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RESEARCH ARTICLE

Antibacterial and Antioxidant Activity of *Solanum nigrum* Stem and Leaves

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Abstract: The antioxidant and antibacterial activity of stem and leaves extracts of *Solanum nigrum*, which is an important ingredient in traditional Indian medicines was determined in this work. It was tested for antioxidant activity using 2, 2- diphenyl- 1- picrylhydrazyl (DPPH) and reducing power assay method. The antibacterial activity was detected by agar well diffusion method against *Bacillus subtilis, Escherichia coli* and *Pseudomonas aeruginosa*. The zones of inhibitions obtained were recorded and analyzed against standard control of Ampicillin.

Keywords: DPPH, Reducing power assay, Ascorbic acid, Agar diffusion

Introduction

For thousands of year's natural products have played a very important role in health care and prevention of diseases. Forty- seven percent of the anticancer drugs in the market come from natural products or natural product mimics[1]. Important drugs such as taxol, camptothecin, morphine and quinine have been isolated from plant sources. The plant possesses various chemotherapeutic, bacteriostatic and antimicrobial agents[2]. Plants generally produce many secondary metabolites which constitute an important source of microbicides, pesticides and many pharmaceutical drugs. Several types of polyphenols (Phenolic acid, Hydrolysable tannins and Flavonoids) show anticarcinogenic and antimutagenic effects[3]. Plant derived natural products have received considerable attention in recent years due to diverse pharmacological properties, including antioxidant and antitumor activity[4].

Solanum nigrum L and *S. Myria canthus*, both are important aspects of medicinal plant resources for treatment of primary health care. *Solanum nigrum* L commonly known as Black nightshade is a dicot weed in the Solanaceae family. The herb is antiseptic, antidysentric antidiuretic used in the treatment of cardiac, skin disease, psoriasis, herpvirus and inflammation of kidney[5].

Experimental

Plants were collected from campus of SHIATS and identified from the Department of agronomy, SHIATS, Allahabad.

Preparation of extract

The dried plant material (stem and leaves) of *Solanum nigrum* was made to fine powder using, homogenizer. The dried powder was extracted separately with continuous shaking for 24 h using different solvents. The extracts are filtered through filter paper to remove all unextractable matters.

Microorganisms

The antibacterial activity was tested against the following 3 selected strains: *Escherichia coli, Pseudomonas aeruginosa* and *Bacillus subtilis*. The selected bacterial strains were obtained from Microbiology& Fermentation technology laboratory, SHIATS, Allahabad.

Evaluation of antibacterial activity

Agar well diffusion method

Agar well diffusion method elucidated by Ahmad *et al*.[6] was followed.

Evaluation of antioxidant activity

Scavenging activity on DPPH radical

The DPPH radical scavenging assays elucidated by Chan *et al*.[7] was followed.

Reducing power assay

Antioxidant activity by reducing power assay developed by Yen and Duh[8] was as followed.

Results and Discussion

The result of antibacterial activity is given in Table 1, 2, 3 and 4. From the tables it is clear that the chloroform: methanol extract of stem of *Solanum nigrum* was highly active against *Bacillus subtilis* and the acetone extract against *Pseudomonas aeruginosa* at 2.0 mg/mL. The chloroform:methanol extracts of leaf of *Solanum nigrum* showed maximum inhibitory activity against[9] *Pseudomonas aeruginosa* and the acetone extract against *Pseudomonas aeruginosa* at 2.0 mg/mL. According to the Table 5, 2.0 µg/mL concentration of Ampicillin showed maximum radius of zone of inhibition of 22.0 mm against *E. coli* followed by 19.0 mm against *B. subtilis* and 23.0 mm *P.aureginosa*[10].

Table 1. Antibacterial activity of *Solanum nigrum* chloroform: methanol (3:2) leaf extract by agar well diffusion method

Concentration mg/mL	Mean radius of inhibition zones of bacteria, mm		
	E. coli	*B. subtilis*	*P. aeruginosa*
0.5	7.0	6.0	8.0
1.0	7.0	7.0	8.0
1.5	9.0	8.0	11.0
2.0	9.0	10.0	11.0

Table 2. Antibacterial activity of *Solanum nigrum* acetone leaf extract by agar well diffusion

Concentration	Mean radius of inhibition zones of bacteria, mm		
mg/mL	*E. coli*	*B. subtilis*	*P. aeruginosa*
0.5	6.0	7.0	8.0
1.0	6.0	7.0	9.0
1.5	8.0	8.0	9.0
2.0	8.0	9.0	10.0

Table 3. Antibacterial activityof *Solanum nigrum* chloroform: methanol (3:2) stem extract by agar well diffusion

Concentration	Mean radius of inhibition zones of bacteria, mm		
mg/mL	*E. coli*	*B. subtilis*	*P. aeruginosa*
0.5	7.0	6.0	6.0
1.0	9.0	6.0	7.0
1.5	14.0	12.0	10.0
2.0	17.0	18.0	11.0

Table 4. Antibacterial activity of *Solanum nigrum* acetone stem extract by agar well diffusion

Concentration	Mean radius of inhibition zones of bacteria, mm		
mg/mL	*E. coli*	*B. subtilis*	*P. aeruginosa*
0.5	6.0	6.0	6.0
1.0	7.0	9.0	9.0
1.5	8.0	9.0	10.0
2.0	10.0	10.0	11.0

Table 5. Antibacterial activity of standard Ampicillin by agar well diffusion

Concentration	Mean radius of inhibition zones of bacteria, mm		
mg/mL	*E. coli*	*B. subtilis*	*P. aeruginosa*
0.5	15.0	15.0	17.0
1.0	16.0	15.0	17.0
1.5	19.0	17.0	18.0
2.0	22.0	19.0	23.0

Table 6. DPPH free radical scavenging assay (%) of*Solanum nigrum* leaf

Extracts	% inhibition at different concentration, µg/mL			
	200, µg/mL	400, µg/mL	600, µg/mL	800, µg/mL
Ether	0.083±0.0049	0.076±0.0078	0.069±0.0015	0.063±0.0025
%	45.75	50.33	54.90	58.82
Ethyl acetate	0.148±0.0050	0.139±0.0055	0.128±0.0035	0.112±0.0075
%	48.43	51.57	55.40	60.98
Chloroform: methanol (3:2)	0.046±0.0040	0.041±0.0061	0.037±0.0025	0.033±0.0031
%	71.78	74.85	77.30	79.75
Acetone	0.167±0.0240	0.156±0.0300	0.144±0.0356	0.127±0.0324
%	42.41	46.21	50.34	56.21
Ascorbic acid	0.033±0.0021	0.030±0.0025	0.028±0.0020	0.024±0.0032
%	84.29	85.71	86.67	88.57

Values were expressed as MEAN±S.D. (n= 3)

The result of antioxidant activity by DPPH method showed that the leaf extract of chloroform methanol (3:2) has the highest value of percentage inhibition of DPPH 79.75% whereas stem extracted by same solvent showed 68.78% at concentration of 800 µg/mL. In this method leaf extract showed better result than stem extracts of *Solanum nigrum*[11].

The result of antioxidant activity by reducing power assay as shown in Table 8 and 9, it is evident that the leaf extract and stem extract of chloroform: methanol (3:2) showed maximum absorbance at 800 µg/mL 0.362 and 0.298 respectively. Highest activity of chloroform: methanol extract for leaf and stem is according to the result of Sudhanshu *et al.*[12] which studied that methanol extract of *Solanum nigrum* showed highest antioxidant activity.

Table 7. DPPH free radical scavenging assay (%) of *Solanum nigrum* stem

Extracts	% Inhibition at different concentration, µg/mL			
	200, µg/mL	400, µg/mL	600, µg/mL	800, µg/mL
Ether	0.124±0.0147	0.117±0.0137	0.097±0.0121	0.086±0.0152
%	29.94	33.89	45.19	51.41
Ethyl acetate	0.134±0.0032	0.122±0.0026	0.105±0.0047	0.086±0.0074
%	29.47	35.79	44.74	54.74
Chloroform: methanol (3:2)	0.087±0.0020	0.077±0.0066	0.064±0.0031	0.059±0.0036
%	53.97	59.26	66.14	68.78
Acetone	0.214±0.0107	0.201±0.0025	0.191±0.0028	0.186±0.0010
%	25.44	29.96	33.45	35.19
Ascorbic acid	0.033±0.0021	0.030±0.0025	0.028±0.0020	0.024±0.0032
%	84.29	85.71	86.67	88.57

Table 8. Reducing power activity of *Solanum nigrum* leaf

Concentration µg/mL	Ascorbic acid	Ether	Ethyl acetate	Chloroform methanol (3:2)	Acetone
200	0.545±0.0030	0.262±0.0010	0.280±0.0020	0.291±0.0015	0.211±0.0010
400	0.604±0.0074	0.265±0.0015	0.292±0.0031	0.318±0.0122	0.219±0.0015
600	0.634±0.0053	0.281±0.0032	0.295±0.0045	0.325±0.0134	0.241±0.0021
800	0.695±0.0061	0.291±0.0066	0.306±0.0072	0.362±0.0055	0.252±0.0025

Values were expressed as MEAN ± S.D. (n=3)

Table 9. Reducing power activity of *Solanum nigrum* stem

Concentration µg/mL	Ascorbic acid	Ether	Ethyl acetate	Chloroform: methanol (3:2)	Acetone
200	0.545±0.0030	0.130±0.0031	0.180±0.0064	0.263±0.0025	0.113 ±0.0025
400	0.604±0.0074	0.140±0.0064	0.193±0.0020	0.275±0.0015	0.139±0.0026
600	0.634±0.0053	0.161±0.0025	0.213±0.0030	0.289±0.0010	0.152±0.0020
800	0.695±0.0061	0.182±0.0025	0.218±0.0025	0.298±0.0030	0.162±0.0017

Values were expressed as MEAN ± S.D. (n=3)

Conclusion

Thus it is concluded that leaf extract of *Solanum nigrum* can effectively scavenge an assortment of reactive oxygen species or free radicals than stem extract and the antibacterial activity exhibited by extracts of *Solanum nigrum* leaf and stem material was however less than the standard drugs used.

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