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REGULAR ARTICLE

PHYTOCHEMICAL SCREENING AND MINERAL CONTENTS OF ANNUAL PLANTS GROWING WILD IN THE SOUTHERN OF TUNISIA

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SUMMARY

Eight annual species growing wild in the southern of Tunisia (*Diplotaxis simplex, Chrysanthemum coronarium, Matthiola longipetela, Erodium glaucophyllum, Reseda alba, Diplotaxis harra, Senecio gallicus* and *Papaver rhoeas*) were evaluated for their mineral contents and phytochemical screening. The mineral analysis showed that calcium and potassium were the most concentrated minerals (1.21-3.60% and 0.36-3.20% respectively) followed by sodium (0.12-1.38%), magnesium (0.16-0.41%) and phosphorus (0.05-28%). The preliminary phytochemical screening revealed the absence of anthraquinones in all studied plants whereas alkaloids were only present in *Papaver rhoeas*. *Senecio gallicus* and *Chrysanthemum coronarium* were the only species that contained essential oils. All species were found to contain saponins, flavonoids and tannins with the exception of *Erodium glaucophyllum* and *Papaver rhoeas*. These results indicate that some of these species may be used as fodder plants for livestock due to their high contents of minerals but the presence of some secondary metabolites may reduce their palatability. In the other hand, these secondary metabolites could be the origin of the medicinal properties of these species.

Keywords: Phytochemical screening, Tunisian annual plants, Mineral contents.

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1. Introduction

Knowledge of the phytochemical constituents of plants is desirable, not only for the discovery of therapeutic agents, but also because such information may be of value in disclosing new sources of such economic materials as tannins, oils, gums, flavonoids, saponins, essential oils precursors for the synthesis of complex chemical substances, etc. In addition, the knowledge of minerals contents of plants is useful to evaluate their nutritive potentialities as fodder for livestock and human. Therefore, the knowledge of the chemical constituents of plants would further be valuable in discovering the actual value of folkloric remedies.

In Tunisia, there are 149 medicinal plants whose the majority are perennial and some of them are actually exploited for the production of essential oils (*Rosmarinus officinalis*, *Artemisia herba alba, Thymus capitatus, Myrtus communis*) [1]. Annual plants growing wild are generally consumed by livestock but not or little used in folk medicine in spite of their abundance especially during the rainy years.

The present study is a contribution to the determination of the chemical composition of some annual plants growing wild in Tunisia: *Diplotaxis simplex*, *Chrysanthemum coronarium*, *Matthiola longipetela*, *Erodium glaucoph*yllum *Reseda alba*, *Diplotaxis harra*, *Senecio gallicus* and *Papaver rhoeas*. Some medicinal uses of these species are presented in Table 1 [2-4]. Several phytochemical and pharmacological studies were carried out on some of these species in other countries [5-19]. In Tunisia, no previous chemical and biological studies have been reported on these species except the two studies carried out by Hammami et al. who isolated and identified phenolic compounds, sterol glycosides and essential oil from the flowers of *Matthiola longipetala* [20,21].

The purpose of this work is the evaluation of nutritive and economic potentialities of eight annual plants growing wild in the southern of Tunisia (*Diplotaxis simplex*, *Chrysanthemum coronarium*, *Matthiola longipetela*, *Erodium glaucoph*yllum *Reseda alba*, *Diplotaxis harra*, *Senecio gallicus* and *Papaver rhoeas*) by the determination of their macromineral contents and their phytochemical composition.

2. Materials and methods

Sample Preparation

The aerial parts of the studied plants (Table 1) were collected at the flowering stage (March-April) from El Fje region (33 30′N and 10 40′E) located at 22 Km from Médenine town in the southern of Tunisia.

Table 1: List of studied plants

Scientific name	Family	Voucher number	Vernacular name	Uses in folk medicine [2,4]
Diplotaxis Simplex	Brassicaceae	Ds01	"Jirjir"	Food for animals
Mathiola Longipetela	Brassicaceae	Ml01	"Chgara"	Anti-inflammatory
Chrysanthemum coronarium	Asteraceae	Cc01	"kahwana"	Stomachic, vermifuge and insecticide
Erodium Glaucophyllum	Geraniaceae	Eg01	"Toummir"	Skins tanning
Reseda Alba	Resedaceae	Ra01	"Dhil Khrouf"	Colic, diarrheas and poisonings
Diplotaxis Harra	Brassicaceae	Dh01	"El harra"	Food for animals
Senecio Gallicus	Asteraceae	Sg01	-	Uterine sedative, regulating venous circulation
Papaver rhoeas	Papaveraceae	Pr01	"Bouguaaroun"	disorders of sleep of the adult and the child, sedative effect against nervousness, anxiety and emotivity, effective, calming of cough and throat irritations

These samples were air-dried in shade at ambient temperature (20-22°C) until constant weight (about 20 days). The dried plant materials were then coarsely crushed with mortar, grounded in powder with a Molinex coffee mill and finally stored at 4°C in a tightly covered bottle until analysis. All the species were identified by Pr. Mohamed Neffati (Range Ecology Laboratory, Institut des Régions Arides, Médenine, Tunisia). Voucher specimens have been deposited in the laboratory. Voucher numbers and medicinal uses of studied species are shown in Table 1.

Phytochemical Screening

Triplicate samples from each species were analysed for the presence of tannins, flavonoids, saponins, anthraquinones, alkaloids and essential oils using standard phytochemical procedures as following:

Tannins (ferric chloride solution), alkaloids (Bouchardat's, Mayers's and Dragendorff's reagents), flavonoids (Magnesium fragments and HCl), saponins (persistence of foam after shaking), anthraquinones (chloroform and ammonia solution) and essential oils (extraction with Clavenger apparatus) [22].

Determination of Mineral Contents

Mineral contents were determined using the AOAC methods adopted by Oshodi [23,24]: Triplicate samples from each species were dry ashed at 550 °C for four hours in a Heraeus furnace and then were prepared for mineral analysis by dissolving the ash with 20% HCl solution then completing the filtrate to 100 ml by deionised water. Sodium and potassium contents were analysed by a SHERWOOD 410 flame photometer. The concentration of calcium and magnesium were determined by a SHIMADZU AA6800 atomic absorption spectrophotometer. The percentage of Phosphorus was investigated using a modified vanado-molybdate method by a SHIMADZU UV-VIS Spectrophotometer.

3. Results and Discussion

Phytochemical Screening

The phytochemical screening revealed the presence of flavonoids, tannins and saponins in all studied plants except in *Erodium glaucoph*yllum which was free of flavonoids and in *Papaver rhoeas* which did not contain saponins. Alkaloids were recorded only in Papaver *rhoeas* (Papaveraceae). Essential oils were present only in *Chrysanthemum coronarium* (Asteraceae) and *Senecio gallicus* (Asteraceae). Anthraquinones were absent in all studied plants. Some of these results are in agreement with those reported by several authors. Flavonoids and essential oils have been previously isolated and identified in *Chrysanthemum coronarium* and *Senecio gallicus* [7-9,13,14,16]. Different polyphenols and flavonoids have been separated and identified in *Diplotaxis simplex*, *Matthiola longipetala* and *Papaver rhoeas* [11,15,20,21]. The presence of alkaloids in *Papaver rhoeas* has been also previously reported by Soulimani et al. [||15]. The absence of essential oil in our *Matthiola longipetala* is in contradiction with the results reported by Hammami et al. [21] and this is can be attributed to the part and the method used for the extraction of this substance or to other parameters such as genetic factors, soil and weather conditions, origin and the stage of the sample the day of its harvest. However, the presence of tannins and saponins in our studied plants has not been previously reported.

The presence of these secondary metabolites in our studied plants may be at the origin of the therapeutic effects of these species and responsible for many pharmacological actions. Saponins have been known to have anticarcinogenic properties, immune modulation activities and regulation of cell proliferation as well as health benefits such as inhibition of the growth of cancer cells and cholesterol lowering activity [25]. The tannin-containing plant extracts are used as astringents, against diarrhoea, diuretics, against stomach and duodenal tumours, anti-inflammatory, antiseptic, antiviral, antibacterial, antioxidant, antitumour by inhibiting HIV replication [26]. Flavonoids were known to posses antioxidative, antibacterial, anti-inflammatory, antiallergic, antimutagenic, antiviral, antineoplastic, anti-thrombotic, and vasodilatory properties [27]. Essential oils were known to exert antibacterial, anti-inflammatory, antiviral, antioxidant, insecticidal, antifungal and antimalarial activities. Alkaloids were known to be used as antiarrythmic, anticholinergic, central nervous system stimulant, potent anticancer agent, topical anesthetic, adrenergic blocking agent, drug of abuse, relatively nonaddictive analgesic, antitussive, paralysis of motor nerves and anaesthesia, stimulants, orally active emetic, amoebicide, powerful narcotic analgesic, addictive drug of abuse, highly toxic, horticultural insecticide, peripheral stimulant of the parasympathetic system, antimalarial, antibacterial, sedative for motion sickness, violent tetanic poison, rat poison, antitumor agent, nondepolarizing, muscle relaxant producing paralysis, adjuvant to anaesthesia and antineoplastic [29].

The biological activities of these secondary metabolites depend on their chemical composition and their concentration in the studied plants. Further studies will be carried out to extract, identify and determine the biological activities of these substances.

Table 2: Mineral contents (g per 100 g dry matter) of studied plants

	Sodium	Potassium	Calcium	Magnesium	Phosphorus
Diplotaxis Simplex	0.47 ± 0.03	2.06 ± 0.11	1.69 ± 0.08	0.16 ± 0.02	0.24 ± 0.03
Matthiola longipetela	0.47 ± 0.04	1.87 ± 0.12	3.25 ± 0.20	0.23 ± 0.02	0.10 ± 0.01
Chrysanthemum coronarium	1.38 ± 0.06	1.80 ± 0.09	1.65 ± 0.11	0.22 ± 0.02	0.12 ± 0.02
Erodium glaucophyllum	0.12 ± 0.02	0.36 ± 0.08	1.26 ± 0.08	0.32 ± 0.03	0.05 ± 0.01
Reseda alba	0.42 ± 0.04	2.4 ± 0.26	1.21 ± 0.06	0.22 ± 0.02	0.25 ± 0.04
Diplotaxis harra	0.44 ± 0.05	1.93 ± 0.09	1.22 ± 0.08	0.18 ± 0.03	0.28 ± 0.03
Senecio gallicus	0.55 ± 0.05	1.03 ± 0.07	2.10 ± 0.24	0.16 ± 0.03	0.11 ± 0.01
Papaver rhoeas	0.66 ± 0.05	3.20 ± 0.26	3.60 ± 0.32	0.41 ± 0.04	0.19 ± 0.03

Mineral Contents

Results of minerals analysis (Table 2) showed that calcium and potassium were the most concentrated nutrients in all studied plants (1.21-3.60% and 0.36-3.20% respectively), followed by sodium (0.12-1.38%), magnesium (0.16-0.41%) and phosphorus (0.05-0.28%).

The calcium concentrations ranged from 1.21% to 3.60%, most species having contents between 1.21 and 1.69%. *Reseda alba* had the lowest Ca concentration and *Papaver rhoeas*. the highest. *Papaver rhoeas*, *Matthiola longipetela* and *Senecio gallicus* can be considered as high calcium content plants (3.60, 3.25 and 2.10% respectively) whereas the others as medium [30]. The amount of calcium in all studied plants was above the required dietary level for feeding animals (0.18-0.33%) [31,32].

The potassium content varied between 0.36% in Erodium *glaucophyllum* and 3.20% in Papaver *rhoeas*. With the exception of *Erodium glaucophyllum* which recorded a very low amount of potassium (0.36%), *Senecio gallicus* which had a low content (1.03%) and *Papaver rhoeas* with a high percentage (3.20%), the remaining studied species contained medium percentage of this nutrient (1.82-2.40%) [30] (Al-Jaloud et al., 1994). The majority of studied plants had potassium content to satisfy livestock requirements (0.18-0.25%) [31,32].

The amount of magnesium ranged between 0.16% in *Diplotaxis simplex* and 0.41% in *Papaver rhoeas*. All studied plants were found to contain almost the same percentage of this mineral (0.16-0.23%) except Erodium *glaucophyllum* and *Papaver rhoeas* that contained higher amounts (0.32 and 0.41% respectively). These species can be considered as plants with low to medium magnesium content but it seems to be enough to satisfy livestock requirements (0.08-0.25%) [30-32].

All studied species were found to contain almost the same amount of sodium (0.42-0.66%) except Erodium *glaucophyllum* with a lower content (0.12%) and *Chrysanthemum coronarium* with a higher content (1.38%). These species could be considered as plants with medium content of sodium (0.12-1.38%). The amount of sodium in all studied plants was above the required dietary level for feeding animals (0.18-0.33%) [30-32].

The phosphorus content was ranged from 0.05% in Erodium *glaucophyllum* to 0.28% in *Diplotaxis harra*. According to the classification reported by Al-Jaloud et al. [30] for phosphorus content, *Diplotaxis harra*, *Diplotaxis simplex* and *Reseda alba* could be considered as plants with high content of this mineral (0.25-0.28%), *Papaver rhoeas* as plant with medium percentage (0.19%) and the other plants as plants with low amounts (0.05-0.12%). Among the studied species, only *Diplotaxis harra*, *Diplotaxis simplex*, *Reseda alba* and *Papaver rhoeas* had phosphorus content to satisfy livestock requirements (0.16-0.38%) [31,32].

The percentages of these minerals in our studied plants seem to be enough to satisfy livestock requirements with the exception of phosphorus which its amount in certain species is relatively low. The concentrations of these minerals were similar to those recorded in some medicinal and herbal species growing wild in arid and semi arid regions of the world [30,32-36], higher than those obtained in some medicinal plants growing wild in Egypt [31,37], some plants used as condiments in Turkey [38], some Mexican fruits and vegetables [39] and some cereals, fruits and vegetables from Finland [40].

It seems that plants growing wild in arid and semiarid regions contained sufficient amounts of macrominerals for optimal livestock and wildlife performance. These amounts were found to be higher than those in cereals, fruits and vegetables. Among these minerals, it appears that potassium is the most concentrated nutrient in the majority of fruits, vegetables, cereals and herbs and its content generally satisfy human and animals requirements.

Conclusions

The results of the present study have revealed the presence of flavonoids, tannins and saponins in the majority of the studied plants. Essential oil was present in only *Chrysanthemum coronarium* and *Senecio gallicus* whereas alkaloids were found in only *Papaver rhoeas*. The presence of these secondary metabolites in these plants might be the origin of some pharmaceutical properties. These plants could also serve as a good source for food for animals due to their high mineral contents, particularly calcium and potassium, but the presence of certain secondary metabolites (tannins, alkaloids and essential oils) may limit the use of these species as fodder.

Further studies will be carried out to isolate, identify and evaluate the biological activities of these secondary metabolites and to determine the amount of other macronutrient (proteins, carbohydrates, fibres, etc.) and micronutrients (zinc, manganese, iron, nickel, selenium, etc.) in these species.

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