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Assessment of bioactive compounds and antimicrobial activity in *Solanum nigrum* in sandy track

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Abstract

Plants are the main source of life on our planet and are necessary for the human survival. Phytoconstituents can be more effective in the treatment of various ailments in mankind as compared to allopathic drugs. The current study focuses on the Phytochemicals found in the stem and leaves of *Solanum nigrum*. Using ethanol extracts, an attempt was made to screen the phytochemicals and antioxidant potential in the different parts of the plant. Results revealed that Carbohydrates, flavonoid, steroid, terpenoids and alkaloids were found in the stem and leaves. Saponin and glycosides compound were absent in both stem and leaves. Phenol, tannins and proteins were only present in stem. Higher value of Total Phenolic Contents (TPC) was measured in the plant stem ($24.500^{A}\pm0.208167$) than the leaves ($9.6333^{B}\pm0.202759$). A higher value Total Flavonoid Contents (TFC) were found in the plant stem ($26.658^{A}\pm0.329034$) than the leaves ($25.468^{A}\pm0.363658$). Total phenolic content and flavonoid content observed higher in plant stem and found lower level in the leaves. DPPH (1,1-Diphenyl-2-picrylhydrazyl) activity was performed in order to measure its potential in the *Solanum nigrum*, which showed its higher value in leaves ($20.964^{A}\pm0.317178$) than the plant stems ($11.936^{B}\pm0.09448$). Similarly, H_2O_2 activity was also calculated where its higher value was detected in value the leaves ($2.9776^{A}\pm 0.00937$) than the plant stem ($2.2872\ ^{B}\pm 0.0092$). In antioxidant activity DPPH activity showed higher in leaves and lower in stem. Whereas, H_2O_2 activities were higher in leaves and lower in stem. Antibacterial activities has confirmed that the *Solanum nigrum* leaves showed larger zone of inhibition against *B. subtilis* (23.3±0.76) and *E. coli* (12±0.5) as compared to *Solanum nigrum* stem against *B. subtilis* (9.6±0.76) and *E. coli* (00). These results indicated that the plant's promising phytoconstituents can be used to combat oxidative stress-based diseases such as cancer, ageing, and ischemic heart diseases.

1 Introduction

Plants are important for human survival. Plants are often used for therapeutic objectives. Plants and phytoconstituents are a better alternative to allopathic medications for treating ailments (Sen *et al*., 2009). Herbal medicine has also been used to treat ailments and infections from the dawn of time. Traditional medicine is supported by the World Health Organization if it has been demonstrated to be effective and safe (Santhi and Sengottuvel, 2016). Medicinal plants are used to promote and maintain a healthy lifestyle, as well as to prevent sickness and treat illnesses. Traditional medicine is supported by the World Health Organization if it has been demonstrated to be effective and safe. The therapeutic efficacy of these plants comes from their bioactive phytochemical contents, which have a specific physiological effect on the human body (Olatunde and Dikwa, 2014). The existence of phytochemical components in medicinal plants is fruitful for human illness. Medicinal herbs are important in the prevention of a variety of ailments. The medicinal herbs' antidiuretic, anti-inflammatory, antianalgesic, anticancer, antiviral, antimalarial, antibacterial, and anti-fungal properties. Medicinal plants are utilized to find and test phytochemical elements that are extremely useful in the development of novel medications (Wadood and Colleagues, 2013). Compounds present in medicinal plants are known as phytochemicals, leaves, vegetables, and roots that act as a

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defence mechanism and give protection against a variety of ailments. The majority of phytochemicals have been shown to have beneficial medicinal properties such as insecticides, antibacterials, antimalirials, and anti-constipants. As a result, the plants' therapeutic efficacy is derived from the phytochemical elements they contain (Begum *et al*., 2015). Antioxidants are necessary chemicals that protect the body from the effects of oxidative stress caused by free radicals. The formation of free radicals causes a variety of important diseases, including atherosclerosis, arthritis, ischemia, Alzheimer's, Parkinson's, diabetes, sclerosis, gastritis, ageing, liver disorders, cancer, and AIDS. Antioxidants aid to neutralise the reaction of free radicals in a variety of ways, including limiting production of free radicals by scavenging free radical scavengers, inhibiting the oxidation process, and blocking the radical chain reaction of oxidation (Monica *et al*., 2016).

The medicinal plant *Solanum nigrum* belongs to the Solanaceae family. Makoi and blacknight shade are two common names for it (Chauhan *et al*., 2012). In Pakistan, there are 15 species of Solanum, 11 of which are medicinally important (Mazher *et al*., 2016). The black nightshade can be found in a variety of settings all around the world. It can be found in moist woods, near rivers, wasteland, old fields, roadside ditches, and cultivated areas. Soils, high in minerals, are ideal for this plant's growth (Albouchi *et al*., 2018). *Solanum nigrum* is particular diverse species in the genus, with genotypes that differ morphologically. It's usually once a year (occasionally biannual) herbaceous plant that grows to be between 0.2 and 1.0 m tall and reproduces through seeds. The leaves are alternate, petiolate, 2-8 cm long, eliptical to heart-shaped, rarely even-edged, dark green, flat or finely hairy, and alternate. The blooms are star-shaped and tiny, with five petals and yellow anthers. They have five petals and are white (sometimes orange-red). The fruits are round, 5-11 mm in diameter, and dark black when fully mature, with countless, small scale flattened seeds. In the same parts of the world, ripe berries and cooked leaves of *S. nigrum* are eaten, and edible cultivars of the plant are grown (Popova *et al*., 2021). *S. nigrum* has long been used to serve various diseases, pain as well as swelling, and pyrexia. This plant is also utilized in medication for antitumorigenic, antioxidant, diuretic, and antipyretic purposes, as well as anti-inflammatory, hepatoprotective, and antiulcer properties. The berries' juice is used as an antidiarrheal, ophthalmic, and diuretic for dropsy and other conditions. Ophthalmopathy, rhinopathy, and hepatitis can all benefit from the roots. (Albouchi *et al*., 2018). Hence, present investigations were planned to measure the medicinal potential of *Solanum nigrum*. So that phytochemical screening, antioxidant activities and antibacterial properties were examined.

2. Materials and Methods

2.1 Identification and collection of samples

Solanum nigrum aerial parts were collected from the Islamia University of Bahawalpur. Experts in forestry, range, and wildlife management identified and verified the plants. The Plants in good condition (as a whole) were collected and washed to eliminate dirt. Plant materials were dried in the shade for 20 days until all of the water evaporated and the plants then were grinded. With an electrical grinder, it was dried, chopped, pressed, and powdered. The dry powdered samples were then kept in polyethylene bottles for more processing.

2.2 Extracts Preparation

For extraction, the 30gm powder of plant material was submerged in 700ml of ethanol in a flat-bottomed container covered with aluminum foil for 15 days. Solution was shacked and stirred occasionally. The extracts were then filtered through Whatman No. 1 and the filtrate was utilized to conduct phytochemical analysis.

2.3 Qualitative phytochemical analysis

Standard procedures were used to check for the presence of bioactive components in the extract (Yadav and Agarwala, 2011).

2.3.1 Test for proteins (Millon's test)

A white precipitate appeared when crude extract was mixed with 2ml Millon's reagent, which became red following mild heating, suggesting the presence of protein.

2.3.2 Test for carbohydrates (Benedict's test)

When extract was heated with 2ml Benedict's reagent, a reddish-brown residue formed, confirms the presence of carbohydrates.

2.3.3 Test for tannins and phenols

Plant extract was combined with 2ml $FeCl_3$ solution. A black/blue-green color shows the appearance of tannins and phenols.

2.3.4 Test for the identification of flavonoids (Shinoda test)

Concentrated HCl was mixed drop by drop to a mixture of crude extract and a few fragments of magnesium ribbon. After a few minutes, a pink scarlet color developed, indicating the presence of flavonoids.

2.3.5 Test for saponins

Crude extract was blended with 5mL distilled water in a test tube and vigorously shaken. The presence of saponins in the development of stable foam has been hypothesized.

2.3.6 Test for glycosides (Salkowski's test)

To the crude extract, 2 mL chloroform was added. After that, 2ml of concentrated H_2SO_4 was added and gently stirred. The existence of the steroidal ring, i.e. the glycoside's glycone component, was indicated by a reddish-brown color**.**

2.3.7 Test for steroid

Extract was combined with 2 mL chloroform, and concentrated H_2SO_4 was pour in a sideways motion. The appearance of steroids was detected by a red color in the bottom layer of chloroform. Another experiment was carried out by combining crude extract

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with 2mL chloroform. The mixture was poured with 2ml of concentrated H_2SO_4 and acetic acid. The presence of steroids was detected by the development of a greenish color.

2.3.8 Test for terpenoids

The crude extract was blended in 2 mL chloroform and evaporated until it was completely dry. 2ml concentrated H_2SO_4 was mixed to this and it was heated for roughly 2 minutes. The presence of terpenoids was indicated by a greyish color.

2.3.9 Test for the identification of alkaloids:

Plant extract was merged in HCl (2mL) and lightly warmed. After then, the Mayer and Wagner solutions were subjected into the mixture. The presence of alkaloids was confirmed by the turbidity of the resultant precipitate.



Fig. 2.3 Qualitative phytochemical screening

2.4 Quantitative phytochemical analysis

2.4.1 Total Phenolic Contents

Folin Ciocalteu reagent was used to direct total phenols. Aqueous Na_2CO_3 and Folin-Ciocalteu reagent were combined with a diluted extract of every component (0.5 mL, 1:10 g/mL) or Gallic acid (standard phenolic compound) (4 mL, 1 M). Colorimetry at 765 nm was used to determine the total phenols after the composition were allowed to settle for 15 minutes. Gallic acid solutions in methanol (50 v): water (50 v) at 0, 50, 100, 150, 200, and 250 mg/L were used to create the standard curve. Each extract's total phenol concentration was calculated in milli grammes of Gallic acid equivalent (GAE) per gramme of dry mass.

2.4.2 Total Flavonoid Contents

Flavonoids were measured with aluminum chloride colorimetric. Each fraction of the methanol extracts (0.5 mL and 1:10 g/mL) was mixed separately with methanol with 1.5 mL, 0.1 mL 10% aluminum chloride, 0.1 mL 1 M potassium acetate, and 2.8 mL pure water. It was kept at normal temperature for not more than thirty minutes. Absorbance was recorded at 415 nm. Quercitin solutions in methanol at concentrations vary from 12.5 to 100 g/mL were used to produce the calibration curve (Alam *et al*., 2012).

2.5 Antioxidants evaluation

2.5.1 Free Radical Scavenger DPPH Activity

The capability to scavenge free radicals was tested against an ethanolic solution of DPPH, a stable free radical. DPPH is converted to 1, 1-diphenyl-2-picryl hydrazine by antioxidants. The amount of discoloration reflects how effective the medication is at scavenging free radicals. Antioxidant activity has been measured using the change in absorbance produced at 517 nm (31). The extracts were dissolved in 95 percent ethanol and DPPH (2.365 mg) was added in 10 ml to form the stock mixture. This was diluted to yield concentrations of 50 to 800 parts per million. Both the blank and the test were given extracts of various quantities (1.5 ml). Only the test received DPPH (1.5 ml), whereas both the blank and the test received 95 percent ethanol (1.5 ml). To allow the reaction to take place, the tubes were placed aside for 20 minutes. The absorbance of the mixture was measured at 517 nm after 20 minutes against the corresponding blanks (32). The reference standard was BHA (Waghulde *et al*., 2011)

$$\% \text{ of scavenging activity} = \frac{\text{Absorbance control - Absorbance sample}}{\text{Absorbance control}} \times 100$$

2.5.2 H_2O_2 scavenging capacity

Potential of extracts was examined to scavenge hydrogen peroxide. In phosphate buffer, 40 mM H_2O_2 and crude extracts/standards (Gallic acid) in various concentrations (25, 50, 100, 150, and 200 g/ml) were prepared (pH 7.4). In 0.6 ml of H_2O_2 solution, an aliquot (3.4 ml) of sample solution was mixed. After 10 minutes, the absorbance of the solutions was measured at 230 nm. The proportion of hydrogen peroxide scavenging in sample and standard compounds was estimated using the equation below.

$$\% \text{ scavenged } H_2O_2 \qquad \underline{[(AC\text{-}AS)/AC] \times 100}$$

Where AC represented the absorbance of the control and AS represented the absorbance of a sample of *Solanum nigrum* (Veerapagu *et al*., 2018)

2.6 Antibacterial activities

2.6.1 Bacterial strains

Bacteria from the bacteriology unit of Bahawalpur Victoria Hospital were cultivated at The Islamia University of Bahawalpur (University College of Veterinary and Animal Sciences). Among the pathogens under investigation are *Escherichia coli* and *Bacillus subtilis*.

2.6.2 Media preparation

The bacteria broth culture was made with nutrient broth and sterile distilled water. The autoclaved medium and distilled water were placed aseptically into a 6mL sterile sealed test tube. Pure samples of subculture bacteria were transferred aseptically to broth media, and inoculum concentrations were adjusted to make an approximate concentration of 1.0108 cells/ml.

2.6.3 Ethanol extract

A conical flask was filled with 12 grams of powdered plant and 100 mL of 100 percent ethanol to prevent ethanol evaporation. After that, the flask was coated with foil. After 42 hours of extraction, the extract was purified using standard Whatman filter paper.

2.6.4 Cutting of discs from disc diffusion method

The discs were made using standard Whatman filter paper. Plant extracts were used to see if the discs could stop germs from growing in culture. Negative controls were made by impregnating discs with ethyl alcohol. As a control, pre-soaked ciprofloxacin (a commercially available antibiotic) discs were utilized.

2.6.5 Determination of antimicrobial activity

The agar disc diffusion method was used to conduct the sensitivity tests. Mueller Hinton Agar Medium was used to inoculate the test bacterial strains. In the wells, different concentrations of leaf extract were added. After one hour at room temperature to allow the strain to diffuse into the agar, the samples were incubated at 37°C for 24 hours. Incubation of Streptococcus sp. was done under micro aerophilic conditions. The zone of inhibition was seen and reported after 24 hours. For each microbe studied, the tests were repeated twice, with the results reported as an arithmetic average.

2.6.6 Minimum inhibitory concentration

The MICs were calculated using the broth dilution method. The test tubes were incubated at 37°C. The minimum inhibitory concentration (MIC) was calculated as the minimum concentration of plant extracts that inhibited the organism's development (Sheeba, 2009)

2.6.7 Determination of inhibition zone

All extracts were tested for antibacterial activity using the agar well diffusion method to determine the zone of inhibition. The test bacterial strains Bacillus subtilis, Salmonella paratyphi, Vibrio cholerae, Proteus vulgaris, and Escherichia coli were put onto the PDA slants after well creation, while the extracts of *S. nigrum* were carefully inserted into the wells (5mm). Petri plates were streaked with the bacterial strains and incubated at 352 ºC for 24 hours to induce bacterial strain inoculums. The diameter of the cleared area, i.e., zone of inhibition, including the 5mm well, was calculated after a day (24 hours) to define the zone of inhibition (Mazher *et al*., 2016)

2.7 Statistical analysis

Data were analyzed using software Statistic 8.1. All of the data is presented as a mean with a standard deviation (SD). Analysis of variance (ANOVA) and Tukey's test was performed to investigate the plant samples.

3. Results

3.1 Qualitative phytochemical analysis

Results for Qualitative phytochemical analysis of *Solanum nigrum* in ethanol was showed in Table 1. Data showed that Carbohydrates, Flavonoid, terpenoids, steroids and alkaloids were present in both stem and leaves of ethanol extracts of *Solanum nigrum*. Saponin and glycosides compound were absent in both stem and leaves of ethanol extract of *Solanum nigrum*. While phenol, tannins and proteins were only present in stem of ethanol extracts of *Solanum nigrum*

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Table-1: Qualitative phytochemical analysis of the leaves and stem of ethanol extracts of *Solanum nigrum*

Solanum nigrum L.			
Sr. No.	**Phytochemicals**	**Stem Ethanol**	**Leaves Ethanol**
1.	Carbohydrate	+	+
2.	Phenol	+	-
3.	Tannins	+	-
4.	Flavonoids	+	+
5.	Saponins	-	-
6.	Glycosides	-	-
7.	Steroids	+	+
8.	Terpenoid	+	+
9.	Alkaloids	+	+
10.	Proteins	+	-

+: present, -: absent

3.2 Quantitative phytochemical analysis

3.2.1 Total Phenolic Content (TPC)

The results for total phenolic contents are showed in Table 2. Significant results were found for Total phenolic contents. The table indicated that total TPC of stem and leaves of *Solanum nigrum* was observed to be statistically highly significant using One-way Anova ($P < 0.01$). In mean comparison *Solanum nigrum* stem shows the higher value ($24.500^{A}\pm0.208167$) than the *Solanum nigrum* leaves ($9.6333^{B}\pm0.202759$).

3.2.2 Total flavonoid content (TFC)

The results for total flavonoid are showed in Table 2. Significant results were found for Total flavonoid contents. The table indicated that total TFC stem and leaves of *Solanum nigrum* was observed to be statistically significant. In mean comparison *Solanum nigrum* stem showed the higher value ($26.658^{A}\pm0.329034$) than the *Solanum nigrum* leaves ($25.468^{A}\pm0.363658$).

Table-2: Results of TPC, TFC, DPPH, H_2O_2 of *S. nigrum* leaves and stem

Test	**Leaves Mean ± SE**	**Stem Mean ± SE**
TPC (mg GAE/100 g)	$9.6333^{B}\pm0.202759$	$24.500^{A}\pm0.208167$
TFC (mg QE/100 g)	$25.468^{A}\pm0.363658$	$26.658^{A}\pm0.329034$
DPPH (% inhibition)	$20.964^{A}\pm0.317178$	$11.936^{B}\pm0.09448$
H_2O_2 (% inhibition)	$2.9776^{A}\pm 0.00937$	$2.2872^{B}\pm 0.0092$

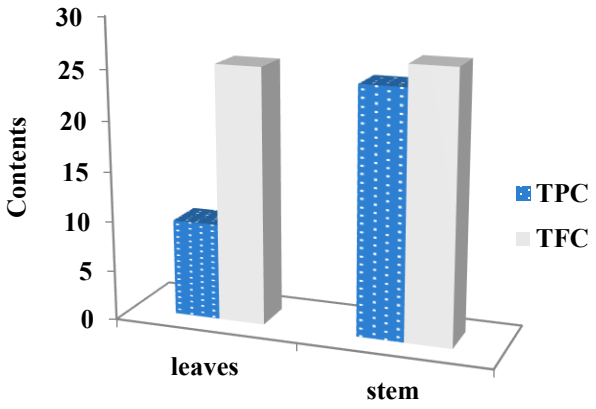
3.3 Antioxidants evaluation

3.3.1 DPPH Activities

The results for DPPH are showed in Table 2. Significant results were found for DPPH. The table showed that DPPH value of stem and leaves of *Solanum nigrum* was observed to be statistically highly significant. In mean comparison *Solanum nigrum* leaves showed the higher value ($20.964^{A}\pm0.317178$) than the *Solanum nigrum* stem ($11.936^{B}\pm0.09448$).

3.3.2 H_2O_2 Activities

The results for H_2O_2 are showed in Table 2. Significant results were found for DPPH. The table showed that H_2O_2 value of stem and leaves of *Solanum nigrum* was observed to be statistically highly significant. In mean comparison *Solanum nigrum* leaves shows the higher value ($2.9776^{A}\pm 0.00937$) than the *Solanum nigrum* stem ($2.2872^{B}\pm 0.0092$).



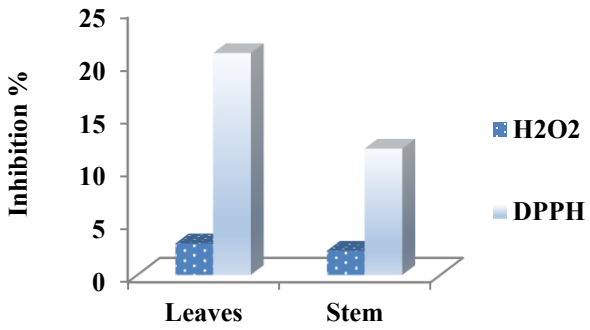


Fig. 3.1 TPC and TFC of *Solanum ngrum* stem and leaves and Fig. 3.2 DPPH and H_2O_2 of *Solanum nigrum* leaves and stem

3.4 Antibacterial assay

Ethanol leaves generated the largest inhibition zone (23.5 mm) against *B. subtilis*, whereas the stem created a 9 mm zone of inhibition. *B. subtilis* was killed by an ethanol extract of *S. nigrum* leaves (23.3 mm mean value) and modest activity was found in the stems. *S.nigrum* ethanol extract was observed to be statistically highly significant using Completely Randomized ANOVA ($P < 0.01$).Ciprofloxacin's zone of inhibition on *B. subtilis* was considerable (29.5 mm) but that on E. coli was less so (24 mm) as shown in table 2

The findings revealed that the largest inhibition zone (12 mm) against *E. coli* was created by the ethanol leaves, whereas the stem formed a 00 mm inhibition zone. Ethanol extract of *S.nigrum* leaves revealed moderate activity against *E. coli* (i.e. 12 mm mean value) and no activity was found in the stem

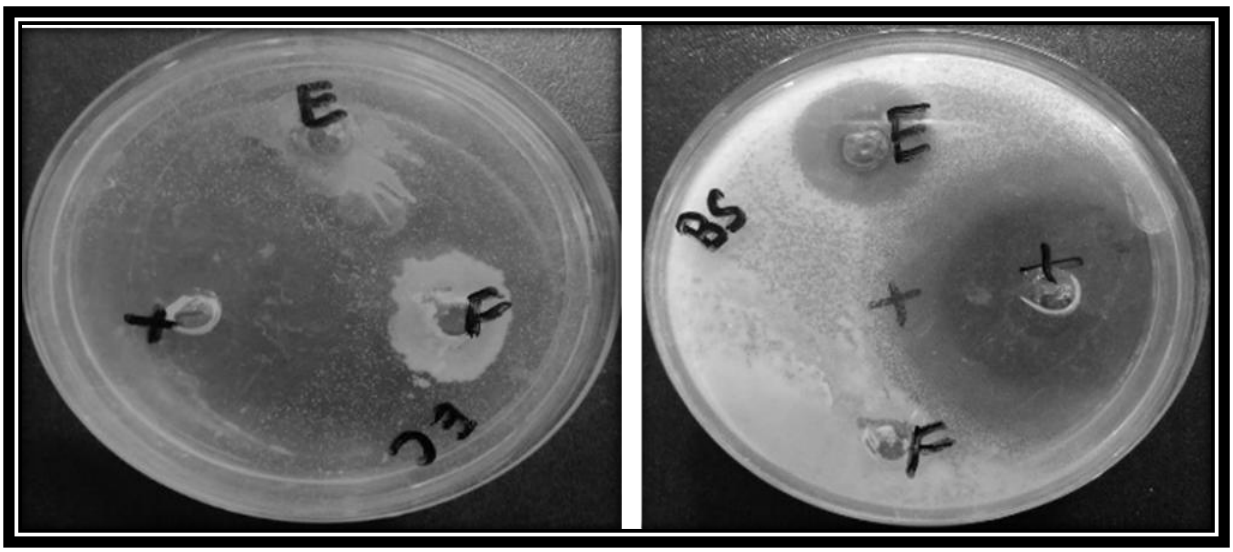


Fig. 3.3 +: Control, H: leaves, I: stem S (zone of inhibition activity against *E.coli* and *B.subtilus*)
Standard Antibiotic: Ciprofloxacin

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Table-3: Value of Zone of inhibition *B. Subtils*, *E. Coli* and control

Treatment	B.S.	E.C
+ control	29mm	24mm
E	23.5mm	12mm
F	9mm	00mm

Bacterial strain used: *Esherichia.Coli*: *E.Coli*, B*acillus subtilis*: *B.Subtilis.*
Standard Antibiotic: Ciprofloxacin

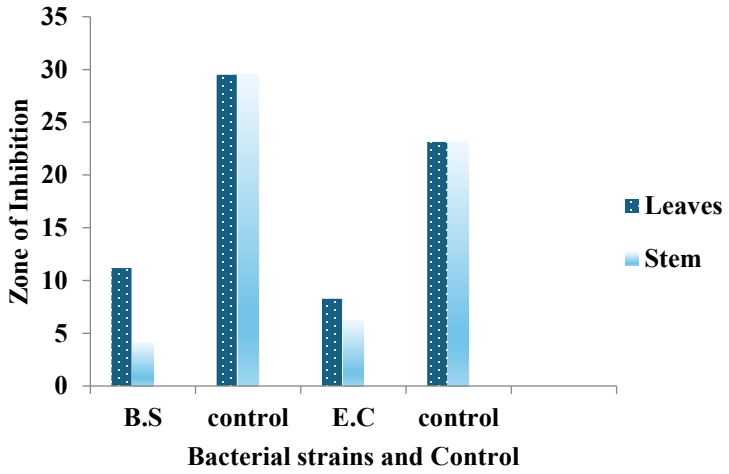


Fig. 3.4 Antibacterial activities of ethanolic extracts of leaves and stem against (*E.coli*, *B.subtilis*)

4. Discussion

The presence of alkaloid, saponin, tannins, flavonoids, proteins, and other phytochemical elements was identified in the leaf extracts of *S. nigrum* L. The alkaloid content found in *S. nigrum* L and is responsible for their well-known therapeutic properties, albeit the exact mechanism of action is unknown (Gogoi and Islam, 2012)

Fabiola and Judia (2018) reported the presence of flavonoids, tannins, saponins, glycosides, terpenoids, alkaloids, fixed oil, protein, amino acids, and carotenoids abundantly in the ethanolic extract (10/15). However, carbohydrates, sterols, phenols, quinones, and anthroquinones were all missing in *S. trilobatum*. Alkaloids, phenols, tannins, carotenoids, and fixed oils were identified in the chloroform extract of *S. trilobatum*, but carbohydrates, saponin, proteins, terpenoids, sterols, glycosids, amino acids, flavanoids, quinones, and anthroquinones were not. An aqueous extract of *S. trilobatum* contained alkaloids, flavonoids, saponins, sterols, glycosides, protein, amino acid, terpenoids, quinones. While tannins, anthraquinone, fixed oils, carotenoid, phenols, and carbohydrates were absent.

Results for qualitative phytochemical analysis of *Solanum nigrum* in ethanol was showed in Table 1. Results showed that Carbohydrates, Flavonoid, terpenoids, steroids and alkaloids were present in both stem and leaves of ethanol extracts of *Solanum nigrum*. Saponine and glycosides compound were absent in both stem and leaves of ethanol extract of *Solanum nigrum*. While phenol, tannins and proteins were only present in stem of ethanol extracts of *Solanum nigrum.* These findings can be compared with those of Gogoi and Islam (2012) in which *S. nigrum* were showed to be rich in various phytochemicals. The extracts proved positive for all chemical categories examined, with varying degrees of present.

The results for total phenolic contents are showed in Table 2. Significant results were found for Total phenolic contents. The table indicated that total TPC of stem and leaves of *Solanum nigrum* was observed to be statistically highly significant. In mean comparison *Solanum nigrum* stem shows the higher value ($24.500^{A}\pm0.208167$) than the *Solanum nigrum* leaves ($9.6333^{B}\pm0.202759$). These findings can be compared with Alam *et al*., (2012) in which the actual value of total phenolic content in an extract can vary depending on the solvent to plant material ratio, period of extraction, and some other parameters; hence the similiar plant material might have varying phenolic compound content. This is supported by the findings of phenolic concentration in *S. nigrum* extracts (Leaf: 2.6 mg, Stem: 0.53 mg, Fruit: 1.47 mg per gram of dry extract). However, it's worth noting that, with the exception of chloroform extract, phenolic chemicals were found to be higher in the leaf than in the fruit, regardless of the solvent used. Besides us, no one has ever studied the phenolic compounds content of *S. nigrum* stem extract, and one-gram dried extract contained 0.53 mg GAE of phenolic contents, which was significantly less than either both of fruit or leaves extract. Phenolic amount in the examined portions of *S. nigrum*

was in the following order: leaf > fruit > stem. Plants high in phenolics chemicals, such as phenolic acids, carotenoids, flavonoids, tocopherol, and tannins, have been shown to have excellent antioxidant properties. Increased dietary consumption of natural antioxidants has been linked to a lower risk of coronary heart disease and cancer mortality, and also a higher life expectancy, according to this research. This research implies that phenols are significant contents of *S. nigrum* and that they could be used to cure oxidative stress-related disorders.

The flavonoid content of *S. nigrum* ethanolic leaf, stem, and fruit extract (Leaf 2.55 mg, Stem 1.32 mg, Fruit 0.62 mg per gram of dried extract QE/ CE) is presented. It's worth noting, however, that, like the phenolic components in the leaf extracted with ethanol and flavonoids were greatest in the same extract among the *S. nigrum* portions tested. Compounds have been reported for their anti-inflammatory properties, as well as their ability to scavenge free radicals and inhibit hydrolytic and oxidative enzymes. Intake of flavonoid was reported to cause death from coronary heart ailment and to increases the chance of heart attacks, according to epidemiological research. According to some research, these chemicals' biological effects are linked to their antioxidant activity via a scavenging process. Flavonoids have long been known to have antioxidant properties, and their impact on human nutrition and health is significant. The high flavonoid content of *S. nigrum*, particularly its leaf is contributing a great in human health and nutrition (Alam *et al*., 2012). The results for total flavonoid are showed in table 2. Significant results were found for Total flavonoid contents. The table indicated that total TFC stem and leaves of *Solanum nigrum* was observed to be statistically significant. In mean comparison *Solanum nigrum* stem shows the higher value (26.658^{A}±0.329034) than the *Solanum nigrum* leaves (25.468^{A}±0.363658).

According to previous work, the ability of different extracts to scavenge DPPH radicals was concentration-dependent and steadily increased over time. According to the findings, the IC50 value of ascorbic acid is 49g/ml, while the IC50 values of all the extracts are different at different concentrations. Accordingly, the IC50 value of ethyl acetate extract is 620g/ml, while ethanol extract is 160g/ml, and the IC50 values of chloroform, methanol, and aqueous extracts are 380, 250, and 180 g/ml, respectively. This demonstrates that all *Solanum xanthocarpum* berry extracts have hydrogen-donating properties and can operate as antioxidants (Demla and Verma, 2012). These findings by showing the presence of DPPH in ethanol extract. The table showed that DPPH value of stem and leaves of *Solanum nigrum* was observed to be statistically highly significant. In mean comparison *Solanum nigrum* Leaves shows the higher value (20.964^{A}±0.317178) than the *Solanum nigrum* stem (11.936^{B}±0.09448).

In cellular components, hydrogen peroxide is a precursor to the generation of hydroxyl radicals. The proton donating capability of *S. erianthum* phytochemical components is responsible for the ethanolic extract's H_2O_2 scavenging activity. Because a compound's reducing power is connected to its capacity to move electrons, it can be used to predict its prospective antioxidant activity. The extract's capacity to reduce the amount of cholesterol in the blood was dose dependent. This can be due to the polyphenols in the extract's capability to donate electrons (Aluko, 2017). These findings by showing the presence of H_2O_2 in ethanol extract of *S. nigrum*. Significant results were found for H_2O_2. The table showed that H_2O_2 value of stem and leaves of *Solanum nigrum* was observed to be statistically highly significant. In mean comparison *Solanum nigrum* leaves showed higher value (2.9776^{A}± 0.00937) than the *Solanum nigrum* stem (2.2872^{B}± 0.0092).

Ethanol leaves generated the largest inhibition zone (23.5 mm) against *B. subtilis*, whereas the stem created a 9 mm zone of inhibition. *B. subtilis* was killed by an ethanol extract of *S. nigrum* leaves (23.3 mm mean value) and modest activity was found in the stems. *S.nigrum* ethanol extract was observed to be highly significant. Ciprofloxacin's zone of inhibition on *B. subtilis* was considerable (29.5 mm) but that on *E. coli* was less so (24 mm) as shown in Table 3. The findings revealed that the largest inhibition zone (12 mm) against *E. coli* was created by the ethanol leaves, whereas the stem formed a 00 mm inhibition zone. Ethanol extract of *S.nigrum* leaves revealed moderate activity against *E. coli* (i.e. 12 mm mean value) and no activity was found in the stems. These findings can be compared with Mazher et al., (2016) that ethanolic fruit extracts have higher zone of inhibition than the ciprofloxacin against *Staphylococcus aureus*. In present study, the fruit extracts in ethanol also showed higher zone of inhibition than the tetracycline against *V. cholera* and *E. coli.* Our results are as, fruits extracts in both studies showed greater antibacterial activity than leaf and stem extracts.

5. Conclusion

The most trustworthy source of a wide range of medicines is medicinal plants. Medicinal plants include phytochemical components that make them helpful for both treating and curing human diseases. Different secondary metabolites were found in the leaves and stem of *Solanum nigrum* was discovered through phytochemical research. *Solanum nigrum* was studied for phytochemicals and antioxidant potential to be used in the development of various synthetic and herbal medications. Our findings revealed that *Solanum nigrum* has potential to be a new source of natural compounds. This plant has antioxidant potential due to its strong DPPH scavenging activity, Ultimately, *Solanum nigrum* can be regarded a medicinal plant in future bioassays, with the potential to be used in the production of herbal medications, resulting in a safer cure.

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References

Alam, M. N.; Roy, S.; Anisuzzaman, S. M.; Rafiquzzaman, M. Antioxidant activity of the ethanolic extracts of leaves, stems and fruits of Solanum nigrum. *Phcog Commn* **2012,** *2*, 67-71.

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Albouchi, F.; Attia, M.; Hanana, M.; Hamrouni, L. Ethnobotanical notes and phytopharmacologiques on Solanum nigrum Linn. (Family: Solanaceae). *American Journal of Phytomedicine and Clinical Therapeutics* **2018**, *6*(1), 5.

Aluko, B. T. Phytochemical analysis and antioxidant activity of ethanolic extract of Solanum erianthum. *Science World Journal* **2017**, *12*(1), 5-8.

Begum, H. A.; Hamayun, M.; Zaman, K.; Hussain, A.; Ruaf, M. Phytochemical evaluation of ethnobotanically selected medicinal plants of Mardan, Pakistan. *J Adv Bot Zool* **2015**, *3*(1), 10-21.

Chauhan, R.; Ruby, K. M.; Shori, A.; Dwivedi, J. Solanum nigrum with dynamic therapeutic role: A review. *International Journal of Pharmaceutical Sciences Review and Research* **2015**, *15*(1), 65-71.

Demla, M.; Verma, H. In vitro antioxidant activity, total phenolic and total flavonoid content of different extracts of Solanum xanthocarpum Berries. *Int J pharm pharm sci* **2012**, *4*(4), 154-157.

Fabiola, V.; Judia, H. S. A study on phytochemicals, antioxidant, antidiabetic and antimicrobial activity of the leaves of Solanum Trilobatum. *International Journal of Engineering and Techniques* **2018**, *4*(1), 393-404.

Gogoi, P.; Islam, M. Phytochemical screening of Solanum nigrum L and S. myriacanthus Dunal from districts of upper Assam, India. *IOSR J Pharm* **2012**, *2*(3), 455-459.

Mazher, M.; Malik, N. Z.; Riaz, M.; Hussain, A.; Ali, Y.; Noshad, Q. Q. Phytochemistry and antibacterial assay of fruit leaf and stem extracts of Solanum nigrum L. in different solvent. *Int. J. Biosci* **2016**, *9*(6), 129-136.

Mazher, M.; Malik, N. Z.; Riaz, M.; Hussain, A.; Ali, Y.; Noshad, Q. Q. Phytochemistry and antibacterial assay of fruit, leaf and stem extracts of Solanum nigrum L. in different solvent. *Int J Biosci* **2016**, *9*, 129-36.

Monika, P. M.; Sharma, K.; Yadav, M. Antioxidant effect of some medicinal plants: A review. *Inventi Rapid: Planta Activa* **2016**, *1*(1), 1-8.

Olatunde, A. Qualitative and quantitative analysis of phytochemicals of Loranthus bengwensis leaf. *Annals of Biomedical Research*, *5*(1).

Popova, V. T.; Stoyanova, M. A.; Ivanova, T. A.; Stoyanova, A. S.; Dimitrova-Dyulgerova, I. Z. Phytochemical composition of leaves and stems of Solanum nigrum L. and Solanum dulcamara L.(Solanaceae) from Bulgaria. In *IOP Conference Series: Materials Science and Engineering* **2021**, *1031*(1), 012091).

Santhi, K.; Sengottuvel, R. Qualitative and quantitative phytochemical analysis of Moringa concanensis Nimmo. *International Journal of Current Microbiology and Applied Sciences* **2016**, *5*(1), 633-640.

Sen, S.; Chakraborty, R.; De, B.; Mazumder, J. Plants and phytochemicals for peptic ulcer: An overview. *Pharmacognosy Reviews 2009*, *3*(6), 270.

Sheeba, E. Antibacterial activity of Solanum surattense Burm. F. *Kathmandu university journal of science, engineering and technology* **2009**, *6*(1), 1-4.

Veerapagu, M.; Jeya, K. R.; Sankaranarayanan, A.; Rathika, A. In vitro antioxidant properties of methanolic extract of Solanum nigrum L. fruit. *The Pharma Innovation* **2018**, *7*(5), 371.

Wadood, A.; Ghufran, M.; Jamal, S. B.; Naeem, M.; Khan, A.; Ghaffar, R. Phytochemical analysis of medicinal plants occurring in local area of Mardan. *Biochem Anal Biochem* **2013**, *2*(4), 1-4.

Waghulde, H.; Kamble, S.; Patankar, P.; Jaiswal, B.; Pattanayak, S.; Bhagat, C.; Mohan, M. Antioxidant activity, phenol and flavonoid contents of seeds of Punica granatum (Punicaceae) and Solanum torvum (Solanaceae). *Pharmacologyonline* **2011**, *1*, 193-202.

Yadav, R. N. S.; Agarwala, M. Phytochemical analysis of some medicinal plants. *Journal of phytology* **2011**, *3*(12).