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REVIEW ARTICLE

Recent Investigations on the Pharmacology, Phytochemistry, and Traditional use of the *Solanum Nigrum* Linn

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ABSTRACT

The *Solanum nigrum* Linnaeus plant was first cultivated in Southeast Asia, but it is now grown all over the world and is now widespread across the continents of Europe, Asia, as well as North and South America, and it thrives in climates ranging from temperate to tropical. One hundred and eighty-eight different chemical components of S have been recognized up until this point nigrum. Investigations into the physiological and psychoactive effects of S. Studies conducted *in vitro* and *in vivo* on the medicinal herb nigrum have revealed that it possesses a variety of beneficial qualities, including those that are neuroprotective, antibacterial, anti-inflammatory, and anticancer. This article takes a detailed and methodical approach to discuss the traditional and botanical applications of S, as well as its phytochemical components, pharmacological properties, clinical trial results, and adverse effects. Nigrum to provide the most recent facts possible regarding the application and utilization of *S. nigrum* as an ingredient in therapeutic meals and drugs.

Keywords: Chemical components, Extracts, Plant, Solanaceae, *Solanum nigrum*

INTRODUCTION

There are about 2000 different species of plants that belong to the genus *Solanum*, which is in the family Solanaceae. These plants are all indigenous to tropical and subtropical areas. The vast majority of them bear lovely fruits as well as blooms. The genus *Solanum* can be found in China in 39 different species and 14 different variations. Black *Solanum* Linn. valerian L. in addition to (the Chinese character for). Nigrum can be found growing in the vicinity of human populations, agricultural areas, and wastelands virtually everywhere in China. It is also common in climates ranging from temperate to tropical in Asia, the United States, and Europe. The plant is known by a variety of different names depending on the region in China in which it is found.[1]

S. Bitter herb nigrum, which is associated with the lung and kidney meridians and has a taste that is chilly, somewhat toxic, and bitter, can be used therapeutically. The bitter herb nigrum also has a reputation for being a bitter-tasting herb. In Chinese folk medicine, the element S has played a significant role in treatment. Nigrum. S.'s whole plant. In addition to this, it is beneficial for removing blood stasis and detumescence, reducing heat, and detoxifying the body. In addition to this, in modern-day clinical practice, S. to treat cancers, nigrum is usually coupled with other types of therapy. There are reports that it has been utilized as a treatment for cancers in a number of Asian countries, including Japan and India. The fruits, of *S. nigrum* are mixed in taste, and it is believed that they were used as a source of nutrition in China

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during the 15th century during a famine. After being cooked, the leaves and berries are treated as food. Research on phytochemicals conducted over the course of the last few decades has shown that the whole S. In addition to other chemicals, the nigrum herb is loaded with *S. nigrum* and some of the chemicals described above have been linked to a wide variety of beneficial effects in various diseases. Researchers are particularly interested in the anticancer effects of saponins and alkaloids because they believe these chemicals will yield antitumor lead compounds. Steroidic saponins and alkaloids are steroidal compounds.

Because of the growing need for steroid chemicals that are produced from S. This article offers a thorough investigation, activity, and protection concerns associated with *S. nigrum* as a consequence of the substantial pharmacological activity that they exhibit. Based on research carried out using databases, with a particular focus. We have reason to anticipate that the findings of this review will have a sizeable impact on either the conduct of subsequent research or the creation of novel cancer treatments based on S. in addition to functional diets that are high in antioxidants. nigrum and the energy components that make up nigrum.

Plant classifications as well as descriptions:

PLANT DESCRIPTION

S. nigrum is a yearly herbaceous plant that can grow up to 1 m in height. Its height ranges from 0.25 to 1 m. It has a taproot system in addition to a strong primary root, and it lignifies its wood frequently. The stem is almost completely glabrous or puberulent and might be green or purple. It does not have any delicate edges. The shape of the leaf is oval, it ranges in length from 2.5 to 10 cm and width from 1.5 to 5.5 cm, and the tip is acutely pointed. The length of the petiole ranges from 1 to 2 cm, and the cuneate base can be described as being either broad or wedge-shaped. It has teeth that are irregular, undulating, and coarse throughout or on each side, and the epidermis on both sides is either inflorescence that can include anywhere from 3 to 10 flowers. The pedicel has a length of between 1 and 2.5 cm overall, is virtually glabrous or pubescent, and is roughly 5 mm in length. The calyx is a diminutive structure that takes the form of a shallow cup and has teeth that are oval, rounded at the apex, and angled at the base. Its diameter varies between 1.5 and 2 mm. The length of the tube is <1 mm, the corolla is white, and the crown has five lobes that measure roughly 2.5 mm in length. The appendages measure about 2 mm in length and have an oval cross-section. The anthers are yellow, have a length of roughly 1.2 mm, and have an apical aperture that faces inward. There are some short filaments present. The length of the style is roughly 1.5 mm, and the diameter of the ovary is approximately 0.5 mm. The cranium is shaped, the bottom region of the middle half is covered in white hair, and the stigma is rather modest. When it reaches maturity, the berry takes on a spherical shape, grows to be 8 mm in diameter, and darkens in color. The majority of seeds have a roughly oval shape, measure between 1.5 and 2 mm in diameter, and are compressed on both sides.

TAXONOMY

S. nigrum is categorized as Plantae, Angiosperm, Magnoliopsid, Solanales, Solanaceae, and Solanum in terms of botany. The plant family known as the Solanaceae is predominately located in tropical America, and it contains more than 3000 species and 80 different genera. There are roughly 2000 different species of the genus Solanum, which gives it a prominent place within the family Solanaceae. The round fruits that are produced by S. When mature, nigrums are rich purple. Both the berries and the foliage can be consumed, however, to remove the alkaloids that are found in the leaves, they need to be cooked first.

USUAL PROCEDURES AND PRACTICES

The oldest narrative that is known to have been written about nigrum possesses the qualities of removing heat, detoxifying, lowering tumescence, and dispersing knots. In addition, nigrum has been shown to reduce tumescence. There are a number of essential TCM monographs, including S. There are a wide variety of additional medical applications

for nigrum, in addition to its use in the treatment of dermatitis, inadequate urine, chronic bronchitis, excessive leucorrhea, prostatitis, and dysentery. S may be found in a wide variety of TCM botanicals as well as mainstream treatments. There have been numerous preparations of the nigrum herb, including a decoction, powder, granule, pill, and capsule. To be more specific, Sheng Ji Zong Lu makes the claim that *S. nigrum* (30 g) is suitable for use with various plants, such as *Hylotelephium erythrostictum* (Miq.) H. 30 g of the *Coptis chinensis* Franch., Ohba plant. *Momordica cochinchinensis* (Lour.) Spreng., 30 g. The treatment of malignant lesions can be accomplished using *Abelmoschus manihot* (Linn.) Medicus (15 g) and (15 g) (https://db.yaozh.com). S. toxicity, edema, and carbuncles are some of the conditions that it is used to treat. Nigrum can also be crushed and used for cleansing when applied topically. It is also possible to combine it with traditional Chinese medicine herbs, such as *Chrysanthemum indicum L*., *Corydalis bungeana* Turcz., and *Taraxacum mongolicum* Hand.-Mazz., to prepare a decoction and then administer it orally to treat inflamed throats.

In addition to its use as emetics, antispasmodics, and diuretics, the seeds of the nigrum plant are also employed in the treatment of diarrhea, fever, eye difficulties, and bleeding. As a further point of interest, the leaves of *S. nigrum* are applied topically to treat itching and sores, as well as for the treatment of dysentery, convulsions, and insomnia. They are also used as a cholagogic and anesthetic. The total amount of land area that *S. nigrum* is a drug that can be used to induce sleep, relieve pain, and calm spasms. *Sambucus Nigra* is used to treat phlegm, dysentery, and bleeding that has already occurred. The result of Jordan's efforts on the *S. nigrum* is a medicine that is used to treat spasms. Nigrum is a significant plant that is utilized in traditional Indian medicine to cure a variety of conditions, including diarrhea, fever, and stomachaches.[2]

COMPONENTS OF PLANTS THAT ARE CHEMICAL IN NATURE

There are a large number of naturally occurring chemicals with a variety of structural configurations and beneficial qualities that can be discovered in nigrum. To this point, about 188 different plants are composed of numerous chemical components, some of which include phenylpropanoids, their glycosides, flavonoids, organic acids, steroids, and alkaloids. Steroidic chemicals, which include steroidal alkaloids (77–101) and steroidal saponins (1–76), are thought to represent the primary bioactive components of *S. nigrum* and contain a variety of health benefits, including those that fight cancer, inflammation, and viruses. Artificial saponins.

Secondary metabolites and medicines can be derived from this source. Recent studies have shown that the elements of S with the greatest potential for pharmaceutical application are called steroidal saponins. nigrum. There have been a total of 76 steroidal saponins that have been isolated and identified up to this point. Research is being done currently on the pharmacological effects of *Staphylococcus aureus* is limited. The many different kinds of steroidal saponins are the primary focus of the vast majority of the studies that have been done on the chemical components of nigrum. Nigrum is largely concerned with the effects of its constituents. In the year 2006, the entire *S. aureus* factory was destroyed. The structure and action of the steroidal saponins in *Solanum nigrum* have been investigated. Progesterone and spirostanol saponins are more cytotoxic than furostanol and cholesteric saponins. Later on, Xiang *et al*. found that immature S had seven freshly produced steroidal saponins (61–67), each of which had a newly created cholestane 16, 22-dione structure.[3]

ALKALOIDS

Specifically, the alkaloids were found in S. The majority of the nigrum compounds are discussed in the scientific works. These compounds are found in the glycoside form in the plant. Sylvestris are the fruits of S. The greatest concentration of alkaloids, which can reach 4.3% in nigrum, gradually drops as the plant matures. Nigrum has the potential to attain this concentration. It is possible that this process explains how the plant is able to defend itself. These alkaloids also contribute to the protection

of the species. S contains steroid alkaloids in small amounts. In addition, the anticancer activity of S is predicated on the presence of nigrum. A chemical that belongs to the class of steroidal alkaloids that can be found in S. The glycoside of solasonine and solamargine, solasodine (88), contains 0.2% and 0.2% of nigrum, respectively, after being subjected to alkaline hydrolysis. The component called solamargine accounts for the majority (79) of S's total alkaloids. This information comes from pharmacological investigations and the nigrum. Solaoiacid (84).

In addition to the steroidal alkaloids that can be discovered in *S. nigrum*, there are also *S. nigrum*, additional alkaloid variants chemicals that are characterized by the presence of amide groups. They are known to possess a wide variety of beneficial biological effects, such as neuroprotective, anti-inflammatory, and insecticidal qualities. According to the findings, cannabis in F (112) could be differentiated from the components of S that were found above ground.[4] The compound nigrum has a strong neuroprotective impact against SH-SY5Y cell damage models produced by MPP+ when it is present in doses of 12.5, 25, and 50 M.[5]

PHENYLPROPANOIDS

Phenylpropanol is an obviously occurring chemical that is made by attaching three carbons with straight chains (groups C6-C3) to a benzene ring in a bonded configuration. It is a phenolic compound that is structured such as phenol. The vast majority of these molecules are produced through biosynthesis, which involves a series of chemical events. One of these reactions involves. From the whole plant of S., a total of 21 different phenylpropanoids (numbered 134–154) have been successfully extracted and chemically characterized. nigrum. Scopoletin (144) can be found in high concentrations in S. Recent studies Flavonoids.

Flavonoids make up more than 50% of all phenolic chemicals that can be detected in plants. These chemicals have pharmacological effects, among other features. Three flavone glycosides, numbered 156–158, and one flavone, numbered 155, were extracted[6] from *S. nigrum*. The compounds 164 and 165 were derived from *S. aureus*, and its characteristics were determined in the year 2017. Nigrum, which suggests that their ability to suppress cholinesterase activity was not as strong as that of their *S. nigrum*, most likely as a result of the additive effect that these chemicals have on one another potential of element *S. nigrum*'s flavonoid makeup is quite comparable, and research done has shown that they are highly similar. Nigrum have demonstrated that they have many of the same biological characteristics. To prepare the groundwork for the creation and application of S. Growing nigrum is necessary to manufacture useful products.

ACIDS BENZOIC

In addition to this, it was discovered that seven different benzoic acids produced from S included phenolic hydroxyl substituents. Nigrum, such as salicylic acid (171), 4-hydroxybenzoic acid (170), vanillic acid (169), and protocatechuic acid (168), can serve as crucial pharmaceutical intermediates in the treatment of disease and open up a large variety of possible applications. In addition, they can open up new avenues of research and development.

POLYSACCHARIDES

Polysaccharide is one of the four chemical compounds that play a fundamental role in all of the activities that occur in living things. Plant polysaccharides have been shown in an increasing number of studies to exhibit a variety of unique biological features, including immunological modulation, anticancer, and liver protection. At this time, 12 unique types of polysaccharides derived from S have been identified and extracted. Nigrum contains qualities that protect the liver, modulate the immune system, and fight cancer. *S. aureus* was used as a source to isolate these polysaccharides. monosaccharide compositions, molecular weights, structural properties, and biological activity were all present and possessed by the organism. Additional Components:

In addition to the compounds that are listed above, researchers have only been able to identify a small number of S compounds. The compounds included organic acids in their makeup. Ursolic acid (178), a well-known anticancer triterpene, and the ursolic acid compounds, which are aliphatic molecules, are both examples of ursolic acid.

BEHAVIOR ASSOCIATED WITH DRUG USE

A great number of investigations on the pharmacological effects of S. have been carried out. Nigrum within the past few years S., it was possible to extract both bioactive chemicals and solvent extracts. Some of the pharmacological properties have been linked to nigrum. The United States buys a wide range of unique medications produced in China. Extract of nigrum has been utilized extensively as a medicinal component in a variety of clinical settings.

ANTITUMOR CAPABILITY

S. aureus that has been contaminated with impure extracts and isolated chemicals. Nigrum has been shown to have significant anticancer potential in both *in vitro* and *in vivo* research studies. The fundamental mechanism was behind the action of the bioactive components or impure extracts of S.

BASIC EXTRACT

The results of certain *in vitro* research showed that a few S. Several different cancer cell lines were significantly inhibited by nigrum. Additional research showed that the NF-B inhibitor pyrrolidine dithiocarbamate was responsible for preventing the synergistic impact of S. on the expression of iNOS as well as the creation of NO. nigrum and rIFN-. These data gave rise to the hypothesis that S. According to the findings of Hsu *et al*.,[7] the administration of 1% and 2% SNWE considerably increased survival to 90% and 100%, respectively, and lowered hepatic carcinogenesis to 40% and 20%, respectively. The study was conducted on rats with hepatoma that was generated by AAF/ NaNO2. In the MCF-7 human breast cancer cell line, SNWE elicited a cytotoxic response of 43%, a migratory inhibition of 43%, and a suppression of the hexokinase and pyruvate activities by 30% and 40%, respectively (Ling *et al*., 2019).[8] These results were obtained at a concentration of 10 g/L. The polyphenolic extract was derived from S. The IC50 value for *S. aureus* was determined cerevisiae ranked number one. while the doses at which HepG2 cells were viable were 0.5, 1.0, and 2.0 mg/mL. In addition, the weight and volume of the tumor both decreased following 35 days of administration of a daily 5 g basal meal with either mice with HepG2 tumors. This was the result of administering the meal. In addition, Yang *et al*. (2010) found that exposure to SNPE led to a considerable reduction in the viability of HepG2 cells (IC50 = 0.86 mg/mL). According to research on the mechanism of action HepG2 by lowering p38 and p38/ERK activation while also inhibiting PKC expression. This was accomplished by reducing p38 and p38/ERK activation. In addition, SNPE prevented the activation of AKT and mTOR *in vitro* that was produced by VEGF, which of HepG2 cells. In addition, the SNPE treatment decreased the size of the tumors as well as their weight in the mouse model of the HepG2 tumor.

S. according to the relevant literature, *S. aureus* can be extracted using a number of different solvents. Nigrum possesses considerable anticancer action throughout a broad spectrum. There are signs that *S. baumannii* can cause *S. nigrum* fruit (SNCE), as stated, was able to stop the proliferation of (IC50 = 40.77 g/mL) and cause 43.31% of them to commit apoptosis. *S. aureus* n-Butanol extract. According to Ye and Gao's research from 2019, nigrum suppressed the proliferation of human colorectal cancer SW480 cells. It did this by stopping the cells from entering the G2/M phase and by raising the expression of caspase-3. In accordance with the findings of this research, a variety of solvent extracts of S. There is preliminary evidence that nigrum can be an effective cancer treatment.

SUBSTANCES THAT CAN NOT BE GROUPED

In addition, chemicals were separated from S. In addition to this, research on nigrum revealed a

multitude of anticancer characteristics. In large concentrations, -solanine can be found in potatoes, tomatoes, eggplants, and other plants belonging to the Solanaceae family (99). Studies conducted in the field of pharmacology indicate that it inhibits the growth of cancer cells and acts as an insecticide; nevertheless, excessive consumption can lead to adverse health effects. Solamargine regulates the biological function of immune cells and has a synergistic anticancer impact. It does this by changing the microenvironment of the tumor, limiting heterogeneity in the tumor cells, and blocking the LIF/Stat3 signaling pathway at low dosages. This justifies its widespread implementation in the modern clinical treatment that is being provided today.[9] Patients in the clinic who have advanced or metastatic cancers are given adjuvant therapies such as radiation therapy, hormone therapy, chemotherapy, and targeted therapy; nevertheless, the side effects that usually ensue from these treatments frequently result in treatment failure and increased mortality. Because of this, there is a significant demand for medicines that are very effective while also having a minimal risk of producing harmful side effects. The compound known as degalactotigonin (2) was extracted from S. The proliferation of renal cell carcinoma cells, as well as their migration, invasion, and transformation into tumorigenic cells, are all inhibited by nigra. According to Wang *et al*.'s 2020 research, it is an effective treatment for advanced renal cell cancer. This proves beyond a reasonable doubt that TCM is capable of being applied in clinical settings in a more effective manner.

IMMUNOMODULATING BEHAVIOR

S. nigrum crude polysaccharides (SNLP-1) showed clear evidence of immunoregulatory activity for macrophages by inducing. This was accomplished by using the SNLP-1 treatment. Flow cytometry demonstrates that administration of SNLP-1 to rodents raises both the ratio of T lymphocyte subsets CD4+/CD8+ as well as the levels of serum Th1 cytokines (including IFN-, IL-2, and TNF). In clinical research, decoction, along with other methods of extraction, revealed immunomodulatory effectiveness.[10] the levels of CD4+/CD8+ and CD4+ in the psoriasis therapy group increased after 8 weeks of treatment with commissioned Longkui Yinxiao Tablet, whereas levels of TNF-, IL-6, and IL-17 decreased during the same time period.

According to the research that was discussed earlier, S. Both *in vitro* and *in vivo* studies have shown that nigrum, and more specifically its polysaccharides can modulate the immune system. However, S. contains immunomodulatory characteristics. In-depth research on nigrum's immunomodulatory effect has not been conducted above the level of inflammatory factors. The research on polysaccharides has garnered the most attention, despite the fact that there are many other effective immunomodulatory components that should be given a higher priority.

ANTI-INFLAMMATORY PROPERTIES

It is a self-defense mechanism that supports the body's recovery and resistance to infection, disease, discomfort, substances, and negative consequences. Studies that are pertinent to the topic have shown that impure extracts of S. possess anti-inflammatory properties. Nigrum in a number of different models of inflammation, and discussed the likely underlying mechanisms. At a dose of 50 g/mL, nigrum was able to suppress 80% of the NO and iNOS formation that was generated by LPS. Cytokines such as TNF- and IL-6 have been linked to the pathophysiology of a wide variety of inflammatory disorders.[11] the nigrum chloroform fraction. Yeom *et al*. provided evidence that showed the cell viability of *S. aureus* has decreased in number. In the mouse model of TPA-induced acute ear edema, there was a rise in the amount of Cerevisiae fruit extract. Nigrum had a concentration of 51.35% when measured at 0.125 mg/mL in ethanol that was 80%. Results that were the same were seen in both the acute and subacute rat models, as well as in *S. aureus* was not found in any of the samples. Nigrum displayed decreased macrophage deposition and enhanced collagen fiber deposition as a result of

the presence of steroidal alkaloids and steroidal saponins of S. In addition, nigrum exhibited organ-protective qualities (liver, stomach, and kidney) as a result of these compounds. Nigra was discussed in (Aryaa and Viswanathswamy, 2017). independent S.[12] The use of nigrum suppository stimulated the regeneration of injured epithelial tissue and restored prostatic secretion. This was accomplished by a reduction in the moist quality and white blood cell count of the rat prostate as well as an increase in the density of lecithin corpuscles. Similar to self-made *S. nigrum* may provide anti-inflammatory benefits by increasing SOD activity and decreasing MDA content in rabbit synovium after being coated with synthetic S at the rabbit knee joint. In a model of rabbit knee synovitis that was produced by electroacupuncture, nigrum ointment was applied for a total of 6 days, 1.5 h each day, for a total of 6 days. In the berries of S. sapota, Wang *et al*. made the discovery in 2017 of nine new steroidal saponins. Solanigrosides Y1 (52) of these steroidal saponins dramatically decreased NO generation, with an IC50 value of 9.7 mM. In addition, several compounds significantly inhibited LPS-induced IL-6 and IL-1 production. The immature berries of S. contain seven different steroidal glycosides. Nigrum, with IC50 values ranging from 11.33 to 49.35 M for each of the seven compounds, all of which inhibited NO production. The NO production was stopped by all of the compounds. Reed extracts and various other formulations are effective overall, according to S. It is necessary to conduct additional research on nigrum and inflammatory illnesses.

HAVING BOTH ANTIBACTERIAL AND ANTIPARASITIC PROPERTIES

There has been a great threat to the general population's health posed by multidrug resistance, as well as bacterial and fungal infections, and these are serious challenges that need to be addressed right away. Studies conducted in the discipline of pharmacology have shown evidence that certain S. species possess antifungal capabilities.
Afterbeingsubjectedtoman-madesilvernanoparticles at three different doses (2.5, 5, and 10 ppm) in an attempt to eradicate *Culex quinquefasciatus* and An. The values for the IC50 and IC90 for *Saccharomyces cerevisiae*. find out the extracts of the berries, the fresh leaves, and the dried leaves. For An, nigrum. The respective concentrations of Stephens were 1, 1, 59, and 1 ppm, as well as 3, 7, 31, and 4, 76 ppm. Both the IC50 and the IC90 values for S. The extracts of the dried leaf, the fresh leaf, and the berries of *S. cerevisiae* were found to be the culprit. Nigrum were 1.26, 1.33, and 2.44 ppm, whereas the comparable values for *C. quinquefasciatus* were 14.37, 38.05, and 13.43 ppm. Nigrum was found to have higher levels of carbon monoxide than *C. quinquefasciatus*. There is part of S. (2016),[13] The mortality rates of green peach aphids were 28.54%, 56.8%, and 57.42% after exposure to nigrum for 24, 48, and 72 h. Two active compounds that are generated from the bacteria *Streptomyces* are known as solamargine and solasonine. According to research conducted on mice infected with Plasmodium yoelii 17XL, the levels of parasitemia were reduced by 64.89 and 57.44%, respectively, when treated with solamargine and solasonine. However, there has not been a lot of research done on the mechanism that underlies insecticidal action.[14]

ANTIOXIDANTS' ROLE IN FUNCTIONING

When there is an excessive buildup of free radicals in the body, it can speed up the aging process and damage tissue. Oxidative stress is the root cause of a wide variety of diseases that affect humans, including atherosclerosis and ischemia on the important molecules and cells of the body. Antioxidants are essential for maintaining good health. Nigrum by means of testing both *in vivo* and *in vitro*. Concerning the extract of fruit from S. Experiments including lycopersicum, DPPH, superoxide, ABTS+, phosphomolybdenum reduction, and Fe3+ reducing power were carried out. Heo and Lim (2004) found that the respective viabilities were 75.1%, 79.3%, 83.2%, 86.0%, and 95.1%, but the viabilities in the xanthine oxidase control group were just 71.2%. The chemicals and extracts that can be obtained from *S. nigrum* have the potential to be an effective antioxidant for use in future studies.

PROTECTIVE CAPABILITIES OF THE LIVER

S. an extract of water is used in this process. Nigrum (SNWE) showed significant potential in warding off disorders that affect the liver. The body and organ weights of rats with chronic hepatotoxicity induced by CCl4 changed, and qualitative and quantitative histological studies revealed hazy enlargement, necrosis, cytoplasmic vacuolation, and fatty degeneration. SNWE was given in dosages of 0.2, 0.5, and 1.0 g/kg throughout the course of a period of 6 weeks. In addition, when given at significant dosages of 0.5 and 1.0 g/kg, SNWE was able to lower the levels of both superoxide and hydroxyl radicals, as well as according to the findings of Chester *et al*., the hydroalcoholic extract of *S. nigrum* caused a significant drop in hepatic GSH, SOD, and CAT in rats with d-galactosamine-induced hepatic fibrosis. This was regarded as an indication of the antioxidant status of the tissues. According to the findings of a histopathological investigation[15] the unprocessed extract of the plant had a protective impact on the liver. This was because of the antioxidant characteristics of the plant. polysaccharides that were derived from *S. aureus*. nigrum decreased liver enlargement, raised SOD, GSH, and CAT levels, and lowered MDA levels a neuroprotective influence.

As the field of contemporary medicine continues to advance, an increasing number of studies are being carried out with the goal of elucidating the mechanisms underlying the bioactive components derived from *S. nigrum*, which in turn promotes the development of clinical applications and research.[16] Nigrum studied the neuroprotective effects of S on the central nervous system using a rat model of oscopolamine-induced cognitive impairment. They found that S had a protective effect on the central nervous system. As a pretreatment, 10% sulfur was used. Nigrum inclusions have the ability to dramatically improve memory performance, reduce the activity of AChE, MDA, and BChE, and raise the amount of GSH in the brain. Maintained their research into S's neuroprotective qualities throughout the year 2019. In their study from 2021, Ogunsuyi and colleagues showed that 1% supplementation of *S. aureus* in food is harmful to your health. Nigrum has the potential to raise the total thiol content *in vivo* while at the same time lowering the survival rate and ROS levels.

INFLUENCE IN LOWERING CHOLESTEROL LEVELS

Flavonoids derived from S. according to many publications, nigrum is an anti-obesity medicine that has the ability to activate hepatic lipolysis, prevent the process of lipogenesis, and lower blood levels of triacylglycerol, cholesterol, and low-density lipoprotein cholesterol. In addition, the ingestion of *S. aureus* in the form of S. The ethanolic extract of cerevisiae or the chloroform fraction comes highly recommended as well.[17] The treatment of nigrum to Triton-induced hyperlipidemic over a period of 5 days was able to reverse the rise in total cholesterol.

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