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An Evaluation of Hepato-protective Activity of Ethanolic Extract of *Solanum nigrum* with Varying Doses on CCL4 Induced Hepatic Injured Rat

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Herbal medicine, an art form as well as a profession, is the use of herbs and herbal remedies to prevent, treat, or cure sickness. In certain tribes, herbal medicine is also known as herbal remedies. In this investigation, rats were used in the research to examine the lipid profiles of the extract from Solanum nigrum. In the case of SGPT, group 6 showed statistically significant outcomes ($p< 0.05$), whereas in the case of SGOT, both groups 5 and 6 showed statistically significant outcomes ($p< 0.05$). In relation to the SGPT and the SGOT, this is being said. Both group 5 and group 6 showed statistically significant amounts of creatinine and urea ($p< 0.05$) during the renal function test. Group

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6 with a dose of 1200 mg/kg showed statistically significant results for high-density lipoprotein (HDL) and low-density lipoprotein (LDL) ($p < 0.05$). Furthermore, at dosages of 600 mg/kg and 1200 mg/kg, respectively, the triglyceride level in groups 5 and 6 was statistically significant ($p < 0.05$). There were no results that were deemed statistically significant for total cholesterol.

Keywords: Herbal medicine; Solanum nigrum; HDL; LDL; phytochemicals; herbal medicine; triglyceride; landular organ.

1. INTRODUCTION

The majority of a person's bodily processes are controlled by the liver, the biggest glandular organ. Numerous times during the day, the whole blood supply of an individual goes through the liver. The liver is very critical for human metabolism. [1]. Hepatotoxicity, the most frequent form of liver illness, is a leading cause of death and impairment in both animals and humans. Several medications can cause it. [2]. Addiction to alcohol or drugs, exposure to harmful chemicals, infections with viruses or parasites, and high levels of reactive oxygen species (ROS) are among the most damaging factors that may affect liver cells (OH, H_2O_2, O_2) [2]. The ability to neutralize free radicals is why ascorbic acid and the tripeptide L-glutathione (L-cysteine, glycine, and L-glutamate) are taken orally as dietary supplements. Because of their anti-inflammatory, antibacterial, and immune-enhancing qualities, they are highly prized by many [3]. On the flip side, they might trigger an allergic response, such as dermatitis, or gastrointestinal issues, such as gas, diarrhea, indigestion, or even difficulties breathing due to airway narrowing. There are 1.5 billion individuals worldwide who suffer from chronic liver disease (CLD). Among Americans aged 45–64, the prevalence of CLD has risen by 31% in recent years. [4]. Some chemical components derived from medicinal plants may have therapeutic uses, say specialists in the subject. It follows that researchers are always on the lookout for new herbal cures and other plant-based therapies to treat a wide range of illnesses. [5]. While phytotherapy is based on scientific study, herbalism is more concerned with the practical applications of medicinal plants. Plants have played a significant role in human medicine for thousands of years due to the wide diversity of chemicals they contain, many of which have medicinal characteristics [6]. The vast variety of chemical components found in medicinal plants allows them to exert a broad spectrum of pharmacological and therapeutic effects. Tanning agents, glycosides, alkaloids, saponins, polysaccharides, essential oils, terpenoids, resins, and plant lipids are all examples of such components [7-9]. Modifying plants genetically allows for the precise regulation of chemical concentrations, allowing for the desired therapeutic effect. Reverse genetics has many potential applications, one of which is to enhance the production of secondary metabolites like alkaloids [10].

Black nightshade, deadly nightshade, or *Solanum nigrum* (SN) belonging to the family Solanaceae, is a widespread weed plant that grows wild in open fields throughout Africa, the Americas, and even the driest parts of India and other parts of the world [11]. It is also known as Enab Eldib in Egypt. A wide range of conditions have been traditionally treated with *S. nigrum* in folk medicine, including: pain, fever, inflammation, cough, asthma, wound, ulcer, leprosy, skin diseases, hemorrhoids, dropsy, liver disorders, antioxidant, hepatoprotective agent, neuroprotective, cytoprotective, antimicrobial, antinociceptive, and antipyretic effects [12–19]. Some people think *S. nigrum* is a great treatment for liver problems [13]. Solasodine, tomatidenol, tigogenin, solamargine, and solasonine are the primary components derived from the aerial sections of *S. nigrum*. Other components include lutein, lycopene, crytoxanthin, vitamin C, glucose, fructose, and tomatidenol. Polysaccharides, glycoproteins, and glycoalkaloids make up the bulk of the active ingredients. Polyphenolic compounds like gallic acid, catechin, protocatechuic acid, caffeic acid, epicatechin, rutin, and naringenin are also present and are thought to be responsible for a variety of therapeutic effects [20].

This research aims to evaluate the potential hepatoprotective benefits of *Solanum nigrum.*

2. MATERIALS AND METHODS

2.1 Plant Collection and Extract Preparation

Solanum nigrum frits were collected from local market of Dhaka. The specimen was verified by the Bangladesh National Herbarium, which also gave it the accession number 568765 for future

use. *S. nigrum* was 1st cleaned properly with distilled water and air-dried. Next, it was severely grinded with mechanical grinder. The powder was soaked in 90% ethanol with 1:2 ratio and kept for 15 days. By this time the solution was vigorously shaken occasionally. Then, the extract was filtered witn Whitman filter paper with gravitational filtration and the filtrate is collected. The filtrate was dried in a rotary evaporator at a 60℃ temperature. Finally, the crude residue with yield 2.01% was subjected to the required pharmacological testing.

2.2 Drugs and Chemicals

Carbon tetrachloride (CCl_4), a well-known hepatotoxicity causing chemical, was purchased from the Sigma Aldrich. The API of typical anti-oxidant medication silymarin was received as a free gift from Incepta Pharmaceuticals Limited

2.3 Experimental Animal Procurement, Nursing and Grouping

A total of 100 male rats weighing between 120 and 150 grams were obtained from Jahangirnagar University in Savar, Dhaka. Each of them was housed in a climate-controlled environment (temperature 25±3°C, relative humidity 55±5%, and a 12-h light/dark cycle) at the University of Dhaka's Institute of Nutrition& Food Science (INFS). Group 1 is negative control group and group 2 is positive control group whereas group 3-group10 is treatment group. They were given a standard diet and were provided with clean water. All of the animals were acclimatized in this habitat for at least one week prior to the research for adaption.

2.4 Animal Model Sample Size Detection

There were 100 rats in all, and they were randomly divided into ten groups of ten. The rats were randomly allocated to one of the groups. The rats were watched closely each day to ensure better health status.

2.5 Dose Selection and Route of Administration for Respective Study

Carbon tetrachloride (CCL_4) is a common chemical agent used in laboratories to study arange of liver diseases, both acute and chronic. Trichloromethyl free radical (CCL_3), a CYP2E1isozyme-produced CCL_4 metabolite, reacts with cellular lipids and proteins to form trichloromethylperoxy radical, which attacks lipids on the endoplasmic reticulum membrane faster than thetrichloromethyl free radical, causing lipid peroxidation and lobular necrosis. A single oral treatment of CCl_4 mixed with olive oil as a vehicle in a 1:1 ratio (3 ml/kg of rat body weight) produced hepatic damage in all animal groups except the usual control group. *Solanum nigrum* extracts were administered to animals with hepatic injury as a post-treatment. The extract was administered orally at doses of 300,600 and 1200mg/kg with Tween-80 solution.

2.6 Evaluation of Hepato–Protective Activity

For this experiment, 100 rats were randomly picked and equally divided into fourteen groups.

2.7 Biological Sample Collection

Blood was drawn from the animals via cardiac puncture and transferred to a centrifuge tube by euthanizing the rats with chloroform. The samples were centrifuged at 5,000 rpm for 5 minutes to create the supernatant fluid. Biochemical testing subsequently required the transfer of this fluid to an additional micro-centrifuge tube.

2.8 Estimation of Biochemical Parameters

Lipid profile (total cholesterol, triglyceride, HDL, LDL), kidney (urea and Creatinin), and liver function tests(SGPT and SGOT) were performed in Humaluzer 3000 using respective parameter Kit.

2.9 Statistical Analysis

All of our findings (raw data) in terms of numerical parameters were recorded and analyzed on a broadsheet using the MS Excel application. The gathered data were subjected to descriptive statistics, with the findings reported as mean SD. To evaluate statistical significance, we used the SPSS 16 software's "One-way ANOVA test" to interpret inter-group heterogeneity in terms of several biological factors. The occurrences are considered statistically significant since the 'p' value was less than 0.05 ($p<0.5$).

3. RESULTS AND DISCUSSION

"Herbal medicine" is the term used to describe the practice of using medicinal herbs to prevent and treat disease. A wide range of treatments

Table 1. Application of treatment efficacy

Group Number	Group Specification	Treatment species	Dose treatment species (mg/kg)	Abbreviation of Groups
1	Negative Control	Physiological saline	10 ml/kg	N
2	CCl_4 Control	N/A	N/A	A
3	CCl_4 + S_{10}	Silymarin	10	S_{10}
4	CCl_4 + SN_{300}	*Solanum nigrum*	200	SN_{300}
5	CCl_4 + SN_{600}	*Solanum nigrum*	400	SN_{600}
6	CCl_4+SN_{1200}	*Solanum nigrum*	600	SN_{1200}
7	S_{10}	Silymarin	10	S_{10}
8	SN_{300}	*Solanum nigrum*	200	SN_{300}
9	SN_{600}	*Solanum nigrum*	400	SN_{600}
10	SN_{1200}	*Solanum nigrum*	600	SN_{1200}

Table 2. Different biochemical parameters of *Solanum nigrum*

Groups	SGPT	SGOT	Creatinine	Urea	TC	HDL	LDL	TG
C	35.39±0.48	46.24±1.28	0.5±0.04	32.47±3.19	96.82±3.28	68.57±3.52	34.28±0.94	50.71±2.62
CCl_4	99.37±6.82	106.43±4.89	2.83±0.08	98.59±0.32	174.28±5.73	42.58±4.48	88.29±5.61	103.57±8.91
CCl_4 + S_{10}	62.45±4.61	57.28±5.38	1.46±0.08	56.27±5.55	141.34±6.42	59.74±4.67	68.22±6.53	74.81±4.53
CCl_4+SN_{300}	99.21±4.15	102.03±5.16	2.50±0.09	95.93±4.21	172.86±3.21	44.23±4.89	86.24±5.15	100.42±7.95
CCl_4+SN_{600}	97.36±5.57	92.10±4.53*	2.09±0.08*	89.41±3.39*	170.53±4.59	44.82±2.30	85.43±3.37	97.63±6.29*
CCl_4+SN_{1200}	94.68±4.02*	86.77±3.27*	1.63±0.06*	84.28±4.29*	169.93±5.21	46.59±3.93*	82.01±5.04*	92.52±6.82*
S_{10}	37.10±1.39	48.32±2.36	0.6±0.05	33.16±1.93	92.32±2.10	67.57±2.91	36.82±1.06	52.59±3.63
SN_{300}	35.60±2.08	45.57V3.13	0.8±0.02	35.21±2.06	96.53±3.16	64.83±3.56	34.53±1.81	50.78±2.32
SN_{600}	37.37±1.28	47.48±3.36	0.5±0.08	30.28±1.50	95.90±2.03	69.20±4.01	35.62±2.80	54.62±3.18
SN_{1200}	34.36±3.38	42.15±0.29	0.7±0.03	32.38±3.17	93.26±3.53	65.23±3.01	34.94±2.42	48.10±2.51

*Note: The results were expressed in Mean±SEM (standard mean error) *p< 0.05, **p< 0.01, and ***p< 0.001 were considered as statistically significant. The statistical analysis followed by one-way analysis of variance (Dunnett's test) compared to the control*

are covered in this area of research, including standardized, tritated therapies and universal therapies. In the course of this study, we evaluated the lipid profile of the herb *Solanum nigrum* in rat models to determine its effectiveness as an anti-diabetic agent. Group 6 demonstrated statistically significant ($p < 0.05$) outcomes in the case of SGPT(Serum glutamic pyruvic transaminase), whereas group 5 and group 6 demonstrated statistically significant ($p < 0.05$) results in the case of SGOT (serum glutamic-oxaloacetic transaminase). This is with regard to both the SGPT and the SGOT. A total of two further studies came to the same conclusions [21,22].

When conducting the kidney function test, it was observed that the levels of creatinine and urea were statistically significant ($p < 0.05$) in both group 5 and group 6. Comparable findings were discovered in a number of other investigations [23,24].

In the case of high-density lipoprotein (HDL) and low-density lipoprotein (LDL), the findings were statistically significant ($p < 0.05$) in group 6 with a dosage of 1200 mg/kg. Additionally, the triglyceride level was statistically significant ($p < 0.05$) in groups 5 and 6 with doses of 600 mg/kg and 1200 mg/kg, respectively. In the case of total cholesterol, there were no findings that were recognized as statistically significant. There were two other investigations that came to the same conclusions [25,26].

4. CONCLUSION

Within the scope of this investigation, the hepatoprotective properties of the 95% ethanolic extract of *Solanum nigrum* were investigated. The results of this study support the idea that an ethanol extract from the plant *Solanum nigrum* might help protect against high cholesterol, liver damage, and kidney problems. As a result, more research is necessary in order to determine the active components in the entire extract that have the ability to reduce hyperlipidemia and diabetes. When it has been determined which chemicals are active, it is possible to conduct a comprehensive exploration.

ETHICAL APPROVAL

All experiments have been examined and approved by the ethical committee under permission number. 278/LUB.Pharm. All experimental methods followed the recommendations of the Institutional Animals Ethics Committee (IEAC).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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