

Ethnobotanical Study and Distribution of the *Solanum* Section *Solanum* Species (Solanaceae) in Iran

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Abstract

Background: *Solanum* section *Solanum* has been extensively used in traditional medicine in Iran for many ailment treatments. The plant contains some substances such as total alkaloid, steroid alkaloid, steroidal saponins and glycoprotein, exhibiting anti-tumor activity.

Objective: In this research, wild species of *Solanum* section *Solanum* has been studied in Iran in the field of ethnobotanical investigation such as interviews, questionnaires, scientific articles, authentic books and ancient documents in traditional medicine. The anthropological uses of the plant have also been taken into consideration.

Method: The wild species of these plants in Iran were studied using field and library methods. In the first method, to determine the distribution of *Solanum* and its related plants, numerous trips were carried out and many samples were collected. The anthropological use of these plants has been examined through interviews and questionnaires from 39 local people. In the second method, traditional Iranian books and published articles on the subject were also studied.

Results: According to this survey, these plants are commonly used for food digestion and constipation in traditional as well as current local medicine. In addition, we identified 180 different growing locations in Iran to illustrate their distribution maps.

Conclusion: These plants are being used as fever-reducing agent, pain-reliever, softener, laxative, diarrhea, anticoagulant and anti-asthma. Some outstanding results are obtained in the treatments of analgesic and sedative, anemia, burns, carminative, constipation, cough, cut restoration, food digestion, infections, mouth disinfection, skin diseases, toothache etc.

Keywords: *Solanum nigrum*, *S. villosum*, Black nightshade, Red nightshade, Solanaceae, Yellow nightshade

Introduction

Ethnobotany is a type of scientific study in the field of botany and pharmacology that seeks to review, record, introduce and document information about the traditional usage of medicinal plants by indigenous people and ethnic groups in traditional, rural and nomadic areas around the world. Many plants in different villages and areas of Iran have different pharmaceutical uses that are not considered in many books of medicinal herbs and scientific papers. These plants which are very effective in their use are known only by experienced people, which have drug use in rural areas of the country.

Till now, information about the traditional uses of these plants has been transferred from one generation to other. Despite the expansion of modernity, this information is unfortunately disappearing. Therefore, ethnobotanical study helps documenting information before being completely disappeared.

Iran, is very diverse in terms of climate, and has over 8,000 native species out of which 20% are endemics. The collection of these plants has led to the establishment of a large number of plant species in different parts of Iran, each of which has different medicinal and traditional uses among different ethnic groups [1].

The genus *Solanum* is one of the large genera of flowering plants in the world, containing about 1500–2000 species. This genus is the largest among Solanaceae family and one of the top 10 genera of the world's plants in terms of species number [2].

Solanum is derived from the Latin name solamen which means calming. This name refers to the medicinal effects of most herbs [3].

Different *Solanum* species are found in temperate and tropical climates at high temperatures with high morphological variation. The genus is considered to have one of the most important economic taxa in the world including some cultivated species in agriculture such as potato (*S. tuberosum* L.), tomato (*S. lycopersicum* L.), eggplant (*S. melongena* L.), and many more species used as food besides those which are fatal due to the presence of toxic substances and secondary compounds present in different pharmaceutical substances and also their consumption in pharmaceutical industries.

The section *Solunum*, typified by the black nightshade (*Solunum nigrum* L.) is one of the largest, most variable/widespread species of the genus *Solanum* L. Species belonging to this section are distributed in temperate to tropical regions of the world from sea-level to over 3000 m altitude. Their most important characterizations are as follows:

Unarmed herbs, sometimes suffrutescent, occasionally shrubs or epiphytes. Stems terete or angled, the angles with smooth or dentate ridges. Inflorescences 2–36 flowered, cymose, pedunculate; cymes umbellate to helicoid. Flower pentamerous; calyx campanulate-stellate, with broadly triangular to ovate-lanceolate lobes; corolla <20 mm diameter, white to purple, often with a conspicuous basal star, stellate to rotate, the petals recurved; fruit succulent, 1–2 ocular, many-seeded, globose to ovoid, black, brown, red, orange, yellow or green berry, with or without sclerotic granules [4].

Solunum nigrum is native to Eurasia and introduced in the Americas, Australia, Asia and South Africa. Parts of this plant can be highly

toxic to livestock and humans, and is also considered as an invasive weed. Nevertheless, ripe berries and cooked leaves are used as food in some locales; and plant parts are used as a traditional medicine [5]. Phytochemical investigation of whole plant reports that, it contains alkaloids, flavonoids, tannins, saponins, glycosides, proteins, carbohydrates, coumarins & phytosterols. According to some investigations, *Solanum nigrum* and its related species also utilized as traditional remedy for ulcer, hepatotoxicity and cancer, employs various immunological applications in cancer and others. These plants are beneficial in preventing liver toxicity & cytotoxicity thus, improving functions of liver and kidney also finds immense utility in abdominal problems, body pain, and central nervous system and brain functioning. Taking great concern of the useful benefits of the plants, they can be subscribed as a safe, highly important, medicinal plant for general mankind [6].

Recent studies show four new steroidal glycosides; alkaloids, solamargine, solasonine, α and β solanigrinechez isolated by berries of *S. nigrum*. Chemical analysis of the methanol extract of root and stem shows a steroidal genin saturated identified as tigogenin (glycoside and two spirosestanol furostanol glycosides) by mixed melting point and IR spectroscopy [7]. Among new compounds recently experienced; solanigrins-CH and degalactotigonin two steroidal saponins (called Nigrumins I and II), two new disaccharides (BDthevetopyranosyl ethyl-(1-4)-BD-oleandropyranoside and BDthevetopyranosyl ethyl-(1-4)- α -Doleand-ropyranoside) identified by spectroscopic methods [8]. The seeds of

S. nigrum have a high fat content and are considered as an important source of linoleic acid [9] which contains solanine, protein, oleic acid, palmitic acid, stearic acid and sitosterol. All parts and immature green contain steroidal glycosides as glycoalkaloids [10]. They are widely considered defensive allelochemicals of plants against pathogens and predators. In economic terms, they are used in place of steroid sapogenin diosgenin as raw material for the industrial production of corticosteroids. The main steroid alkaloids are solanine and solasonine [11–17].

So far, in Flora Iranica [18] and [19], five species have been reported and accepted from section *Solanum* in Iran, namely, *S. nigrum*, *S. olgae*, *S. luteum*, *S. alatum* and *S. carmanicum*. According to recent systematic studies in the world, *S. olgae*, *S. luteum*, *S. alatum* and *S. carmanicum* have been considered as synonyms of *S. villosum* that has yellow, orange or red fruits while in *S. nigrum* only black fruits are seen [20–21]. It should be noted that, *S. carmanicum* both reported in Flora Iranica as a type species of Iran but in Flora of Iran [19] it was synonym with *S. alatum*. The senior author is also currently studying the biosystematic and molecular biology of this genus in Iran to distinguish their species and the results will be published later. The fruit of this plant is green in the beginning and turns color when get ripens. In Iran, it is locally called “Taaj-rizi” or “Sag-angour” but in ancient books of traditional medicine, it has been named as “fox tail” or “fox grape”. (Fig. 1). This plant is distributed in almost all regions of the country and in most cases grows as weed in farms and gardens (Map 1).

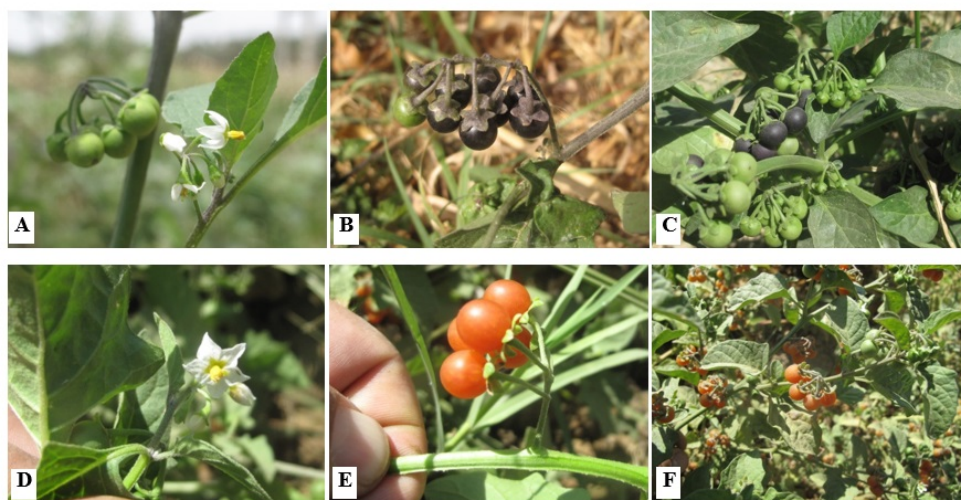
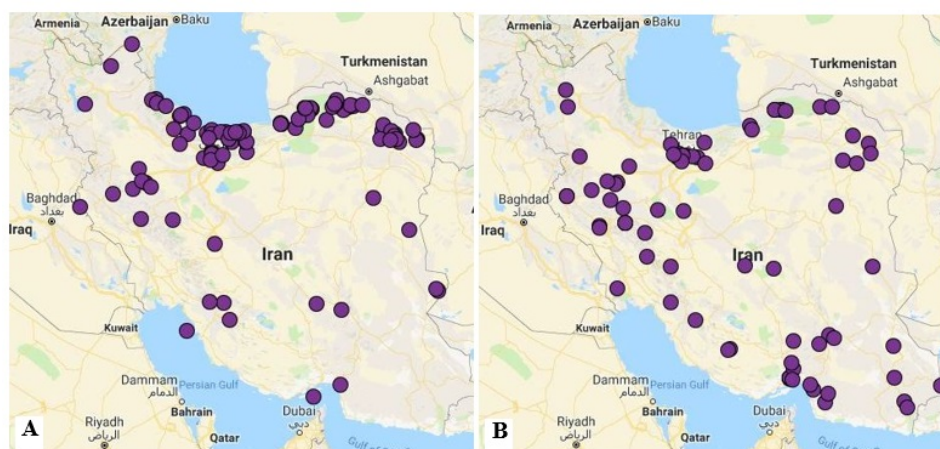


Fig. 1- *Solanum nigrum* (A. Flowers, B. Fruits, C. Habitat) and *Solanum villosum* (D. Flowers, E. Fruits, F. Habitat).



Map 1- Distribution of *Solanum* section *Solanum* in Iran. A: *S. nigrum*. B: *S. villosum*.

Materials and Methods

In this research, the wild species of *Solanum* in Iran was studied using field and library methods. In the field method, to determine the distribution of *Solanum* section *Solanum*, numerous trips to different parts of Iran were carried out and many samples were collected. After accurate identification with the help of usual methods, plants were transferred to the "IRAN" Herbarium. They were then sampled in different stages according to the

principles of collecting plant specimens including drying and freezing for the inactivation of the pests. After receiving herbarium code, they were kept for further investigation. At least, one photograph was taken from each specimen. Additionally, information and reports related to Iranian specimens of *Solanum* section *Solanum* were studied in different herbaria including:

E (Royal Botanic Garden, Edinburgh), FAR (Kharazmi University), FUMH (Ferdowsi

University), GUM (University of Guilan), Hamedan (Hamedan Agricultural Research Center), HAU (Alzahra University), HUMZ (University of Mazandaran), IAUH (Islamic Azad University, Olum-o-Tahghighat), IRAN (Iranian Research Institute of Plant Protection), K (Kew, Royal Botanic Gardens), TARI (Research Institute of Forests and Rangelands), TMRC (Shahid Beheshti University of Medical Sciences), TUH (Tehran University), and W (Naturhistorisches Museum Wien). (Table 1).

Besides, use of research methods in the field of ethnobotanical studies, scientific articles, authentic books and ancient documents have been studied in traditional medicine. In addition, the anthropological use

of these plants has also been examined through interviews and questionnaires from local people, especially those of older drug dealers, native farmers and pharmacists. Native racial data was collected from 39 native people (22 females and 17 males). Ethnic data were collected using a pre-determined data collection questionnaire and open interviews (Fig. 2). In the library method, traditional Iranian books and published articles on the traditional and traditional uses of this drug in Iran have been studied. In this method, reviews and books of great scholars such as Abu Ali Sina [22], Herawi [23], Sahl-e Tabari [24] and Aghili Shirazi [25] have also been used.

Table 1- Specimens collected from *Solanum* section *Solanum* in Iran, respectively: Scientific name/Herbarium Code-Number:

<p><i>Solanum nigrum</i> L.: E-00617872/ E-00617873/ FUMH-1168/ FUMH-1304/ FUMH-13650/ FUMH-23753/ FUMH-24594/ FUMH-27812/ FUMH-31822/ FUMH-38346/ FUMH-38419/ FUMH-41623/ FUMH-44972/ GUH-4173/ GUM-14270/ Hamedan-5140/ Hamedan-5348/ Hamedan-5884/ IAUH-10122/ IAUH-10125/ IAUH-10128/ IAUH-10130/ IAUH-10131/ IAUH-10135/ IAUH-10143/ IAUH-1228/ IAUH-14370/ IRAN-26455/ IRAN-40474/ IRAN-40475/ IRAN-40477/ IRAN-40478/ IRAN-63838/ IRAN-65240/ IRAN-65334/ IRAN-65337/ IRAN-65339/ IRAN-65344/ IRAN-65345/ IRAN-65365/ IRAN-65388/ IRAN-65389/ IRAN-65449/ IRAN-65450/ IRAN-65455/ IRAN-74603/ IRAN-74604/ IRAN-74779/ IRAN-74787/ IRAN-74789/ IRAN-74790/ IRAN-74794/ IRAN-74827/ IRAN-74828/ IRAN-74829/ IRAN-74830/ IRAN-74831/ IRAN-74832/ IRAN-74833/ IRAN-74834/ IRAN-74899/ IRAN-74901/ IRAN-75313/ IRAN-75327/ IRAN-75627/ IRAN-75720/ K-001151674/ K-001151703/ K-001151707/ K-001151709/ K-001151710/ K-001151711/ K-001151715/ TARI-24399/ TARI-75847/ TMRC-0002397/ TMRC-0003375/ TMRC-0003376/ TMRC-0003396/ TMRC-0003490/ TUH-29665/ W-1958-0003170/ W-1960-010737/ W-1964-0012563/ W-1965-0015232/ W-1965-0016921/ W-1967-0018776/ W-1969-0002497/ W-1972-0018107/ W-1976-0003450/ W-1999-0007529/ W-1999-0007532/ W-1999-0007533</p>
<p><i>Solanum alatum</i> Moench (synonym: <i>S. villosum</i> Mill.): E-000251353/ IRAN-40444/ IRAN-40445/ IRAN-40446/ IRAN-40447/ IRAN-40448/ IRAN-40449/ IRAN-40451/ IRAN-450408/ IRAN-52407/ IRAN-52408/ IRAN-65336/ IRAN-65346/ IRAN-65445/ TARI-16153/ TARI-38074/ TARI-39751/ TARI-58319/ TMRC-0003176/ W-1958-0003171/ W-1958-0003537/ W-1958-0003676/ W-1958-0007258/ W-1960-10978/ W-1960-0010977/ W-1958-0003537</p>
<p><i>Solanum luteum</i> Mill. (synonym: <i>S. villosum</i> Mill.): E-00320659/ E-00617755/ E-00617779/ E-00617850/ E-00617888/ E-00617890/ FUMH-11789/ FUMH-19183/ FUMH-23671/ FUMH-37029/ Hamedan-1431/ Hamedan-2674/ Hamedan-3662/ IAUH-10123/ IAUH-10136/ IAUH-11730/ IRAN-65343/ IRAN-65421/ IRAN-65422/ IRAN-74184/ IRAN-74783/ IRAN-74786/ IRAN-74835/ IRAN-74836/ IRAN-74837/ IRAN-74994/ IRAN-75900/ K-001151901/ K-001151904/ K-001151905/ TARI-1495/ TARI-1637/ TARI-1684/ TARI-1684/ TARI-1979/ TARI-21705/ TARI-39717/ TARI-49638/ TARI-52364/ TARI-53353/ TARI-63672/ TARI-7442/ TARI-88973/ TARI-96883/ W-1951-0011012/ W-1960-0001502/ W-1965-0016922/ W-1971-0021658/ W-1972-0009540</p>
<p><i>Solanum olgae</i> Pojark. (synonym: <i>S. villosum</i> Mill.): IRAN-40476/ IRAN-65338/ TARI-32530/ TARI-41033/ W-1968-0017994/ W-1968-17994/ W-1999-0007530</p>

Solanum گیاه مورد گیاه Ethnobotanical Documentation Sheet for Solanum		Ethnobotanical Documentation Sheet for Solanum nigrum and its related species	
شماره برگه:	تاریخ:	محل:	نام علمی گیاه:
نام علمی گیاه:	هویت مصاحبه شونده:	نام:	نام خانوادگی:
سن:	جنسیت: زن <input type="checkbox"/> مرد <input type="checkbox"/>	محل تولد:	محل اقامت:
نام محلی گیاه:	زیستگاه:	Do you use this plant? Yes <input type="checkbox"/> No <input type="checkbox"/> In the past <input type="checkbox"/>	As food <input type="checkbox"/> Oral medication <input type="checkbox"/> Pesticide or insecticide <input type="checkbox"/> Other items <input type="checkbox"/>
آیا از این گیاه استفاده می کنید؟ بله <input type="checkbox"/> نه <input type="checkbox"/> در گذشته <input type="checkbox"/>	به عنوان غذا <input type="checkbox"/> داروی خوراکی <input type="checkbox"/> داروی جلدی <input type="checkbox"/> آفت کش یا حشره کش <input type="checkbox"/> موارد دیگر <input type="checkbox"/>	Which part of the plant do you use? Leave <input type="checkbox"/> stem <input type="checkbox"/> flower <input type="checkbox"/> root <input type="checkbox"/> raw fruit <input type="checkbox"/> feeds fruit <input type="checkbox"/> other items <input type="checkbox"/>	How do you use it
کدام بخش از گیاه را استفاده می کنید؟ برگ <input type="checkbox"/> ساقه <input type="checkbox"/> گل <input type="checkbox"/> ریشه <input type="checkbox"/> میوه خام <input type="checkbox"/> میوه رسیده <input type="checkbox"/> موارد دیگر <input type="checkbox"/>	چگونه استفاده می کنید؟ چقدر از این گیاه استفاده می کنید؟ روزی یک بار <input type="checkbox"/> هفته ای یک بار <input type="checkbox"/> ماهی یک بار <input type="checkbox"/> سالی یک بار <input type="checkbox"/>	How much do you use this plant? Once a Day <input type="checkbox"/> once a week <input type="checkbox"/> once a month <input type="checkbox"/> once a year <input type="checkbox"/>	Does eating have a negative effect on your health? How?
آیا خوردن آن تاثیر منفی بر روی سلامت شما دارد؟ چگونه؟	آیا خوردن آن تاثیر منفی بر روی سلامت دام ها دارد؟ چگونه؟	Does eating have a negative effect on animal health? How?	I've never seen it, just heard about it <input type="checkbox"/>
من هرگز آن را ندیده ام، فقط در مورد آن شنیده ام <input type="checkbox"/>	یادداشت:	note:	

Fig. 2- Sample questionnaire form (in Persian and English languages).

Results

The results of this research are divided into following three parts:

The first part is the survey of questionnaires and public interviews on the medicinal properties of the plant. For the present study, 39 people of 11 different villages were interviewed. According to this survey, *Solanum nigrum* and its related species is the most commonly used for food digestion and constipation in traditional medicine and after that use for another the treatment such as analgesic and sedative, anemia, burns, carminative, cough, cut restoration, infections, mouth disinfection, skin diseases, toothache etc. (Table 2, Figs 3–4).

The second part identifies 180 different growing locations in Iran which generates their distribution maps. Of these, over 26 new

samples were collected and identified by the authors; and while receiving the herbarium code, they were ultimately kept in the “IRAN” Herbarium. According to results obtained in second part, these plants are found in most parts of the country and so as weeds that grow in most parts of Iran at altitudes of 0–3100 m (Table 1).

Finally, the results of this study on ancient and traditional books and published articles of ethnobotany from different regions of Iran, is presented below:

The important aspect in the results of this research is that, medicinal and ethnobotany uses of the species available in the section *Solanum* in Iran, including *S. nigrum* and related species, showed equal therapeutic effects based on related references and questionnaires. These plants have been

extensively used in traditional medicine in Iran for many ailment treatments such as toothache, gastrointestinal parasites, dysuria, bladder

pain, cancer, voice problem, relieve pain, fat and glucose reducing etc.

Table 2– The results of the ethnobotanical questionnaires and interviews performed in this study

Locality (Iran)	Herbarium Code	Number of People	Part Used	Treatment of the Disease	Preparation
Alborz: Taleghan, Joestan	IRAN-74783	4	Leaves and fruit	Constipation Burns Infections	Oral decoction Balm Balm
Azarbaijan-W: Maku	IRAN-75720	4	Leaves	Cut restoration	Balm
Golestan: Kalaleh	IRAN-74604	3	Leaves and fruit	Skin diseases Food digestion	Balm Oral decoction
Khorasan-N: Bojnurd,	IRAN-74829	4	Fruit	Cough	Oral decoction
Ashkhaneh, Aziz-abad				Constipation	Oral decoction
Khorasan-N: Shirvan,	IRAN-74835	3	Leaves and fruit	Skin diseases	Balm
Honameh				Food digestion	Oral decoction
Khorasan-R: Mashhad,	IRAN-75627	3	Leaves and fruit	Cut restoration	Balm
Torghabeh				Food digestion	Oral decoction
Kohgiluyeh-o-Boyer	IRAN-74994	4	Leaves and fruit	Cough	Oral decoction
ahmad: Gachsaran				Toothache	Mouth balm
				Mouth disinfection	Mouth balm
Mazandaran: Juybar,	IRAN-74790	3	Leaves and fruit	Carminative	Oral decoction
Kiakola				Anemia	Oral decoction
				Food digestion	Oral decoction
Mazandaran: Savadkuh,	IRAN-74789	4	Leaves and fruit	Constipation	Oral decoction
Zirab, Sorkh-kola				Anemia	Oral decoction
Tehran: Darakeh	IRAN-74184	4	Leaves and fruit	Analgesic and sedative	Balm
				Constipation	Oral decoction
Tehran: Kahrizak,	IRAN-74837	3	fruit	Food digestion	Oral decoction
Ghalehno, Haji musa					

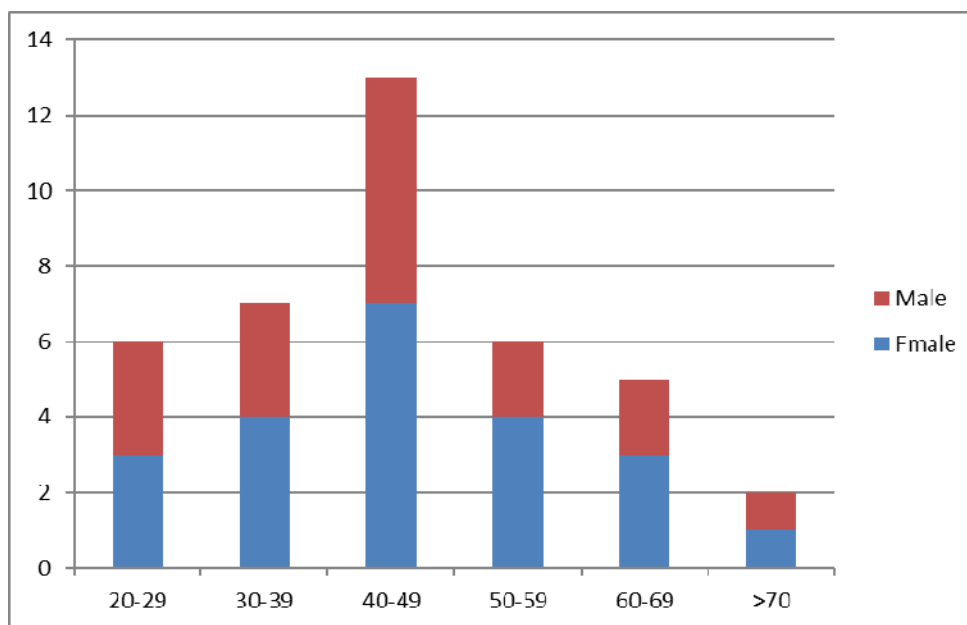


Fig. 3- Number of traditional healers by age category and gender

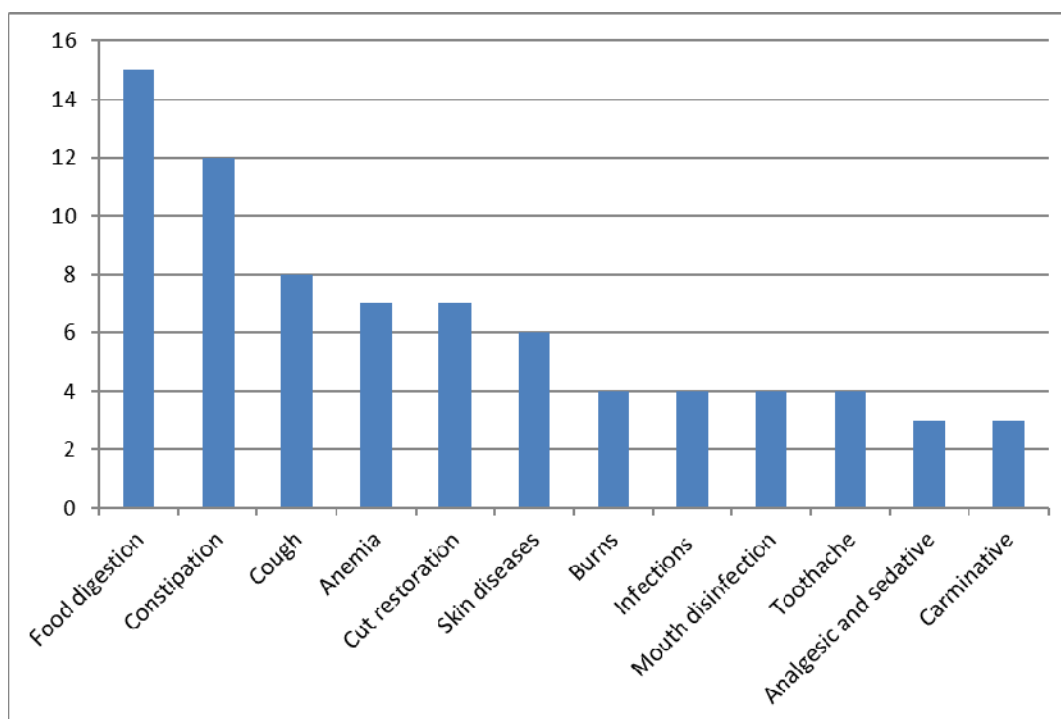


Fig. 4- Graph showing important diseases treated (based on ethnobotany questionnaire).

Discussion

The nature of the *Solanum* in traditional Iranian medicine is moderate and dry. The plant is also being used as fever-reducing agent, pain-reliever, softener, laxative, diarrhea, anticoagulant and anti-asthma. Eating a small amount of fresh fruit is needed to relieve constipation. Although, *S. nigrum* has a cold and dry temperament but it is believed that, it can sometimes have a hot nature too because of its steroidal structure which causes plants to have this antagonistic nature [25].

To use the plant, a three-hourly daily intake of 2–4 gm of dried fruit in a crushed form is recommended. Dried fruits of colorful vegetables (yellow, orange and red) are one of the most famous medicinal ingredients that are commonly used in conjunction with some

other medicinal plants (e.g. *Adiantum capillus-veneris* L., *Nepeta bracteata* Benth., *Cordia myxa* L., *Alcea digitata* Alef., *Ziziphus jujuba* Mill. and *Viola odorata* L.). These combined drugs are commonly consumed in traditional Iranian medicine and are used as anti-fever, softener and laxative, especially for children.

The flowers and leaves of this plant are toxic and often used in different materials in external treatment. Compressed and dehydrated forms of dried plants are beneficial for influenza, intense running-nose and headache. Also, boiled parts of the plant are suitable for relieving muscle bumps and stiffness and help removing some itching. Leaf scrubs and fresh flowers are useful externally to relieve rheumatic and articular pains, burn injuries, smallpox, swelling and

cancer pain. It should be noted that, due to the presence of a toxic substance called solanine in this plant, it should be used in a small amount and in a short period of time. It can occur naturally in any part of the plant, including the leaves, fruit, and tubers. Solanine has pesticidal properties which is one of the plant's natural defenses. It is worthy to note that, solanine was first isolated in 1820 from the berries of the European black nightshade (*Solanum nigrum*), after which it was named for [26]. It belongs to the chemical family of saponins. The toxicity is higher in leaves and flowering branches, therefore, overdosing should be treated with caution. Using more than 20 gm is fatal, with dystonia and tongue fever, hiccups, vomiting, and mucus secretion symptoms which are similar to milk in the mouth [25].

In ancient Iranian traditional medicine, many scholars such as Avicenna [22], Herawi [23], Sahl-e Tabari [24] and Aghili Shirazi [25] have mentioned about the properties of this plant and its combination with other plants. Galen quoted by Mohammad Zakaria Razi “the combination of this plant is suitable for the thyroid gland disease treatment, meningitis, ear and chronic erythrocytes of the eye and uterus”. Sahl-e Tabari has stated that, *S. nigrum* is cold, delicate and dry-tempered and is useful for liver and stomach inflammation recommending its roots cooked with salt, mixed with mint and black cumin. Abu Mansour Herawi, the author of the oldest remnant “Pharmaceutical-letter” in Persian (4th century), also believes in cold and dry-nature of this plant and recommends its extract for making suitable ointments to cure

swollen skins. Hooper & Field [27] reported the edibility of *S. nigrum* in Iran, affirmed that “Iranian women in the rural areas, consume its leaves just like spinach, and also use it to improve skin freckles”. In India, the whole plant is used but fruits of black color are not consumed as they possess toxicity, although reddish brown-coloured fruits are edible [28].

Some of the uses of herbal medicine of *S. nigrum* and related species in different regions of Iran are as follows: Fruits used by Kurdish community in Dehloran and Abadan districts, Ilam province (Western Iran) as medicinal plants for skin diseases, wound healing and eczema [29]. In the traditional medicine of Shiraz (Southern Iran) and Urmia (Northwest Iran), these plants are considered as antidiabetic herbs [29–31]. In Sirjan (Kerman province) the fruits are used to improve toothache and gastrointestinal parasites [32]. In Kohgiluyeh-o-Boyer Ahmad province, fruits are eaten to cure constipation [33]. In Sistan and Balouchestan (Southeast Iran) and Mobarakeh (Isfahan), these plants are taken to relieve toothache and leaves and fruits are also used for hemorrhoid treatment [30, 34–35]. Flowers and leaves are used by the indigenous people of Mobarakeh (Isfahan province) for anti-parasite treatment [35]. In Urmia (Northwest of Iran), fruits and seeds are consumed in the form of decoction used as sedatives and antidepressant [36]. In Vameghabad-e Bidoieh (Kerman province), leaves are used for eye pain treatment [37]. In East Mazandaran province, these plants are used for gastrointestinal tract and anemia treatment [38]. In medicinal plants sold in

markets of Mashhad (Northeast of Iran), fruits of *S. nigrum* are used for treatment of osteoarthritis, mastitis, expectorant, hypnotic, sedative and gastritis [39].

In general, based on the claims retrieved from oriental medicine, *S. nigrum* has been specially utilized for treatment of inflammation and edema [40]. It has been traditionally believed that, the plant demonstrated healing effects in burns and infections [41]. ITM physicians declared that, aqueous extract of *S. nigrum* leaves with its cool and dry temperament, has astringent and restraint effect, so it has been used as a swelling reliever in ITM burn prescriptions with *Malva sylvestris* L. or other ingredients [22, 25, 42–44].

According to in vitro studies of this plant on the treatment of inflammatory bowel disease, methanolic extract; *S. nigrum* fruit is useful for free radical scavenging activities in the DPPH assay [45]. In addition, A glycoprotein (SNL glycoprotein) isolated from fruit of this plant has scavenging effects on both superoxide anion and hydroxyl radical [46].

Active anti-cancer effects have been reported from *Solanum nigrum* fruits. Anti-proliferative effects of this plant showed a direct correlation with antioxidant properties. The herbs as natural antioxidants with limited side effects could potentially improve the outcome of human breast cancer therapy [47]. More information is provided in Table 3.

Table 3- Effects of traditional treatment of *Solanum nigrum* and its related species in ethnobotanical sources in Iran

Ailment Treatment	Part Used	Preparation	Reference
Analgesic and sedative	Leaves and fruit	Oral decoction and balm	22, 25, 30, 39, 42, 43, 44, 49, 52, 58
Antidepressants	Fruit	Oral decoction	36
Antimalarial activity	Fruit	Extract	56
Anti-parasite	Leaves and fruit	Oral decoction	35
Carminative	Fruit	Oral decoction	55
Chest conditioner	Aerial parts, leaves and fruit	Oral decoction	51
Cut restoration	Fruit	Balm	48
Decrease fat and blood glucose	Fruit	Oral decoction	30
Effective on cough	Aerial parts, leaves and fruit	Oral decoction	49, 51, 53, 54
Expectorant	Fruit	Oral decoction	39, 52
Gastrointestinal tract to ease food digestion	Root	Oral decoction	23, 24, 32, 38
Healing effect in burns and infections	Leaves and fruit	Balm	41
Hypnotic	Fruit	Oral decoction	39
Inflammatory bowel disease	Fruit	Isolated glycoprotein	45, 46
Treatment of addiction	Fruit	Oral decoction	36
Treatment of anemia	Fruit	Oral decoction	38
Treatment of bladder pain	Aerial parts, leaves and fruit	Oral decoction	50
Treatment of cancer	Aerial parts, leaves and fruit	Heated on embers, decoction	47, 50
Treatment of children smallpox	Ripe fruit	Oral decoction	23
Treatment of constipation	Fruit	Oral decoction	33, 55
Treatment of diabetes	Aerial parts and fruit	Oral decoction	29, 30, 31

Table 3- Continue

Ailment Treatment	Part Used	Preparation	Reference
Treatment of dysuria	Aerial parts, leaves and fruit	Oral decoction	50
Treatment of eczema	Fruit	Balm	47
Treatment of eye pain	Leaves	Balm	36
Treatment of gastritis and stomach ulcers	Ripe fruit	Oral decoction	23, 38
Treatment of hemorrhoid	Leaves and fruit	Balm	49
Treatment of inflammation and edema	Leaves and fruit	Balm	39, 40
Treatment of menorrhagia	Fruit	Oral decoction	57
Treatment of osteoarthritis	Fruit	Balm	39
Treatment of toothache	Fruit	Mouth balm	19, 23, 35, 49, 54
Treatment of voice problem	Aerial parts and fruit	Oral decoction	50
Treatment of warts and skin diseases	Leaves and fruit	Balm	23, 27, 48

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