properties are attributed to the presence of several bioactive compounds. It possesses anti-inflammatory, antiseptic, antispasmodic, anti-ulcerogenic, sedative, antioxidant, antimicrobial, antihelmintic, antibacterial and antifungal activities [20-22], [36-39].

In Algeria, *Ruta chalepensis* L., commonly known as "*Fidjel*", is a small shrub, from the Rutaceae family, and widely distributed in the Mediterranean region [25].

It is used as a traditional medicinal plant, for treating many health problems such as fever, rheumatism, monstruel problems, and microbial infections [40], [41], [27].

Many secondary metabolites have been revealed in this plant such as alkaloids, flavonoids, saponnins, tannins, terpenoids and others. Hence, it possesses a significant pharmacological activity as analgesic, antimicrobial [42], anticancer [43], antiparasitic [44], antioxidant [29], anthelmintic [45], analgesic [46], amebicide [32] and inflammatory [30] properties.

4. Conclusion

Many plants contain different types of phytochemical substances possessing pharmacological properties. In this study, these phytochemicals have been investigated for the presence in three medicinal plant species from Algerian steppe namely *Ajuga iva*, *Matricaria chamomilla*, and *Ruta chalepensis*. It has been found that most of the phytochemical compounds are present in all the studied plants, with variations in the chemical constituents of each solvent extract (methanol, acetone, chloroform, petroleum ether and water).

Further studies, such as quantitative analysis, characterization, isolation and pharmacological activities, will be of great interest.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

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