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Phytochemical Screening of Some Medicinal Plants in Al Jouf, KSA

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Abstract

The utilization of ethnobotanical and phytochemical investigations in the discovery of novel medications is beneficial. Screening for phytochemicals is an important step in detecting the bioactive ingredients of medicinal plants which are used in conventional therapy. For the first time, 23 medicinal plants utilized in Saudi Arabian traditional therapy were examined. From August 2020 to July 2021, ethnobotanical fieldwork was conducted. There was some plant species identified, divided into pertinent families. Standard procedures were used to screen these medicinal plants for the occurrence of glycosides, alkaloids, saponins, resins, saponins, tannins, and flavonoids. Among the medicinal plants used, the most common phytochemicals were alkaloids (95.65%), glycosides (86.96%), saponin (82.61%), tannins (73.91%), flavonoids (56.52%), and resin (52.17%). The least widely distributed chemicals, on the other side, were resins. *Trigonella foenum-graecum* L., *Pimpinella anisum* L., and *Cuminum cyminum* L. seeds were shown to contain all six categories of secondary metabolites. The ethnographic importance of these medicinal plants is consistent with the content of secondary metabolites.

Keywords

Medicinal Plants, Phytochemicals, Glycosides, Alkaloids, Saponins, Resins, Saponins, Tannins, and Flavonoids

1. Introduction

The weight of medicinal plants used in the pharmaceutical industry development and alternate therapies has been highlighted by environmental aspects and related habitat consequences connected with desert climate, high salinity, nutrient scarcity, and water (Al-Omar *et al.*) [1]. Due to the extreme climatic conditions, plants are forced to maintain increased levels of compounds with defensive activities as a survival mechanism against excessive oxidative stress Khalaf

Allah *et al.*) [2], bacterial infection, and animal grazing invasion. Plant secondary metabolites (PSM) are compounds like these (Al-Qahtani *et al.*) [3], Youssef *et al.*) [4]. For millennia, the knowledge of how to use plants medicinally has been passed down from generation to generation, and it has evolved based on observations, experience, and trial and error tests (Karunamoorthi *et al.*) [5], Abdein and Osman [6], Plants have long been used as a source of health throughout human history Abdein [7]. The knowledge of the many medicinal powers of plants has been passed down through the generations through trial and error (Mendoza *et al.*) [8]. A variety of halophytes have been used in various applications (Abualreish and Abdein) [9]. Plant-derived secondary metabolites are used as medicaments to meet the basic needs of people and animals (Osman and Abdein [10] [11], Jamshidi-Kia *et al.* [12]). Because of the great diversity, procurement, and sustainability of natural products, these plants are widely accepted Abdein *et al.*) [13]. Their acceptability may due also to the safeness, viability, and accessibility (Gurib-Fakim) [14]. Plants that have been shown to be medicinally useful and are commonly used in traditional medicine may contain chemicals that could be used as medication candidates (Rayan *et al.*) [15], Stevanovic *et al.*) [16]. In addition, the distribution of these substances in various sections of the plant is different (Abdel-Mageed *et al.*) [17]. Traditional medicine employs a variety of plant parts, including barks, leaves, flowers, stems, fruits, rhizomes, resins, seeds, and roots. People, on the other hand, use these herbs for specialized purposes to treat some important ailments (Anywar [18]). The need to investigate the activity of medicinal plants against different diseases has persisted since ancient times. The scientific affirmation of bio-activity of the phytochemicals is a set up strategy for the discovery of new medication and evolution in the current era (Egbuna *et al.*) [19]. Furthermore, the existence of such chemicals gives important nutritional and health-promoting benefits, as well as therapeutic qualities in these plants (Alqethami, *et al.*) [20]. Because of their diversity, active chemicals vary among plants, and they have a distinct physiological effect on humans (Jithesh *et al.*) [21]. Several parts of Saudi Arabia have a greater-salinity ecology, that impacts the growth of plants and is a major factor in the region's delayed agricultural development (Abd El-Moneim *et al.*) [22].

For the last few decades, demand for herbal medicines has been rising due to a growing public awareness of the importance of getting "back to nature" for a better lifestyle (El-Refai *et al.*) [23].

The purpose of this study is to look for secondary metabolites in some medicinal plants used in traditional medicine and to investigate whether a correlation between the ethnomedicinal value of medicinal plants and their secondary metabolite content exists.

2. Materials and Methods

2.1. Study Area

This study was conducted in AlJouf province, KSA (**Figure 1**). It is located in the

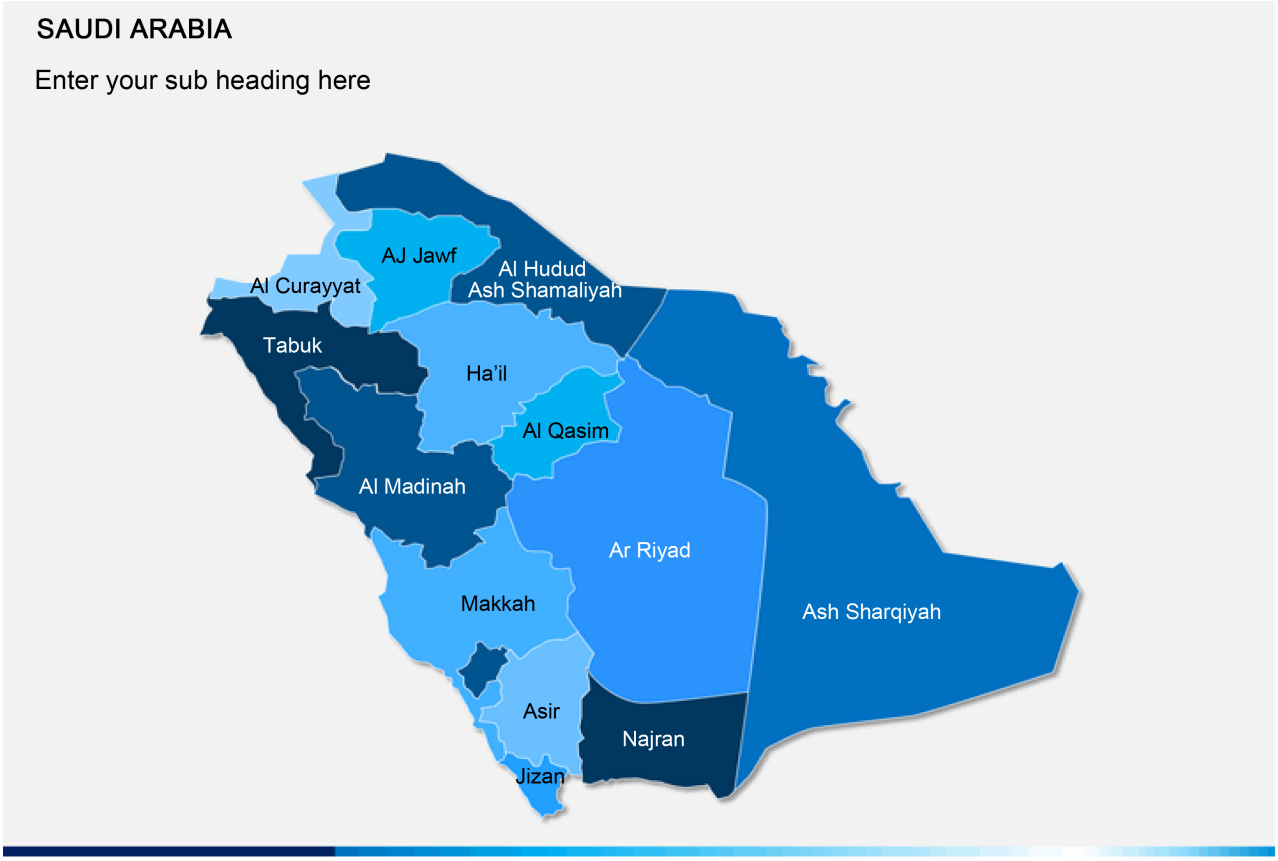

Figure 1. Map of KSA showing Al Joufregion.

northwestern part of KSA. The province has Latitude: 29˚29'59.99"N and Longitude: 39˚29'59.99"E. The climate of Al Jouf is indicated in **Figure 2**.

Al Jouf has a Subtropical desert climate and is located at an elevation of 654.76 metres (2148.16 feet) above sea level (Classification: BWh). The city's annual temperature is 24.39˚C (75.9˚F), which is −2.62 percent lower than the Saudi Arabia average. Al Jouf gets about 7.49 millimetres (0.29 inches) of rain per year and has 19.45 rainy days (5.33 percent of the time) (https://tcktcktck.org/saudi-arabia/al-jawf).

The province of Al Jouf is dry all year. Each month receives less than or even significantly less than 20 mm (0.78 inch) of rain (Al-Rowaily *et al.*) [24]. January is the wettest month of the year. If you don't like rain, you should avoid this month. July is the driest month of the year (Modaihsh *et al.*) [25]. August is the warmest month in Al Jouf Province, with an average maximum temperature of 40˚C.

2.2. Sample Preparation

Plant samples (**Table 1**) were obtained based on field research in ethnobotany conducted in Al Jouf over the course of a year, starting August 2020 till July 2021. The American Anthropological Association's ethical rules [26] were observed, as well as the International Society of Ethnobiology's Code of Ethics [27].

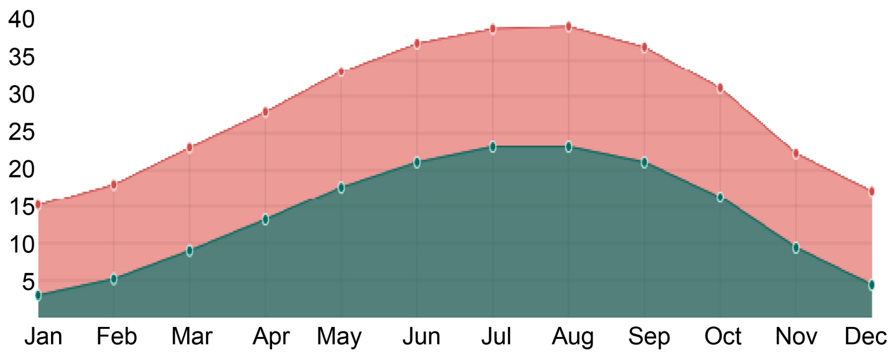

Figure 2. The climate of Al Jouf (All data correspond to the average monthly values of the last 20 years.).

Table 1. Phytochemical screening of some plants ((+) present, (−) absent)) of some medicinal plants in Al Jouf.

Family	Plant species	Plant part	Alkaloids	Glycosides	Saponin	Tannins	Flavonoid	Resin
Fabaceae	*Trigonella foenum-graecum* L.	Seeds	+	+	+	+	+	+
Apiaceae	*Pimpinella anisum* L.	Seeds	+	+	+	+	+	+
Apiaceae	*Cuminum cyminum* L.	Seeds	+	+	+	+	+	+
Apiaceae	*Carum carvi* L.	Seeds	+	+	−	+	+	+
Apiaceae	*Carum carvi* L.	Roots	+	+	+	−	+	+
Anacardiaceae	*Pistacia lentiscus* L.	Resin	+	+	+	+	−	+
Lamiaceae	*Salvia rosmarinus* Schleid.	Leaves	+	+	+	+	−	+
Brassicaceae	*Lepidium sativum* L.	Seeds	+	+	−	+	+	+
Fabaceae	*Lupinus albus* L.	Seeds	+	+	+	−	+	+
Brassicaceae	*Anastatica hierochuntica* L.	All plant	+	+	+	+	−	−
Asteraceae	*Aucklandia costus* Falc.	Roots	+	+	+	+	−	−
Amaranthaceae	*Chenopodium quinoa* Willd.	Seeds	+	−	+	−	+	+
Lauraceae	*Cinnamomum tamala*	Leaves	+	+	+	+	−	−
Rutaceae	*Citrus aurantium* L.	Fruits	+	+	−	+	+	−
Zingiberaceae	*Curcuma longa* L.	Rhizome	+	+	+	+	−	−
Apiaceae	*Foeniculum vulgare* Mill	Seeds	+	+	+	−	+	−
Cucurbitaceae	*Luffa aegyptiaca* Mill.	Fruits	+	+	+	−	+	−
Asteraceae	*Matricaria aurea* L.	Flowers	+	+	+	+	−	−
Lamiaceae	*Mentha spicata* L.	Leaves	+	+	−	+	+	−
Ranunculaceae	*Nigella sativa* L.	Seeds	+	−	+	+	+	−
Rosaceae	*Prunus mahaleb* L.	Seeds	+	+	+	−	−	+
Lythraceae	*Punica granatum* L.	Peel	+	+	+	+	−	−
Fabaceae	*Glycyrrhiza glabra* L.	Roots	−	+	+	+	−	+
	Total species	23	22	20	19	17	13	12
	%		95.65%	86.96%	82.61%	73.91%	56.52%	52.17%

2.3. Plant Extracts Preparation

To obtain a homogeneous sample, plant materials were pre-washed, dehydrated, and ground. Plant powder was, then, split into two portions for distinct extractions: aqueous extraction and solvent extraction on edible oils as natural antioxidants (Hikal [28]).

2.4. Aqueous Extraction

Five grams of plant samples were combined with 200 mL of distilled water. At 30˚C - 40˚C, this mixture was cooked for 20 minutes with continuous stirring. Whatman No. 1 filter paper was used to filter the aqueous extract (Yadav and Agarwala, [29]).

2.5. Solvent Extraction

In a conical flask, ten games of plant material were placed in one hundred ml of solvent (methanol and ethanol were used as solvents), blocked with cotton, and stored for 24 hours before being filtered using Whatman No. 1 filter paper (Thangaraj, [30]).

2.6. Analysis of Phytochemicals

The following qualitative examination of phytochemical content was carried out according to known methods:

Flavonoids (Pandey and Tripathi) [31], alkaloids (Thangaraj) [30], resin (Hikal) [32], tannins (Yadav *et al.*) [33], glycosides (Yadav and Agarwala) [29], and saponin (Abdel-Mageed *et al.*) [34].

2.7. Detection of Tannins

Two to three ml of (ethanol extract) filtrate were treated with a few drops of $FeCl_3$ (10%) solution. Tannins (**Figure 3**) indicate a solution that is greenish grey or dark blue in color.

Detection of Saponins

With vigorous shaking, five ml of distilled water were combined with five ml of filtrate (aqueous extract). Saponins (**Figure 4**) indicate that the foam is stable.

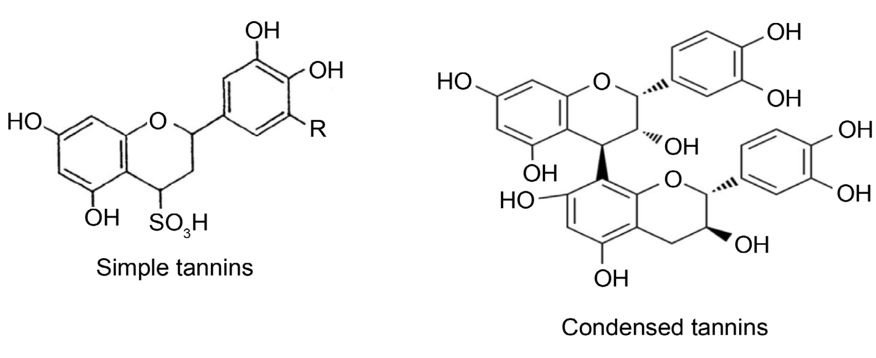

Figure 3. Chemical structure of tannins (Attia-Ismail) [35].

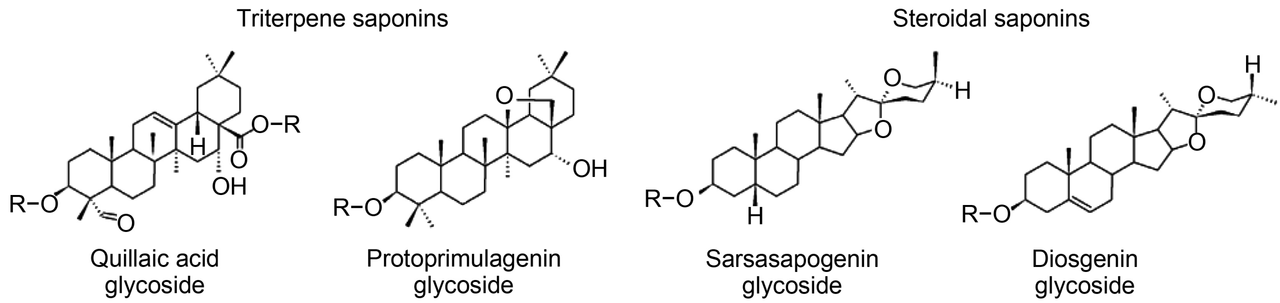

Figure 4. Chemical structure of saponins (Budan *et al.*) [36].

2.8. Detection of Alkaloids

The ethanol extract was filtered after being diluted in a few ml of dilute Hydrochloric acid. A few drops of Hager's reagent (picric acid in a saturated aqueous solution) were added to 2 ml of filtrate. The presence of a bright yellow precipitate shows that the test of alkaloids (**Figure 5**) is positive.

2.9. Detection of Glycosides

To two ml of filtrate, one ml of glacial acetic acid, one ml of $FeCl_3$, and one ml of H_2SO_4 were added (ethanol extract). The presence of glycosides (**Figure 6**) is indicated by a green-blue hue.

2.10. Detection of Resins

The presence of resins (**Figure 7**) is indicated by a precipitate.

2.11. Detection of Flavonoids

Two to three ml of (methanol extract) filtrate were treated with a piece of magnesium ribbon and one ml of strong HCl. The presence of flavonoids (**Figure 8**) is indicated by the pink-red or crimson coloring of the solution.

3. Results

Folk medicine's traditional uses are scientifically supported. The cultural or chemical grounds for utilizing these therapeutically herbs in traditional Al Jouf treatment may be any or both. The chemical causes have been highlighted in light of the current study's findings. Glycosides, tannins, alkaloids, saponins, flavonoids, and resins are examples of secondary metabolites that play asignificant role in pharmacological as well as physiological activities (Yadav and Agarwala) [29].

An add up to 23 different therapeutic plants utilized within the conventional treatment within the KSA were screened for the nearness of the phytochemical substance counting glycosides, flavonoids, alkaloids, saponins, resin, and tannins **Table 1**. The majority of disseminated compounds among therapeutically plants utilized within the conventional treatment in Al Jouf were alkaloids, glycosides, saponins, tannins, flavonoids, and resin. The presence of these compounds in

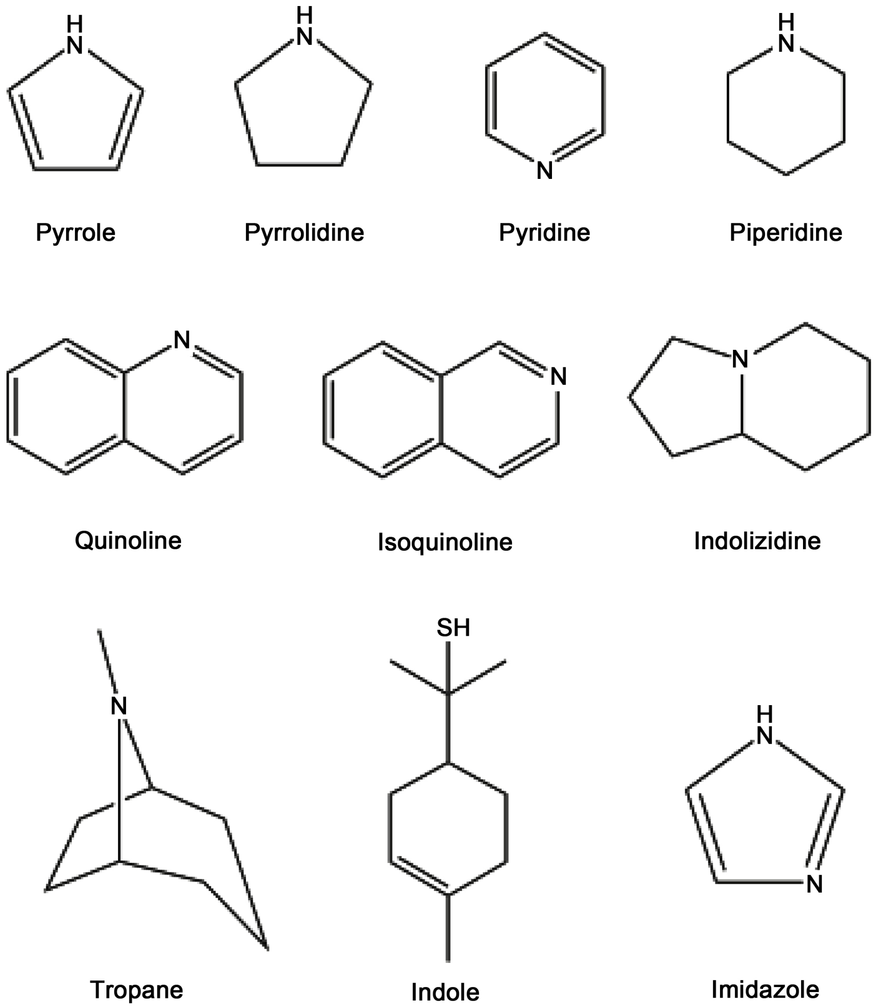

Figure 5. Chemical structure of alkaloids (Gutiérrez-Grijalva *et al.*) [37].

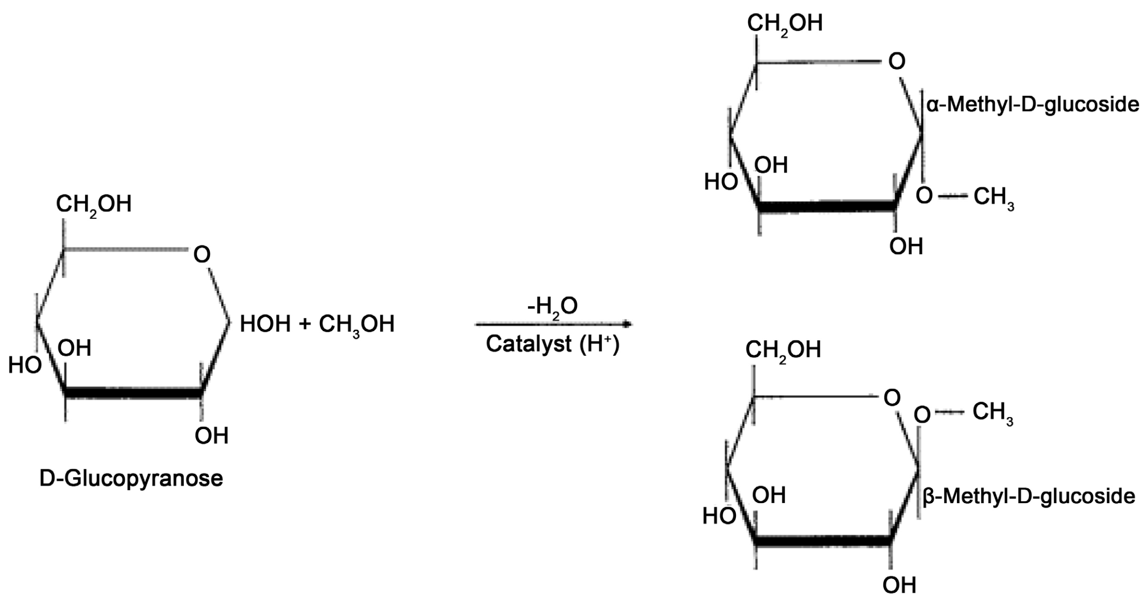

Figure 6. Chemical structure of glycosides (Onaolapo and Onaolapo) [38].

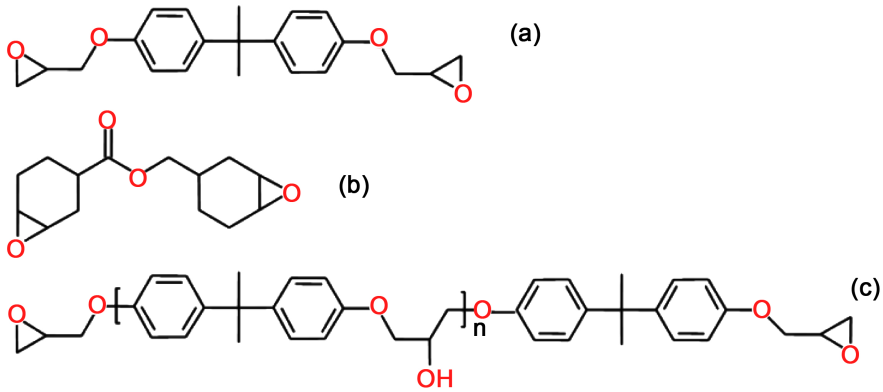

Figure 7. Chemical structure of Resins. (a) 2,2-Bis[4-(glycidyloxy)phenyl] Propane (DGEBA); (b) 3,4-Epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate (ECC); (c) DGEBA oligomer, n = 0.2 typically (González *et al.*) [39].

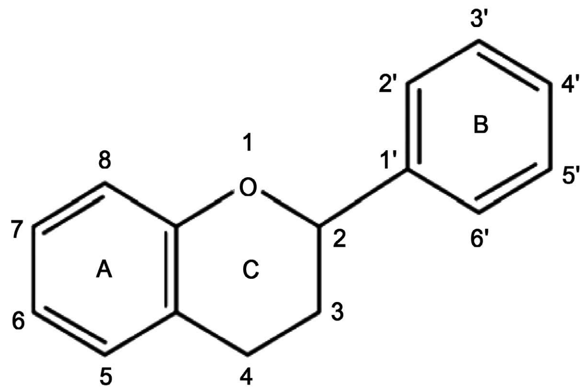

Figure 8. Chemical structure of Flavonoids (Pal and Saha) [40].

the screened medicinal plants is representative to these plants. The overall percentages of these compounds were 95.52% for the alkaloids, 86.96% for the glycosides, 82.61% for saponins, 73.91% for the tannins, 56.52% for the flavonoids, and 52.17% for the resins. Table 1 shows the presence or absence of these compounds in the screened plants. Table 1 also shows that family Apiaceae had the highest occurrence within the screened plant families (21.74%). The family Fabaceae followed with the percentage of 13.04%. Both families had the highest occurrence within the studied area. Families Lamiaceae, Brassicaceae, and Asteraceae were present equally with percentage of 8.70%. Other families had the lowest occurrence (4.35%). These families included Anacardiaceae, Amaranthaceae, Lauraceae, Rutaceae, Zingiberaceae, Cucurbitaceae, Ranunculaceae, and Lythraceae. Figure 9 shows the occurrence percentage of the screened plant families.

On the other hand, the results shows that *Pimpinella anisum* L., *Cuminum cyminum* L., and *Trigonella foenum-graecum* L. seeds included all six classes of chemical compounds. All plant parts, including leaves, flowers, fruits, peels of fruits, peels of seeds, rhizomes, resins, seeds, and roots, were tested. Leaves

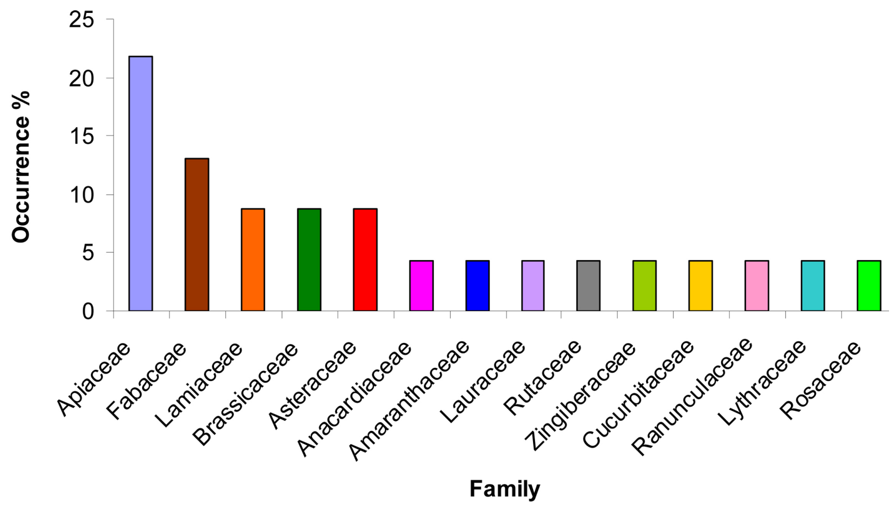

Figure 9. The occurrence percentage of different famlies in Al Jouf area.

(13.04 percent; three species), seeds (43.48 percent; ten species) and fruits (8.70 percent; two species) were the portions of these species with the most alkaloids. With concern to the glycosides, the seeds had the most with eight plant species (34.78%), while roots represented 8.70% (two species), leaves represented three species (13.04%), fruits. Saponins, on the other hand, were present in the seeds of eight species representing 34.78%, and roots in three species with 13.04%. Tannins were present in the seeds of six species representing 26.09%, and roots in three species with 13.04%. Flavonoids were present in the seeds of nine species representing 39.13%. Resins were present in the seeds of eight species representing 34.78%.

Figure 10 shows the percent distribution of phytochemicals among screened medicinal plants. Alkaloids were the leading phytochemical among the screened ones. Alkaloids represented 95.65% in all plants. The glycosides followed with a percentage of 86.96%. Saponins exhibited the third rank among screened phytochemicals with a percent of 82.61%.

Tannins had the fourth rank with a percent of 73.91% followed by flavonoids which had a percent of 56.52%. Last one was the resins with a percent of 52.17%. This survey shows a tentative approximation of the presence of phytochemicals in the selected medicinal plants in the Al Jouf area.

Looking for these phytochemicals in different plant parts, Figure 11 shows the number of plants that have phytochemicals in their seeds. Alkaloids were present ten times in the roots of plants, while glycosides were present 8 times. Equally present was the saponins (8 times), and resins. Tannins were found six times, while flavonoids were found nine times.

Figure 12 shows the distribution of phytochemicals in the leaves of screened plants. Alkaloids were present ten times in the leaves of plants, while glycosides were present 8 times. Equally present was the saponins (8 times), and resins. Tannins were found five times, while flavonoids were found nine times.

Figure 13 shows the distribution of phytochemicals in the fruits of screened

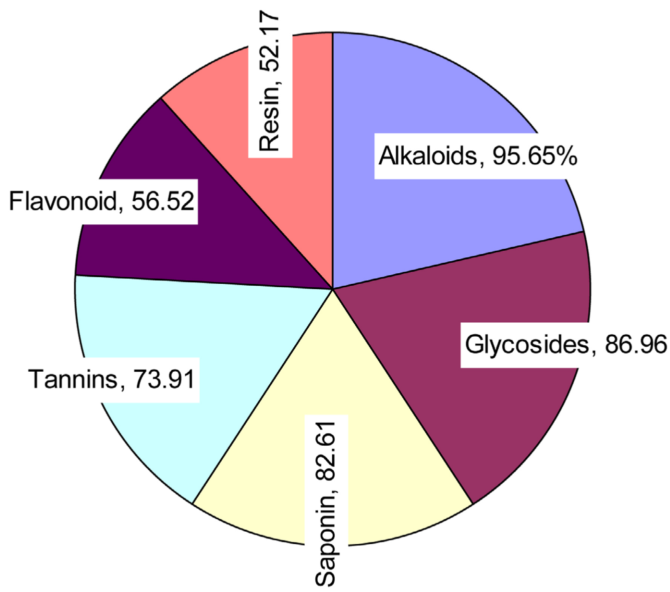

Figure 10. Percent distribution of phytochemicals among screened medicinal plants.

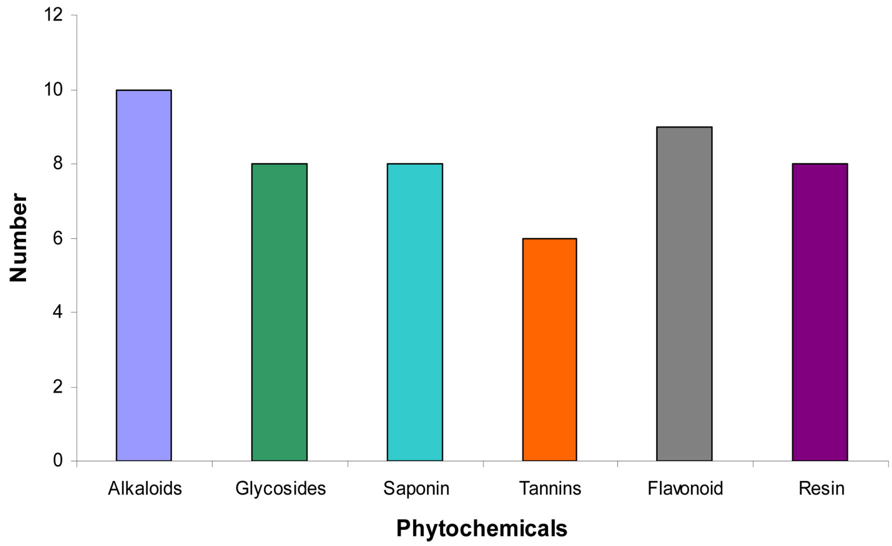

Figure 11. Phytochemicals in the seeds of screend medicinal plants.

plants. Alkaloids were present two times in the fruits of plants, and so did glycosides. Equally present was the saponins (1 times), and tannins. Flavonoids were found two times, while resins were present in the fruits of screened plants.

Figure 14 shows the distribution of phytochemicals in the roots of screened plants. Alkaloids were present two times in the roots of plants, and so did saponins and resins. Tannins were present three times, while flavonoids were present one time.

Figure 15 shows the distribution of phytochemicals in the rhizomes of screened plants. Alkaloids were present two times in the rhizomes of plants, and so did saponins and resins. Tannins were present three times, while flavonoids

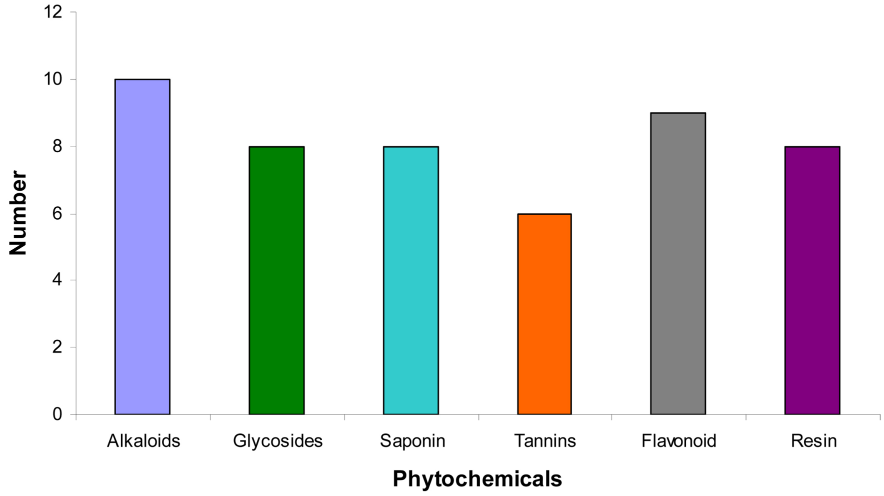

Figure 12. Phytochemicals in the Leaves of screend medicinal plants.

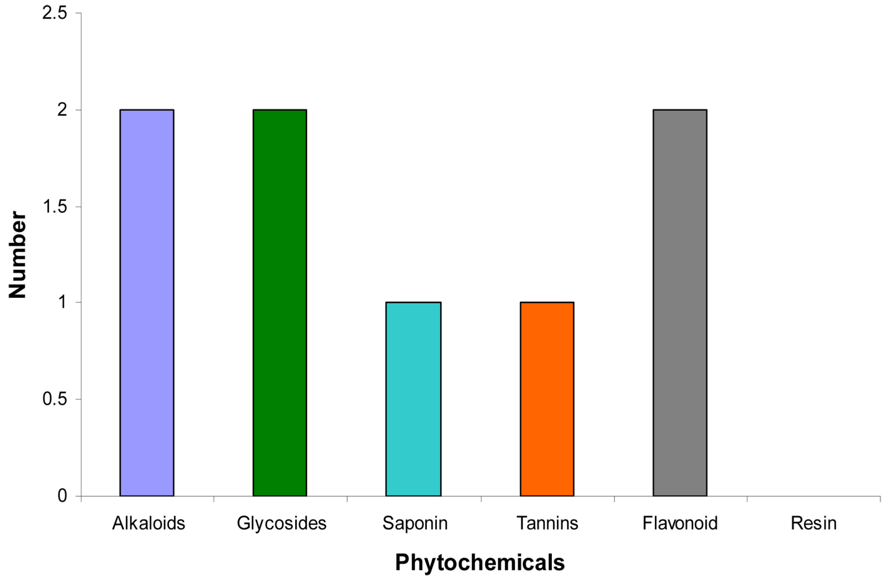

Figure 13. Phytochemicals in the Fruits of screend medicinal plants.

were present one time.

Figure 16 shows the distribution of phytochemicals in the plant families of the screened plants. The family Apiaceae showed alkaloids five times in different plants, and so did glycosides and flavonoids. Saponins were present four times were present four time, and so did resins. Tannins were the least found in Apiaceae (three times).

Family Fabaceae had alkaloids two times, and so did tannins and flavonoids. Glycosides, saponins, and resins were present three times each.

Family Lamiaceae showed alkaloids two times, and so were glycosides (Figure 13) and tannins. Saponins were present one time, so did flavonoids and resins.

Family Brassicaceae had alkaloids, glycosides, and tannins two times. Saponins, flavonoids, and resins were present only one time.

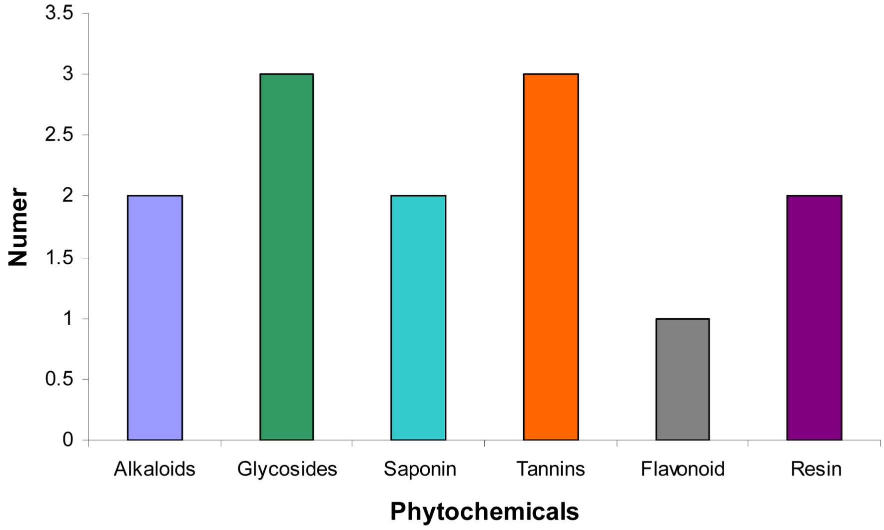

Figure 14. Phytochemicals in the Roots of screened medicinal plants.

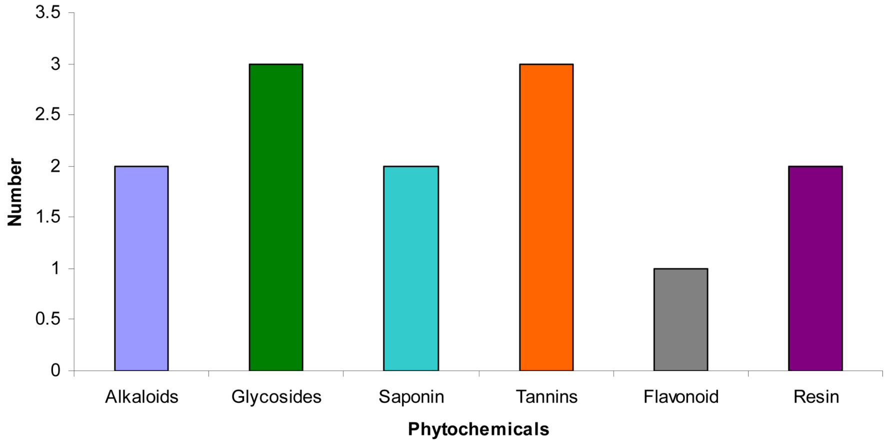

Figure 15. Phytochemicals in the Rihzomes of screened medicinal plants.

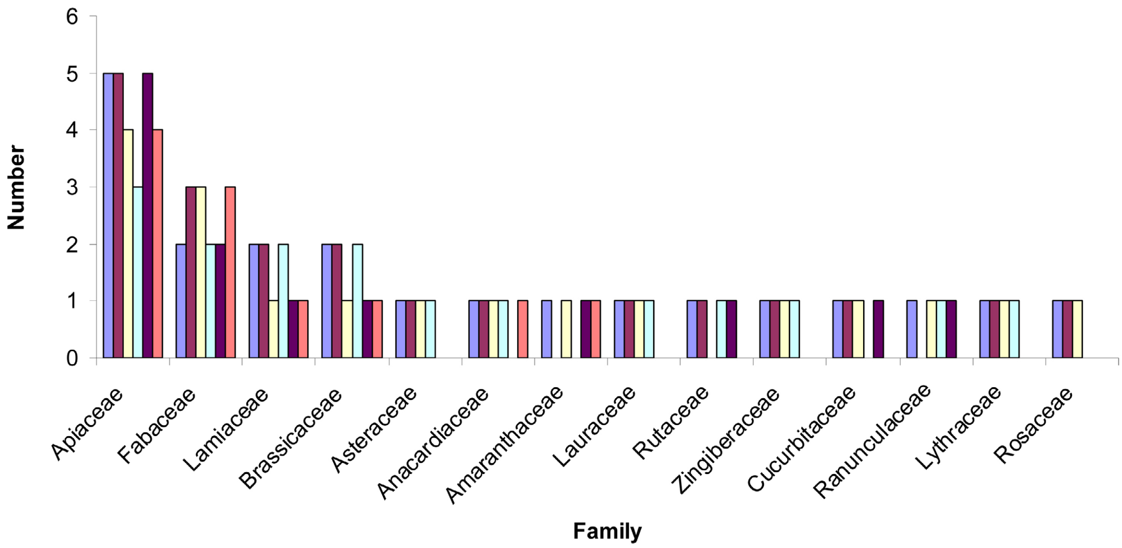

Figure 16. Phytochemical distribution on plant families.

Family Asteraceae had alkaloids, glycosides, saponins, and tannins only one time, while both falvonoids and resins were not found.

Family Anacardiaceae had alkaloids, glycosides, saponins, rseins, and tannins only one time. Falvonoids were not present.

Family Amaranthaceae showed alkaloids, saponins, flavonoids, and resins only one time. There were no glycosides, or tannins.

Lauraceae showed alkaloids, glycosides, saponins, and tannins only one time. There were no flavonoids or resins.

Family Rutaceae had alkaloids, glycosides, tannins and flavonoids only one time. The saponins and resins were not found.

Family Zingiberaceae had alkaloids, glycosides, saponins and tannins only one time. There were no flavonoids, or resins.

Family Cucurbitaceae had alkaloids, glycosides, saponins, and flavonoids only one time. There were no tannins, or resins.

Family Ranunculaceae had alkaloids, saponins, tannins, and flavonoids only one time. There were no glycosides, or resins.

Family Lythraceae had alkaloids, glycosides, saponins, and tannins only one time. There were no flavonoids, or resins.

Family Rosaceaehad alkaloids, glycosides, and saponins one time. There were no tannins, flavonoids, or resins.

4. Discussion

The most common chemicals found in the medicinal plants were glycosides. In this investigation, glycosides were found in every Apiaceae, Lamiaceae, Zingiberaceae, Fabaceae, and Asteraceae species. Glycosides are found in practically all medicinal plants and offer a wide range of therapeutic effects (Yadav *et al.*) [29], Alqahtani *et al.*) [41]. Glycosides have been demonstrated to have sedative and digesting actions in prior investigations (Galvano *et al.*) [42], anti-cancer (Zhou *et al.*) [43], (Hikal *et al.*) [44], (Al-Harbi *et al.*) [45], (Alhaithloul *et al.*) [46], (Ghazzawy *et al.*) [47], and cough suppressants (Kabera *et al.*) [48]. As a result, these may be the causes for the large number of reported uses in conventional therapy in Al Jouf for these families, which are considered the most widely used families (Alhaithloul *et al.*) [49]. Tannins were the second most prevalent chemical found in medicinal plants used in folk medicine in Al Jouf. Tannins have a lot of stifling effects. They aid in the healing of wounds and inflamed mucosal membranes. Plant extracts containing tannins are employed as astringents, diuretics, analgesic, antiseptic, and hemostatic medications, as well as against diarrhoea, stomach and duodenal cancers (Khanbabaee and van Ree) [50]. Medicinal plants utilized in popular medicine in Al Jouf contain alkaloids, saponins, and flavonoids. Alkaloids have a positive impact on the body. They're also recognized for their sedative qualities, which have a big impact on the neurological system (Renu) [51].

Saponins (**Figure 4**) are compounds found in plants that have been used for medicinal purposes. Saponin is found in many herbal medicines (Kareru *et al.*) [52], while because flavonoids have antioxidant properties, they may help to prevent heart disease and cancer. Resins were discovered in such therapeutic plants as well, but they were not as frequent. Many resins have antibacterial properties and aid in wound healing (Al-Harbi *et al.*) [53].

The phytochemical components of plants belonging to the same family are strikingly similar. Plants from the same family, on the other hand, have a diverse range of secondary metabolites. Plants were found to have secondary metabolites in various sections. When compared to other plant components, eaves and seeds have the highest concentration of secondary metabolites. Traditional medicine will make extensive use of plant components that contain a large number of secondary metabolites.

However, alkaloids (**Figure 5**) are important in medicine and various aspects of human life as diet elements, supplements, and medications. Alkaloids are also significant substances in organic synthesis for the development of novel semi-synthetic and synthetic drugs with potentially higher biological activity than their parent compounds (Patel *et al.*) [54].

Tannins (**Figure 3**) are naturally occurring water-soluble polyphenols found mostly in plant-based products, including food (Arafat *et al.*) [55], (Basuny *et al.*) [56]. Tannins are an important raw ingredient for green sectors that are committed to sustainability. As a result, they're mostly used in a variety of industries, including leather, feed, fisheries, and drinks (Chung *et al.*) [57].

In some circumstances, the glycosidic residue (**Figure 6**) is required for activity; in others, it only enhances pharmacokinetic characteristics (Ragab *et al.*) [58].

Saponins (**Figure 4**) are a type of bioorganic compound that is abundant in the plant kingdom. The backbone of contemporary medicine or pharmaceuticals is made up of naturally occurring chemicals. They are naturally occurring glycosides that have soap-like foaming properties and, as a result, generate foams when agitated in aqueous solutions (El Aziz *et al.*) [59].

Flavonoids (**Figure 8**) are crucial for human health because of their significant pharmacological actions, in addition to their importance in plants. The potential health advantages derived from the antiviral activity of *Illiciumverum* and *Zingiberofficinale* ethanolic extracts have sparked renewed interest in these molecules (Habeballa *et al.*) [60].

Many plants, notably coniferous trees, secrete resin (**Figure 7**), which is a hydrocarbon. It's prized for its chemical ingredients and applications, including as varnishes and adhesives, as well as a valuable source of raw materials for organic synthesis and incense and perfume. Amber is made from fossilized resins (Parimal *et al.*) [61]. Alhaithloul *et al.* [62] studied the dramatic biochemical and anatomical changes in eggplant due to infection with *Alternariasolani* causing early blight disease. Lo'ay *et al.* [63] studied the biochemical responses of grapes coated with an edible composite of Pectin, Polyphenylene Alcohol, and Salicylic Acid. Lo'ay *et al.* [64] found the useful chemical in fruit ripening uniformity and accelerate the Rutab stage by using ATP in dates during the shelf life. The Effects of a Gum Arabic with Salicylic Acid on Guava & Peach fruits El-Gioushy *et al.* [65] Mohamed *et al.* [66].

5. Conclusions

The findings of the current study show a wide diversity in secondary metabolite spread among the 23 medicinal plants used in traditional medicine in Al Jouf. Furthermore, the ethnomedicinal significance of such 23 plants can be attributed to their content of secondary metabolites.

In this manner, further investigations ought to be carried out quantitatively of phytochemicals in these 23 restorative plants utilized in conventional pharmaceutical in Al Jouf (e.g., assessing the phytochemicals having antioxidant effects). Phytochemical screening on ethnobotanical is a required investigation in this respect. Comprehensive inquiries about into conventional pharmaceutical which leads to the revelation of unused drugs are required.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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