

An Ethnobotanical Survey of Poisonous Medicinal Plants in the Shouf Biosphere Reserve, Lebanon

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ABSTRACT

Local communities of the Shouf Biosphere Reserve (SBR) have a long history of traditional use of medicinal plants. However, such use has sometimes been accompanied by toxicity symptoms. Therefore, this study aimed to document the ethnobotanical knowledge about the toxicity of medicinal plant species used by local people. Ethnobotanical information was collected during 2019-2021 using semi-structured questionnaires and personal interviews involving 133 local informants (68 women and 65 men with an average age of 58 years). The Frequency of Citation (FC) index was calculated from the data collected during the interviews, which allowed the generation of a list of poisonous plant species used to treat different diseases.

The toxicity of highly cited species was discussed according to phytochemical profiles reported in the literature. The findings resulted in a list of 31 plant species from 22 botanical families, with Asteraceae, Euphorbiaceae, and Solanaceae being the most dominant. The most toxic plant species were *Ecballium elaterium* (L.) A.Rich (FC 11%), *Sambucus ebulus* L., *Ricinus communis* L., and *Arum palaestinum* Boiss. (each of FC 10%). Herbs were the most dominant life form of the cited species. The most toxic parts were the leaves (22% of citations), followed by whole plants and seeds (each 17%), and fruits (11%). Oral ingestion and skin contact were the main routes of toxicity.

According to the published literature, toxicity can be primarily attributed to biochemical compounds, such as cucurbitacins, proteaceous glycoprotein, ricin, tropane alkaloids, atropine, cyanogenic glycosides, and pyrrolizidine alkaloids, among other compounds. This work highlights the importance of the traditional knowledge of poisonous plants used in folk medicine and the need for phytochemical and toxicological research. The development of regulatory measures on the use and trade of medicinal plants as well as raising awareness of practitioners and public are also deemed necessary.

Keywords

Ethnobotanical, Poisonous medicinal plants, Traditional knowledge, Shouf Biosphere Reserve, Lebanon.

Introduction

Wild plants provide a diversity of uses, which are directly and indirectly beneficial to humans and the environment. They contain many bioactive compounds that serve as rich sources of medicines, pharmaceuticals, agrochemicals, food additives, fragrances, and flavouring agents [1]. In addition, several plant species also

contain some toxic compounds that can adversely affect humans and animals and cause death in some instances. Such plants are referred to as poisonous plants [2,3] and can cause severe illnesses, be dangerous to human life, generate livestock losses, and ultimately have been the cause of economic stagnation ever since the beginning of ancient human civilisations [4]. However, it is not easy to define a poisonous plant precisely because many can also be used in traditional medicine and can be a source of many valuable substances [5]. The distinction between medicinal and toxicity properties is not always clear-cut, as specific doses of plant

remedies can be beneficial while an overdose might be poisonous [5]. Ingestion, inhalation, or dermal contact with toxic plants can lead to poisoning conditions [4]. Alkaloids, glycosides, tannins, oxalates, terpenes, and phenolics are the toxins of poisonous plants that feature specific structural and chemical properties [6,7].

Research on poisonous plants from different geographical regions has grown in recent years. Botanists and pharmacologists study toxic plants to recognise the symptoms of toxicity displayed by humans and cattle and to design specific therapeutic procedures accordingly [8-10]. In Jordan, Al-Qura'n listed 125 poisonous species from 56 plant families [11]. A similar research from the Qassim region of Saudi Arabia identified 42 species belonging to 39 genera and 23 families [12].

Situated in the Mediterranean Basin Hotspot, Lebanon has more than 2,600 different flora species [13], around 14% of which are known for their value in traditional medicine [14-17]. For example, *Berberis libanotica* Ehrenb, *Teucrium capitatum* L. and *Rheum*

ribes L. are used to treat diabetes, liver infections and hemorrhoid. For instance, berries of *B. libanotica* and the stems of *R. ribes* are also edible and traditionally believed to be rich with minerals, vitamins and phytochemicals [18].

Despite the popularity of Lebanese herbal products, wild medicinal plants' toxicity has been largely ignored scientifically. There is still a lack of information and inadequate documentation regarding the safety of herbal products and poisonous plant species, both native and exotic. Therefore, it is crucial to identify plant species that pose a risk to both humans and animals and to understand better how their beneficial, healing and poisonous properties coexist.

This study aimed to compile a comprehensive list of toxic plant species and associated traditional knowledge in the SBR. Findings will serve in future research to identify toxic active constituents and develop awareness programs and regulatory measures to prevent plant poisoning.

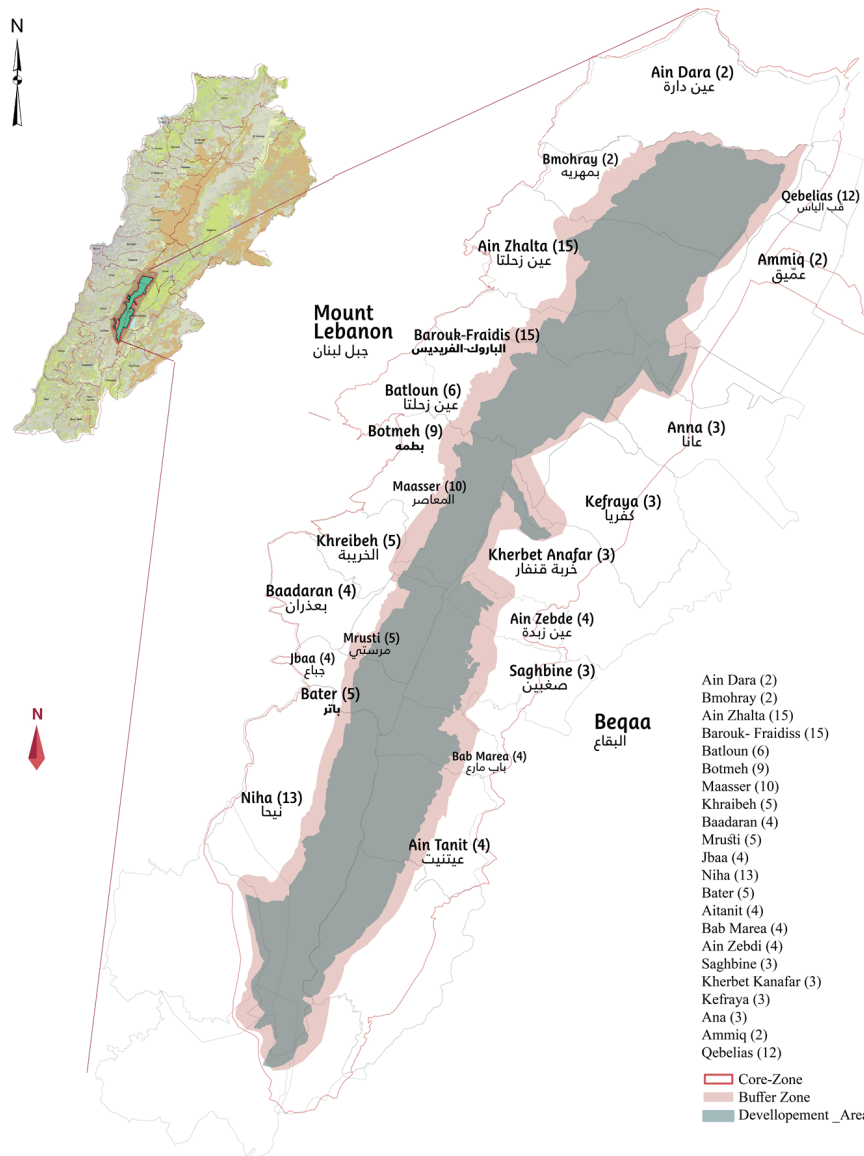


Figure 1: Map of the study area covering the Shouf Biosphere Reserve and showing the number of informants from each village.

Methods and materials

Study Area

The area of this study was the Shouf Biosphere Reserve (SBR), the largest nature reserve in Lebanon and one of the largest in the southern Mediterranean region (Figure 1). Located between 800 and 1950 m of altitude on Mount Lebanon, the SBR covers an area of 500 km² (50,000 hectares), approximately 5% of the Lebanese territory. It has a bioclimatic gradient similar to the Mediterranean climate, with a cold, wet, and snowy winter and warm to hot summer weather. The average annual rainfall is about 1200 mm. In addition to functioning as a multipurpose environment, the SBR is home to more than 1,000 wild plant species, many of which are still used in traditional medicine. The study was conducted as part of an ethnobotanical survey that covered 22 villages and towns of the SBR [16].

Data collection

The study occurred from 2019 to 2021 and was based on traditional ethnobotanical data collection through focus groups and one-on-one interviews with 133 knowledgeable informants and locals (68 women and 65 men and average age of 58 years old). Using the purposive selection technique [19], a random sample of informants (between 1 and 15) were chosen from each village based on their expertise in traditional herbal medicine and their knowledge of medicinal plants (Figure 1). The interviews were conducted using a semi-structured questionnaire asking about the vernacular names of plant species, the ailments and diseases they treated, and the potential toxicity of the cited plants as well as the toxic parts, route of toxicity and toxicity symptoms.

The data collection followed and respected the guidelines of the Convention on Biological Diversity [20] and the CBD Nagoya Protocol on Access and Benefit Sharing [21], as well as the International Society of Ethnobotany's Code of Ethics [22]. Before starting the study, the objectives, design, and methodology were approved by the SBR committee. Additionally, each informant gave their verbal agreement after thoroughly describing the study's goals.

To guarantee that the seasonal changes and the entire floral cycle were captured, the interviews with the informants were primarily performed during routine field walks, primarily during the flowering season. In restrictive circumstances, informants were instead shown fresh plant specimens and images. The cited species were photographed, and some interviews were recorded on a mobile phone or filmed on video by an experienced photographer. Immediately after being collected, pressed, and labelled in the field, voucher-fresh floristic specimens were placed in the SBR herbarium.

The New Flora of Lebanon and Syria's taxonomic keys were used for plant identification [13]. Botanical families and the new names of the species were checked on Plants of the World Online [23]. The International Plant Names Index's nomenclature was used for the species' ID [24]. Life forms of cited species were categorised using Raunkiaer's life form classification method [25].

The Frequency of Citation (FC) index was calculated as the number of use reports (times a particular species was mentioned)/(total number of times that all species are cited) × 100 (FC%) and was used as the quantitative index. The highly ranked poisonous species were discussed and validated in view of their chemical composition reported in the literature.

Results

A total of 133 informants from various demographic categories were interviewed about the toxicity of medicinal plants. They identified 31 poisonous plant species used as medicinal plants. These species are listed in Table 1, which comprises the botanical names of plants, families, IPNI, vernacular names, medicinal traditional uses, life forms, toxic parts and toxic symptoms. The cited poisonous plant species distributed over 22 botanical families, with 9 species of which belonged to Asteraceae, Euphorbiaceae, and Solanaceae.

Table 1: List of cited poisonous medicinal plant species, toxic parts, toxicity symptoms and other details.

No.	Botanical Name (Family) Speciman Number - IPNI ID*, New name if applicable**	Arabic/ English common names	Life forms ***	Therapeutic indications and way of administration****	Parts reported toxic	Toxicity symptoms	FC %
1	<i>Acanthus syriacus</i> Boiss. (Acanthaceae) SBR 001 - 44923-1 New name**: <i>Acanthus hirsutus</i> subsp. <i>syriacus</i> (Boiss.) Brummitt	Shawk al Jamal- Keff al dibb كف الدب - شوك الجمل Syrian acanthus	H	Otitis, Arthritis, Catarrhs, Skin emollient / I & E	Whole plant	Skin and eye irritant	2
2	<i>Amaranthus retroflexus</i> L. (Amaranthaceae) SBR 003 - 10698-2	Menia - Dillāq منية - دلاقي Redroot pigweed	H	Anemia, Laxative, Diuretic, Antioxidant, Jaundice, Menstruation, Bleeding, Diarrhea, Hoarseness, Hemorrhoids / I&E	Leaves	Renal failure, mortality for livestock	3
3	<i>Arum hygrophilum</i> Boiss. (Araceae) SBR 017 - 86037-1	Luf Akhdar لوف - سم الحبي Green arum	H	Diarrhea, Stomach-ache, Aphrodisiac, Fatigue, Antiseptic, Sore throat, Cancer, Cough, Asthma / I	Leaves, Seeds	Irritant for affected tissues	7
4	<i>Arum palaestinum</i> Boiss. (Araceae) SBR 018 - 86101-1	Samm el Haye, Louf filastini سم الحية - لوف فلسطيني Palestine arum	H	Purgative, Anthelmintic, Wound infections, Rheumatism, Prostate disease, Cancer / I	Leaves, Seeds	Irritant for affected tissues	8

5	Capparis spinosa var. canescens Coss. (Capparaceae) SBR 069 - 60443497-2	Kabbar sha'ik كبار شانك Spiny caper	S	Diuretic, Anthelmintic, Skin tonic, Cramp, Toothache, Arthritis, Rheumatism, Back pain, Rheumatism, Diabetes, Liver diseases, Abdominal pains Fever, Emmenagogue, aphrodisiac, Skin tonic / I&E	Fruits, Flower buds, Seeds	Large quantities can cause weakness, abdominal pain, salivation, and diarrhea	6
6	Chrozophora tinctoria (L.) A. Juss. (Euphorbiaceae) SBR 088 - 340969-1	Ghbayri, Obbad al-shams el-nili غبيري، عباد الشمس النيلي Turnsole	H	Kidney stones, Tranquilizer, Cancer, Infection diseases Warts, Fever, Cathartic, Emetic, Cough / I	Whole plant	Lethargy and mortality	2
7	Cyclamen persicum Mill. (Primulaceae) SBR 148 - 700765-1	Douaik el-Jabal, Sakawka دويك الجبل Persian cyclamen	H	Diarrhea, Cough, Headache, Hemorrhoids, Skin ulcers, Rhinosinusitis, Nervous emotion states, Menstrual disorders, Anticancer, Purgative / I&E	Leaves, Fresh bulbs	Stomach pain, nausea, vomiting, and diarrhea	7
8	Cynoglossum creticum Mill. (Boraginaceae) SBR 062 - 115089-1	Lissan el Kaleb el-azraq نسان الكلب الأزرق Cretan hound's tongue	H	Warts / E	Leaves	Skin irritation and death for livestock	2
9	Datura stramonium L. (Solanaceae) SBR 173 - 314738-2	Datoura داتورة Common thorn apple	H	Toothache, Rheumatism, Asthma, Wounds, Spasms, Cough, Sedative, Aphrodisiac, Gonorrhea, Dyspepsia, Headaches, Aching eyes, Backache / E	Wholes plant especially the foliage and seeds	Respiratory failure and cardiovascular collapse, impaired short-term memory, disorientation, confusion, hallucinations	5
10	Ecballium elaterium (L.) A.Rich (Cucurbitaceae) SBR 082- 292573-1	Khiar el himar, Qitha'a al- himar خير الحمار او قثاء الحمار Squirting cucumber	H	Sinusitis, Jaundice, Asthma, Hemorrhoids, Ear infection, Rheumatism, Violent purgative, Diuretic, Emetic, Lever, Eczema / I&E	Juice (fruit)	Dry mouth, blurred vision, tachycardia, and constipation.	11
11	Eupatorium cannabinum L. var indivisum DC. (Asteraceae) SBR 027 - 205581-1	Ghabithiat Ibn Sina غافثية ابن سينا Common hemp-agrimony	H	Laxative, Stomach-ache, Common cold, Fever, Sore, Arthritis, Malaria, Pneumonia, Fever, Expectorant, Stimulant, Influenza, Feverish chills, Liver disorders, Spleen, Gallstones / I	Aerial parts	Tremor, delirium, liver damage, and death	6
12	Euphorbia helioscopia L. (Euphorbiaceae) SBR 089 - 346754-1	Halabloub حلبلوب Sun spurge	H	Laxative, Purgative, Warts, Constipation, Abdominal, Plaster skin diseases / E	Latex, Seeds	Digestive disturbances, breathing difficulties, and heart failure	7
13	Foeniculum vulgare subsp. piperitum (Ucria) Bég (Apiaceae) SBR 016 - 842680-1 New name: Foeniculum piperitum (Ucria) C.Presl	Shoumar mabthoul شومر ميثول Common fennel	H	Antitumoral, Diuretic, Cholesterol, Constipation, Urinary disorder, Mouth sores, Dysuria, Carminative, Galactagogue, Gastrointestinal disorders, Respiratory disorders, Hypertension / I	Seeds	Dizziness, hypotension, facial pills	6
14	Hedera helix L. (Araliaceae) SBR 019 - 90723-1	Habl el-Maskin , Leblab lawlabi لبلب لولبي - حبل المسكين Common ivy	H	Anti-cellulite, Wounds, Warts, Respiratory diseases, Chronic bronchitis, Inflammatory, Semulcent, Cardiac diseases, Vermifuge / I &E	Leaves	Diarrhoea, vomiting and allergy	5
15	Hyoscyamus aureus L. (Solanaceae) SBR 174 - 815891-1	Banej dhahabi, Soukran بنج ذهبي - سوكران Golden henbane	H	Toothache, Sedative, Fever, Soporific, Stomach and colon ulcers, Neural and Rheumatic pains, Cancer / E	Whole plant	Hallucinations, delirium, depression, impaired vision, convulsions and death	8
16	Hyoscyamus reticulatus L. (Solanaceae) SBR 175 - 815948-1	Banej shabaki el-zaher بنج شبكي الزهر Netted henbane	H	Skin disorders / E	Whole plant	Nausea, respiratory depression and consciousness	6
17	Hypericum triquetrifolium Turra (Hypericaceae) SBR 109 - 433931-1	Braighiti, Dathy Mouthalath el- Warak دادي مثلث الورق - بريغيتي Curled-leaved St John's-wort	H	Blood purification, Duretic, Diarrhea, Cystitis, Hepatitis, Rheumatism, Diuretic, Tonsillitis, Anxiolytic, Antidepressant / I	Aerial parts	Skin irritation	3
18	Inula graveolens (L.) Desf. (Asteraceae) SBR 042 - 201892-1 New name: Dittrichia graveolens (L.) Greuter	Tayoun albak طيون البق Heavy-scented inula, Stinkwort	H	Wounds, Toothache, Skin infection, Rheumatism, Anti tumor, Anti infection Anthelmintic, Stomach ulcer, Diabetes, Bronchitis / E	Aerial parts	Abortion, sterility, irritants, and allergic dermatitis.	5

19	<i>Lonicera etrusca</i> San. (Caprifoliaceae) SBR 070 - 148750-1	Soltan el-Jabal سلطان الجبل Etruscan honeysuckle	H	Diuretic and urinary disorders, Inflammatory, Cough healer, Common cold, Flu, Fever, Hemostatic, Boils and sores inflammations / I	Berries	CNS effect and musculotropic depressants	4
20	<i>Papaver rhoeas</i> L. (Papaveraceae) SBR 134 - 306058-2	Chekayk شقيق Corn poppy	H	Soporific for babies, Cardiac affections, Pectoral emollient, Calmative, Slightly narcotic, Expectorant, Flu, Sedative to soothe coughs / I	Fruits, Flowers	Neurological disorders or liver damage, vomiting, nausea, fatigue, and exhaustion	6
21	<i>Prunus ursina</i> Kotschy (Rosaceae) SBR 154 - 730386-1 New name: <i>Prunus cocomilia</i> Ten.	Khawkh al-bubb خوخ الدب، البرقوق Bear plum	T	Diarrhea, Skin diseases, Liver cirrhosis, Diuretic, Arteriosclerosis / I	Seeds, Young shoots	Diarrhea, skin diseases, liver cirrhosis, and diuretic	7
22	<i>Pteridium aquilinum</i> (L.) Kuhn (Pteridaceae) SBR 150 - 17210060-1	Dishar دشار (سرخس بري) Eagle fern	H	Bruises, Sores, Antiemetic, Tonic, Rheumatism, Stomach-ache, Chest pain, Internal bleeding, Diarrhea, Common cold, Diuretic, Vermifuge, Cancer / I&E	Young shoots and fronds	Livestock hazardous and causing blindness for the sheep	7
23	<i>Rhus coriaria</i> L. (Anacardraceae) SBR 009 - 70477-1	Summaq el-Dabaghin سماق Tanner's sumac	S	Edema, Gingivitis, Tooth pain, Diarrhea, Gastrointestinal disorders, Diabetes, Hemostatic / I&E	Dry fruits (powder)	Stomach pain, nausea and vomiting (big dose)	5
24	<i>Ricinus communis</i> L. (Euphorbiaceae) SBR 091 - 355498-1	Kharrou'a shaii'a خروع شائع Common Palma-Christi	S	Wounds, Burns, Skin problems, Hair health, Acne, Constipation, Brown spots, Emmenagogue, Diarrhea / I&E	Seeds	Weakness, diarrhea, dehydration, dilation of pupils, depression, tachycardia, dyspnea, and colic	10
25	<i>Ruscus aculeatus</i> L. (Asparagaceae) SBR 022 - 540443-1	Sorm el Deek صرم الديك Knee-holly, Butcher's Broom	H	Diuretic, Cough, Kidney stones and sandstones, Hemorrhoids, Swelling, Hypotension, Gallstone, Improve blood circulation, Swelling, Vertigo, Obesity / I	Roots	Convulsions, paralysis, and diarrhea	6
26	<i>Sambucus ebulus</i> L. (Caprifoliaceae) SBR 072 - 149315-1	Dandamoun, Beylassan barri بيلسان بري Dwarf elder	H	Purgative, Rheumatism, Rheumatism, Wounds, Insect stings, Burns, Hemorrhoids, Stomach-ache, Asthma, Antirheumatic, Purgative, Flu, Diuretic, Purgative / I&E	Berries, Flowers	Nausea, vomiting, abdominal cramps, diarrhea, and weakness	10
27	<i>Spartium junceum</i> L. (Fabaceae) SBR 098 - 519057-1	Wazal asali, Lesan el-asfour وزال Spanish broom	H	Palpitation, Duretic, Respiratory system, Purgative, Diabetes, Skin diseases, Burns, Warts / I&E	Whole plant	Abdominal pain, nausea, vomiting, and seizures	9
28	<i>Teucrium scordium</i> L. (Lamiaceae) SBR 123 - 460713-1	Shkardioun, Thoum el-Hayi شقرديون - الحية ثوم Water germander	H	Asthma, Diarrhea, Fever, Intestinal parasites, Hemorrhoids, Wounds, Cystitis / I&E	Leaves	Liver damage	7
29	<i>Tussilago farfara</i> L. (Asteraceae) SBR 055 - 256904-1	Hashishat el-soa'al حشيشة السعال Coltsfoot	H	Expectorant, Tonic, Emollient, Respiratory infections, Sore throats, Flu, Fever, Asthma, Swelling, Sedative, Joint pain / I&E	Leaves (smoking)	Respiratpry system	5
30	<i>Urtica dioica</i> L. (Urticaceae) SBR 180 - 260630-2	Qurrays Kabear قرويص كبير Great nettle	H	Antidiabetic/ I	Aerial parts	Allergic rash, stomachache, skin irritation	8
31	<i>Urtica urens</i> L. (Urticaceae) SBR 181 - 857987-1	Qurrays قرويص Small nettle	H	Cancer, Blood Purification, Eczema, Hair loss, Skin diseases, Wounds, Ulcers, Prostate, Poisoning, Tonic, Rheumatism, Diarrhea, Aphrodisiac, Hemorrhoids, Nose bleeding / I	Leaves	Urtication	7

* IPNI ID The International Plant Names Index, ** New name: according to Plants of the World Online (POWO) *** Herb (H), Climber (C), Shrub (S), Tree (T), **** Internal(I) and External (E)

According to the FC% values indicated in Table 1 *Pteridium aquilinum* (L.) Kuhn, *Teucrium scordium* L., *Urtica urens* L., *Hyoscyamus aureus* L., *Urtica dioica* L., *Spartium junceum* L., *Arum palaestinum* Boiss., *Ricinus communis* L., *Sambucus ebulus* L., and *Ecballium elaterium* (L.), recorded the ten highest FC between 7% and 11% (Figure 2).

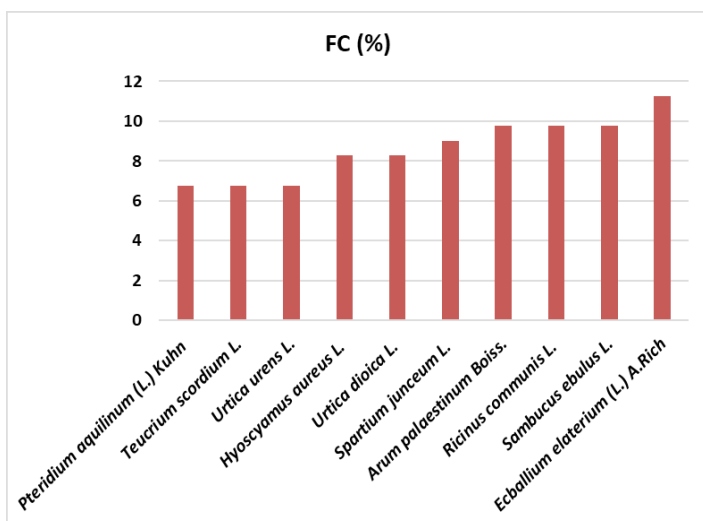


Figure 2: Ten toxic species with the highest Frequency of Citation (FC).



Figure 3: Morphological characterization of some important toxic species of SBR: *R. communis* (1), *E. elaterium* (2), *A. palaestinum* (3), *P. cocomilia* (4), *D. stramonium*. (5), *S. ebulus* (6), *E. cannabium* (7), *T. farfara* (8).

Among the plants collected, herbs were the most common, representing 87% of total species, followed by shrubs (10%) and trees (3%).

Toxicity was cited in plants as a whole or restricted to certain parts (Figure 5). While the leaves ranked as the most toxic parts (22%), the whole plant, aerial parts and seeds were ranked equally second (17%), fruits came third (11%), and other parts collectively represented (50 %). Nevertheless, some of the cited plants were indicated to have more than one toxic part. For example, both leaves and seeds of *A. palaestinum* were reported to cause skin irritation, whereas the leaves of *U. dioica* and seeds of *R. communis* were the only toxic parts. Also, all parts of the *C. spinosa* and *D. stramonium* were reported as toxic.

According to the informants, the cited plants were used to treat a wide range of diseases, and toxicity occurred when the dose was higher than required. The main conditions treated were gastrointestinal, cardiovascular, renal, central nervous, and genital systems, diabetes, rheumatism, skin symptoms and inflammation. In parallel, skin irritation, dermatitis, abdominal disturbances, diarrhoea, dilation of pupils, blurred vision, blindness, depression, convulsions, neurological symptoms, inflammation, coagulation of blood, tachycardia, dyspnea, colic, and abortifacient effects were the cited toxic symptoms.

While the main routes of toxicity were via oral ingestion by accidents or overdosing reported in 60 % total citations (n= 266) and direct skin contact in 20% of citations (N=88), drops (eye, ear, nostril), inhalation and enemas collectively represented the remaining share of citations (20%, n=88). Using combinations of species and additives in herbal remedies was indicated by some informants (n= 3) as a mechanism for masking toxicity.

Informants reported that plant poisoning occurred more often accidentally or as a result of a mistake between species or even overdosing.

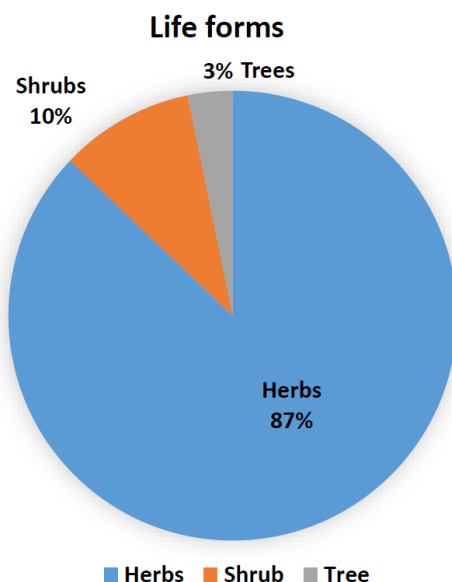


Figure 4: Life forms of the toxic plant species according to informants.

Parts reported toxic

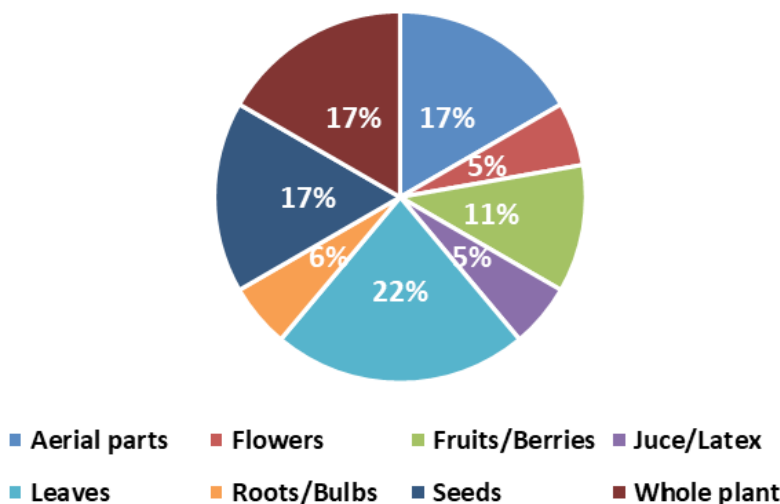


Figure 5: Plant parts reported toxic by informants.

Discussion

The present study is the first report on poisonous plants used in traditional medicine in Lebanon. The data were gathered during a field ethnobotanical survey. The high FC % values of *E. elaterium*, *A. palaestinum*, *R. communis*, and *S. ebulus* indicate the high toxicity levels, and all informants agreed on the toxicity of these species. Differences in the toxicity claims among informants can be linked to the level of toxicants in the plant parts consumed, route of exposure, dosage, and overall susceptibility of individuals to toxicants [4].

In addition, botanical families represent an important classification of the different plant species to determine potential toxicity. Findings indicate that Asteraceae, Euphorbiaceae, and Solanaceae were the most important families containing toxic plant species. This is in line with previous studies reporting high representation of toxic members of these families, attributed their high contents of alkaloids, glycosides, saponins, teroids, and other cyanogenic glucosides and glucosinolates [26-28].

Despite its relative high toxicity (FC 11%), *Ecbalium elaterium* (Cucurbitaceae) known as Squirtng Cucumber in the Mediterranean region and Khar el Himar in Lebanon is reported as highly popular for the treatment of sinusitis, jaundice, asthma, haemorrhoids, ear infection, rheumatism, violent purgative, diuretic, emetic, liver, and eczema [16]. The lobed, greyish-green leaves and bristly stems have a downy underside and a rough upper surface. The flowers are around 5 cm in diameter, pale yellow, and feature the classic cucumber funnel shape. While fruit-producing female flowers are solitary, male flowers are formed in racemes (Figure 3). The 5 cm long, fleshy, ovoid, bristly fruits explode to release and disperse the seed several meters away when they are mature. *E. elaterium* includes cucurbitacins, a class of oxidised tetracyclic triterpenoids, known to be highly toxic [29]. One of the most frequent reported toxicity symptoms of the plant is uvular oedema, which can cause hypoxemia and be fatal [30]. Thus, the toxicity of this plant species should never be underestimated.

Ricinus communis, commonly known as castor oil plant or Common palma-christi, and in Arabic as Kharrou'a, belongs to the Euphorbiaceae family. This species is a fast-growing, suckering perennial shrub which can reach five meters tall. The glossy leaves are 15-45 cm long, long-stalked. The flowers are borne in terminal panicle-like inflorescences of red monoecious flowers without petals. The fruit is a spiny, greenish (to reddish-purple) capsule containing large, oval, shiny, bean-like (Figure 3). It is indigenous to the southeastern Mediterranean Basin, Eastern Africa, and India but is widespread throughout tropical regions and is widely used as an ornamental plant.

The relatively high toxicity in *R. communis* (FC 10%) (Figure 3) can be due to the presence of proteaceous glycoprotein and ricin, which affect the haemoglobin level and have a deleterious impact on cardiac fibres [11]. Ricin is an enzyme that prevents ribosomal activity, which stops protein synthesis and causes cellular death by consuming the plant's seeds orally. If untreated, it can cause dehydration, shock, respiratory failure, burning sensations in the mouth and throat, severe abdominal pain, bloody diarrhoea within 36 hours and death within 3-5 days [31]. *R. communis* is classified among the most poisonous plant on earth for humans and animals [32]. Animals show varying toxicity levels, with horses being the most sensitive and chickens being the most resistant [33]. Intoxication causes symptoms similar to humans, including weakness, watery diarrhoea, dehydration, dilation of pupils, depression, tachycardia, dyspnea, and colic [34].

Similarly, the reported *Datura stramonium* (Solanaceae), often called Devil's Trumpet or Common Thorn Apple, is an erect annual herb that grows into a 1- to 1.5-meter-tall shrub. The leaves are serrated, undulating wildly, and velvety. The trumpet-shaped, fragrant flowers range in colour from white to creamy to violet and are 6.5 to 9 cm long. They rarely fully open. The egg-shaped seed capsule is the size of a walnut and is either bald or covered in spines. When fully grown, it divides into four chambers, each containing many tiny black seeds (Figure 3). The toxicity of *D. stramonium*

may be attributed to its dangerous levels of the tropane alkaloids atropine, hyoscyamine, and scopolamine atropine in all parts of the plants. These compounds are recognised to severely affect the central nervous system at relatively small dosages [35,36]. Children are substantially more affected by atropine poisoning than adults. Symptoms of neurological disorders include ataxia, impaired short-term memory, disorientation, confusion, hallucinations (visual and auditory), psychosis, agitated delirium, seizures, and coma. Other symptoms include cardiovascular collapse, respiratory failure, dry skin and mucosa, flushing, mydriasis, sinus tachycardia, hyperpyrexia, and urinary retention [37].

Arum palaestinum (Araceae) is a perennial herbaceous plant native to the Levant and the surrounding areas of the Mediterranean Basin. It can reach a height of 25 cm. It can be identified by its springtime blooming reddish-brown spathe and dark, purplish-black spadix. The plant grows from the tuber throughout the fall to produce an attractive clump of foliage for pollinators that remains up during the winter. Because of the toxicity of its dark green fruit and trowel-shaped foliage, this plant is known locally as Sam el-Hayi (Palestine arum). At maturity, its berry-like fruits turn bright red (Figure 3). The leaves *A. palaestinum* is edible after cooking. The informants described its toxic low symptoms as erythema, mouth agitation, drooling, and irritation (Table 1).

Similarly, and with moderate FC (5%), the toxicity of *Tussilago farfara* (Asteraceae), traditionally used in treating primarily respiratory system infections, may be associated with its content of pyrrolizidine alkaloids [38].

Also, *Prunus cocomilia* (Rosaceae) with FC of 7%, which is a commonly well-known tree species in the SBR, its Arabic vernacular name is Barakrouk or Khawkh el Dib, its flowers, fruits, and seeds used locally to treat diarrhoea, skin diseases, liver cirrhosis, diuretic, and arteriosclerosis, from the fruits some local women make a very delicious jam. The plant's toxicity can be associated with its content of cyanogenic glycosides such as amygdalin and prunasin [38]. Its seeds and young shoots at high doses can be toxic. Likewise, the toxicity of *Eupatorium cannabinum* (Asteraceae) can be attributed to its high levels of hepatotoxic pyrrolizidine alkaloids, which can impede blood flow in veins and cause liver damage, cancer, breathing problems and death [39,40].

The literature contains numerous incidents involving the toxicity and safety implications of herbal remedies linked to various toxins. In addition, the high level of external contaminants, such as traces of metals, may also be among the drivers of toxicity of wild plants. Therefore, collectors, practitioners and consumers should be advised to wash these herbs before use [41].

Leaves being reported as the most toxic plant parts, is consistent with the findings of other studies from different regions [27]. The reason behind this is that leaves are physiologically most active in plants and are recognised to have a high content of bioactive constituents [42]. Also, leaves are readily collected compared to seeds and fruits [16].

The current study revealed the cited poisonous plants caused various important categories of symptoms. Dermatological and gastrointestinal problems were reported as the most frequent and acute symptoms. If they are not diagnosed and treated promptly, such symptoms might lead to severe health conditions and even death. Plants with a high value of FC, such as *E. elatorium*, and *R. communis*, have been reported to cause dermatitis and affect the gastrointestinal tract in some other studies [33,43].

The higher score of the internal route (70%) primarily by accidental intoxications agrees with many previous studies from other regions [27,42]. Notably, the cited plants serve other purposes, such as food, bee forage, and pest control, raising the need for a very high level of caution when dealing with these plants. Therefore, knowledge of these plants is critical in practising traditional medicine and avoiding poisoning incidents [44]. This is especially relevant given the increasing inclination of communities to turn to herbal therapy in the face of the country's current economic challenges and limited healthcare services. Previous research has found that herbal treatments might cause serious side effects, even death in some situations [45].

Herbal therapies, not only new synthetic drugs, must meet worldwide quality, safety, and efficacy criteria [46]. Also, there is a need to produce standardised conventional treatment guidelines for medicinal plants, considering that natural products are not always safe. The WHO regulations on medicinal plants [47] may be an excellent starting point for such policies and regulations. Also, research on the safety and efficacy of herbs is required to assess effectiveness and whether a cause-and-effect relationship between therapeutic and health outcomes and treatment exists [48].

Finally, the findings of this study confirm the need for phytochemical and pharmacological research to understand the poisonous properties of plants used in traditional medicine and the means to counteract with antidotes and other emergency medical procedures. Regulating the use of herbal medicines to the prescribed doses and raising awareness about plant toxicity among practitioners and public are recommended.

Conclusion

This ethnobotanical study presents the first inventory of toxic plants used in traditional medicine in SBR and Lebanon. The findings provide important knowledge and recommendations for safeguarding against the potential risks of using these species and preventing related poisoning outbreaks in humans and animals. The study supports the need for adopting policies and regulations that direct traditional medical care as well as raising public awareness of the possible toxicity of medicinal herbs. It is important to conduct phytochemical and toxicological research on toxicity doses, active principles, and their mode of action.

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