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## Preliminary phytochemical analysis, traditional uses and pharmacological activities of *Solanum nigrum* L. flora of Palestine

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### Abstract

The purpose of this study is to provide information about the Chemical composition of the leaves, flowers, and fruits *Solanum nigrum* L., a plant that is native to Palestine and is a member of the *Solanaceae* family.

Several kinds of particular chemical reactions were used in the chemical analysis of different extracts from fruits, flowers, and leaves to look for physiologically active chemicals. From the results of the analytical analysis of physiologically active substances derived from members of the widely distributed *Solanum nigrum* L. plant in Palestine, showed presence the following active components for the first time: alkaloids, amino acids, coumarins, flavonoids, phenol compounds, tannins, and other active chemicals.

From the results of our study, and according to multiple studies and researches shown that *Solanum nigrum* L. is used in traditional medicine across the globe to treat a variety of conditions, including rheumatism, gouty joints, skin conditions, nervous disorders, nausea, and tuberculosis. It is also used to treat acute nephritis, urethritis, eczema, leucorrhea, cancer, toothaches, dermatitis, carbuncles, and furuncles. Additionally, this plant has a wide range of pharmacological effects, including anti-inflammatory, anti-convulsant, anti-tumor, anti-neoplastic, hepato-protective, immunomodulatory, anti-ulcer, antibacterial, antidiabetic, antioxidant, and pain-relieving properties.

The results of the current research have shown the reason for the widespread use of the *Solanum nigrum* L. in folk medicine in many countries of the world. This is because certain plant chemical components are present, which have a variety of medicinal effects and are used to treat a wide range of diseases.

In order to reap the benefits of this plant and employ it in the manufacture of cosmetics and pharmaceuticals, the researcher suggests conducting more research on the raw extract of these plants based on the results of the current study.

**Keywords:** *Solanum nigrum* L., phytochemicals, medicinal plants, flora of Palestine

### 1. Introduction

*Solanum nigrum* L. is a member of the Solanaceae family of plants, which includes medicinal herbs. Known by most as black nightshade. *Solanum nigrum* L. is a reasonably common plant or transient perennial shrub that occasionally exhibits a purple-green hue. It is hairy, having both simple and glandular hairs; prickles are absent. Its leaves are oblong to heart-shaped, with edges that are either big or wavy, and either hairy or hairless on both sides; There is a 1-3 cm petiole. Its height is 30-120 cm. The fruit typically measures 6-8 meters and is drab or purplish black in color. As the blooms mature, their greenish-white petals become more numerous, and they are strikingly encircled by bright yellow anthers (1) as shown (Fig.1).

Due to its diverse pharmacological properties, the traditional use of *Solanum nigrum* L. in eastern medicine is extensive. In addition, the leaves and berries are used to cure a variety of illnesses. The leaves are used to treat skin conditions, anti-tuberculosis medications, gouty joints, and joint pain.

Diaphoresis is also a result of their responses. Leaves are also used to treat neurological disorders, dropsy, and nausea.

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Fig 1: *Solanum nigrum* L.

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You can drink a decoction of the berries and blossoms to relieve a cough. These diuretic medications are used to treat lung pneumonia and tuberculosis. The berries' juice is used to treat diarrhea, ophthalmopathy, and hydrophobia. Treatment for cardiovascular issues is also provided. Berries are used for their stimulating, euphoric, and purgative effects for a very long time. They can also be used to treat skin problems and aggravation. The roots are beneficial for ophthalmopathy, hepatitis, and osteopathy. The whole plant is used to treat swelling, coughing, asthma, diuretics, digestion, diaphoretics, sedatives, antispasmodics, antiseptics, laxatives, and swelling. This plant can be used to treat nephropathy, cardiomyopathy, leprosy, ophthalmopathy, and general debility. Decocting the plant suppresses the CNS and spinal reflexes [2-6].

Conventional applications due to its several significant pharmacological properties, *Solanum nigrum* L. has been used as a folk treatment worldwide, as shown in (Table 1) lists some of the typical applications for it.

Table 1: Traditional uses in folk medicine of the *Solanum nigrum* L.

Organ of the plant	Traditional Uses
Leaves	<b>Used to treat</b> <ul style="list-style-type: none"> <li>▪ Skin conditions and burns.</li> <li>▪ Gout and rheumatoid arthritis; dropsy and neurological conditions.</li> <li>▪ Used as a wart dressing.</li> <li>▪ Rabies, wound healing.</li> <li>▪ Digestion; liver excitant.</li> <li>▪ Ringworm infection.</li> <li>▪ Stomachache, stomach ulcer.</li> </ul>
Flowers	Utilized to treat the following conditions: diarrhea, ophthalmopathy, rabies, cough, and erysipelas.
Fruit (Berries)	Utilized to treat the following conditions: Blindness, glaucoma, conjunctivitis, trachoma, cataract, and prevention of bedwetting in children
Roots	Used to treat the following conditions: Ophthalmopathy, otopathy, hepatitis, rhinopathy, whooping cough, asthma, and increasing a woman's fertility.

*Solanum nigrum* L. possesses various pharmacological activities, including hepatoprotective, anticancer, immunomodulatory, anti-ulcer, relaxing, anti-convulsant,

cardio defensive, antibacterial, antidiabetic, and pain relief effects (Table 2).

Table 2: Common actions of *Solanum nigrum* L. in pharmacology

Pharmacological activity	References	Pharmacological activity	References
Anti-tumor activity	7-10	Antioxidant Activity	11-18
Immunomodulatory effects	19-20	Hepatoprotective Activity	21-23
Antidiarrheal activity	19,24	Anti-inflammatory activity	25-27
Anti-HCV- activity	19,28	Anticonvulsant activity	19,29
Anti-ulcer activity	30-31	Antidiabetic activity	35-32
Cardio protective activity	14,24,36	Anti-convulsant	19
Analgesic activity	19,24,37	Management of COVID-19	19
Diuretic	7	Antiulcer genic	19
Antipyretic agent	25	Depressive effect	19
Antimicrobial	39, 389	Antiviral action	19
Anticancer Activity	40-43	Toothache relief	44
Larvicidalactivity	45	Anti-seizure activity-antiepileptic activity	46
Nematicidaland properties	9	Protective effect	47
Hypolipidemic, hypotensive potentials and anti-hyperglycemic	48	Antihypertensive effects	49
Anti-fungal effect	50	Anthelmintic study	51
Antimycotic activity	52	Anti-allergic effect	53
Neuropharmacological activity	31		

*Solanum nigrum* L. has a significant number of chemical substances with a range of pharmacological effects. Alkaloids, flavonoids, steroids, tannins, polysaccharides,

and polyphenolic chemicals make up the majority of the chemical components [1, 31, 53-59]. The chemical composition of the leaves, flowers, and fruits of *Solanum nigrum* L., a

plant that is widely distributed in Palestine, has not been studied in the literature. Therefore, the current study aims to evaluate the preliminary phytochemical examination of the different parts of this plant using a set of specific chemical reactions to reveal the nature and quality of active substances spread in its parts.

## 2. Materials and Methods

### • Collection of plant material

In the months of July, August, and September, the leaves, flowers, and fruits of *Solanum nigrum* L. were harvested from the wild plants that were growing in the hamlet of Kaffa in the Tulkarm Governorate in the West Bank, Palestine.

### • Preparation of plant extract

To prepare the extract, all portions of *Solanum nigrum* L. were cleaned with cold distilled water, allowed to air dry, and then ground into a powder using an electric grinder. The powder was then kept in opaque plastic containers until it was needed. Powdered leaves, flowers, and fruits of *Solanum nigrum* L. were delipidated for a whole night at 60–80 °C using petroleum ether. The majority of the lipid and

chlorophyll were carefully scraped off the side of the flask.

The resulting powder was extracted using a variety of solvents, including hexane, chloroform, acetone, and alcohol in varying concentrations, using a Soxhlet apparatus at 60–80 °C. These extracts were kept at 4 °C until they were needed, after being concentrated in a rotating vacuum evaporator.

## Methods

### Preliminary phytochemical screening

In accordance with recognized methods and conventional processes, the extracts underwent qualitative and preliminary phytochemical screening (60–64).

## 3. Results and Discussion

Extracts extracted using a variety of solvents, including hexane; chloroform, acetone, and alcohol in varying concentrations, using a Soxhlet apparatus, from the leaves, flowers, and fruits of (*Solanum nigrum* L.) were examined utilizing a series of particular procedures to identify this plant's principal distinctive chemical components (Table 3).

**Table 3:** Initial qualitative analysis of active substances from *Solanum nigrum* L. parts.

No.	Name of chemical compound	Test name	Test procedures
1	Anthraquinones	Borntrager's	10 ml of benzene was added to 20 ml of aqueous-alcoholic extract from the leaves, flowers, and fruits ( <i>Solanum nigrum</i> L.) and shaken for 3-4 minutes. In this case, the benzene layer turned yellow-orange. 5 ml of benzene extract was mixed with 5 ml of 10% ammonia solution. The ammonia layer acquired a red or cherry-red color, indicating the presence of anthraquinone glycosides in the raw material L.
2	Alkaloids	Wagner's	A few drops of Wagner's reagent were applied to 1-2 ml of extract obtained from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. in a test tube. The presence of alkaloids was revealed by the production of a reddish brown precipitate.
		Dragendorff	A little amount of <i>Solanum nigrum</i> L. extract was mixed in 5 ml of water with 2 M hydrochloric acid until an acid reaction was seen. After adding 1 ml of Dragendorff's reagent (potassium bismuth iodide solution), an orange-red precipitate was indicated, which showed the presence of alkaloids.
		Mayer's	When Mayer's reagent (Potassium mercuric iodide solution) was combined with crude extract from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L., a cream-colored ppt was produced that indicated the presence of alkaloids.
		Hager's	Hager's reagent was applied to 2-3 ml of extract obtained from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. A yellow precipitate indicated the presence of alkaloids.
3	Phenolic compound	Ferric chloride	FeCl <sub>3</sub> (5%), water, and a little amount of alcoholic and aqueous extracts from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. were mixed together. Blue appearance when combined with FeCl <sub>3</sub> (signals phenol present).
4	Saponins	Foam Froth	After being diluted with 20 ml of distilled water, 1 ml of the alcoholic extract from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. was shaken in a graduated cylinder for fifteen minutes. A single centimeter of foam suggested the existence of saponins.
5	Sterol	Liebermann's Burchard	A dry test tube was filled with 2 ml of chloroform after the extract from the leaves, flowers, and fruits ( <i>Solanum nigrum</i> L.) was dissolved. Two drops of strong sulfuric acid and ten drops of acetic anhydride were now added. The hue of the solution changed from red to blue to bluish green.
6	Flavonoids	NaOH	A few drops of sodium hydroxide were added individually to the extract obtained from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. in a test tube. The presence of flavonoids is indicated by the production of a bright yellow hue that becomes colorless when a few drops of diluted acid are added.
		Shinoda	Five to ten drops of dilute hydrochloric acid were added to the test tube containing the alcoholic extract of the leaves, flowers, and fruits ( <i>Solanum nigrum</i> L.), and then a little piece of magnesium. The hue became pink, reddish pink, or brown when flavonoids were present.
		Lead acetate	A few drops of lead acetate solution were added to the extract of <i>Solanum nigrum</i> L. leaves, flowers, and fruits. The presence of flavonoids identified by the production of a yellow precipitate.
7	Tannins	1% Gelatine containing 10% sodium chloride	A certain amount of extract from <i>Solanum nigrum</i> L.'s leaves, flowers, and fruits was dissolved in distilled water. Two ml of a 1% gelatin solution with ten percent sodium chloride were added to this mixture. The formation of white precipitate suggested the existence of tannin and phenolic

			chemicals.
		10% lead Acetate solution	Distilled water was used to dissolve a portion of the extract obtained from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. A few drops of lead acetate solution were added to this mixture. The presence of tannin and phenolic compounds was shown by the production of a white precipitate.
		FeCl <sub>3</sub> Solution	When ferric chloride solution was added to the extract sample from the leaves, flowers, and fruits ( <i>Solanum nigrum</i> L.), the sample showed signs of tannin content in the form of a dark blue or greenish black hue.
8	Coumarins	NaOH solution	In a test tube, 0.5 g of the moistened methanolic extract of <i>Solanum nigrum</i> L. leaves, flowers, and fruits was added. Filter paper prepared with 1 N NaOH solution was placed over the tube's mouth. After submerging the test tube in boiling water for a short while, the filter paper was taken out and the tube was inspected under a UV lamp to check for yellow fluorescence, which indicated the presence of coumarins.
9	Amino acid	Biuret's	A purplish-violet or pinkish-violet tint that denotes the presence of proteins is formed when 2–3 ml of the extract from the leaves, flowers, and fruits ( <i>Solanum nigrum</i> L.) are added to 1 ml of 40% sodium hydroxide solutions and 2 drops of 1% copper sulphate solution. Mix carefully.
		Ninhydrin	Add three drops of 5% ninhydrin to three ml of crude sample, then heat in a boiling water bath for ten minutes. Amino acid content was indicated by a purple or bluish hue.
10	Terpenoids	Salkowski	Two ml each of chloroform and concentrated H <sub>2</sub> SO <sub>4</sub> were added to two ml of extract obtained from the leaves, flowers, and fruits of <i>Solanum nigrum</i> L. It was a well-shaken solution. The interference's reddish-brown coloring suggested the presence of terpenoids.
		Libermann Burchard's	Chloroform was applied to the extract of <i>Solanum nigrum</i> L. leaves, flowers, and fruits. A few drops of acetic anhydride were added to this mixture, which was then heated and cooled. Sulfuric acid concentrate was poured through the test tube's walls. When two layers converge, a brown ring forms; if the upper layer turns green, this indicates the presence of steroids; if a deep red hue forms, this indicates the presence of triterpenoids.

The phytochemical analysis of extracts from the leaves, flowers, and fruits (*Solanum nigrum* L.) is presented in (Table 4).

It has been shown that extracts including amino acids, coumarins, alkaloids, flavonoids, saponins, tannins, sterol, and triterpenoids are present in the leaves, flowers, and fruits of *Solanum nigrum* L.

**Table 4:** Chemical composition of the extracts from different organs of *Solanum nigrum* L.

Organs	leaves	Flowers	Fruits
<b>Active substance</b>	<b>Result</b>		
Anthraquinones	-	-	-
Alkaloids	+	+	+
Phenolic compound	+	+	+
Saponins	+	+	+
Sterol	+	-	-
Flavonoids	+	+	+
Tannins	+	+	+
coumarins	-	-	+
Amino acid	+	-	-
Terpenoids	-	-	+

(-): Denotes the lack of an active ingredient.

(+): shows that there is an active ingredient present.

It is evident from the data that the leaves, flowers, and fruits of the *Solanum nigrum* L. plant contain a large and diverse group of effective chemicals, which scientific studies have proven to have various medical effects, the most significant of which are terpenoids, alkaloids, amino acids, coumarins, phenols, flavonoids, and saponins. This helps to explain why this plant is used extensively in traditional medicine throughout many nations (Table 4).

From the results of our study, and according to multiple studies and researches shown that how widely *Solanum nigrum* L. is used in traditional medicine to treat a variety of conditions, including rheumatism, gouty joints, skin issues, neurological disorders, and nausea. In addition, toothaches, dermatitis, eczema, leucorrhea, carbuncles, furuncles, acute nephritis, and urethritis are treated with it (Table 1).

Numerous pharmacological activities are exhibited by this plant, including anti-tumor, anti-inflammatory, anti-tumor, immunomodulatory, anti-ulcer, antibacterial, antidiabetic, antioxidant, and anti-neoplastic effects (Table 2).

#### 4. Conclusions

The aim of this study is to present data about the chemical composition of the leaves, flowers, and fruits of the *Solanaceae* family plant *Solanum nigrum* L., which is endemic to Palestine.

In order to find physiologically active molecules, a variety of specific chemical processes was employed in the chemical analysis of various extracts from fruits, flowers, and leaves.

Amino acids, coumarins, flavonoids, phenols, tannins, and alkaloids were discovered for the first time in Palestine when physiologically active substances from members of the widely spread *Solanum nigrum* L. plant were subjected to an analytical analysis.

Numerous studies have demonstrated the widespread use of *Solanum nigrum* L. in traditional medicine to treat a wide range of ailments, such as rheumatism, gouty joints, skin problems, neurological disorders, nausea, and TB. Additionally, it is used to treat toothaches, dermatitis, carbuncles, furuncles, eczema, leucorrhea, acute nephritis, and urethritis. The pharmacological effects of this plant are also extensive and include anti-inflammatory, anti-convulsant, anti-tumor, anti-neoplastic, hepatoprotective, immunomodulatory, anti-ulcer, antibacterial, antidiabetic, antioxidant, and analgesic qualities.

The new study's findings have illuminated the rationale behind the plant's extensive usage in traditional medicine across several nations. This is because some chemical components found in plants have a range of therapeutic properties and are used to treat a wide range of diseases.

Based on the findings of this study, the researcher recommends further research on the raw extract of these plants in order to fully use the advantages of this plant and use it in the production of medicines and cosmetics.

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