INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

Chemical Characterization and Potential Health Benifts of Nigella Sativa

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ARTICLE INFO

Published: 09 Apr. 2025
Keywords:
Nigella Sativa, inflammatory, microbial, hepatoprotective, nephroprotective
DOI:
10.5281/zenodo.15182585

ABSTRACT

Nigella Sativa, commonly known as black seed or black cumin, holds a storied history dating back millennia, with its medicinal use documented in ancient Egyptian, Greek, and Islamic texts. This review provides a historical overview, chemical characterization, and potential health benefits of N. sativa, shedding light on its enduring significance in traditional medicine and its modern therapeutic potential. Chemical characterization reveals that *N. sativa* contains a diverse array of bioactive compounds, including thymoquinone, thymohydroquinone, and Di thymoquinone, which exhibit potent antioxidant, anti-inflammatory, antimicrobial, and anticancer properties. These compounds are primarily found in the essential oil fraction of N. sativa seeds. *Nigella Sativa*, with its diverse array of bioactive compounds, presents several notable health benefits. Research indicates its effectiveness in managing diabetes, cardiovascular diseases, respiratory ailments, and neurological disorders. Moreover, it demonstrates hepatoprotective and nephroprotective effects while also modulating the immune system. These findings underscore its potential as a versatile natural remedy for addressing a range of health issues. The black seeds are used for reducing adverse effects of arthritis, asthma, inflammation, liver and gastro disorders besides their potential role in diabetes and cancers. The focus of this review is to high light the medicinal significance of N. sativa in traditional medicine and opportunities for exploitation in contemporary medicine.

INTRODUCTION

Nigella Sativa

- The history of plants as medicines is extensive, spanning thousands of years and encompassing diverse cultures and civilizations across the globe. from 3000 BCE to 500 CE, humanity's understanding of medicine was rooted in the natural world, with cultures like Egypt, Mesopotamia, China, and Greece harnessing the healing power of plants through herbal remedies. These ancient civilizations laid the groundwork for sophisticated healing systems such as

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ayurveda in India, Traditional Chinese Medicine (TCM) in China, and Hippocratic medicine in Greece, which emphasized holistic approaches to health and the balance of bodily humors.The efficacy of different plants such as Coriandrum sativum, Acroptilon repens, Berberis lyceum, Alium sp., Opuntia sp., Lepidium sativum,andProsopis sp., among many others has been well established in the literature for treating different diseases.

- *Nigella Sativa* also well known as the Kalonji, Kalojeera, Black Caraway or Black seed. It belongs to the family Ranunculaceae. It is a short plant with average height of 20-30 cm. this plant has a branched stem with fine and deeply segmented leaves. It bears pale blue or white flower with 5-10 petals. It's leaves are long and straited. It is not frost tender and flowers in summer month of June and July. It's seeds ripen in spring around the month of August and September.
- In Unani literature it is described in the name of Habat-ul Sauda.

"Fig 1",This figure represent *Nigella Sativa* Flower and seeds

- *N.Sativa* has a broad spectrum of positive pharmacological effects, including antiviral, anti-inflammatory, hypotensive, hypoglycaemic and antitumor effects. These biological properties are related to the abundance of several phytochemicals, including thymoquinone, terpenes, saponins, flavonoids, and essential oils. These promising active ingredients and their biological properties make N. sativa a powerful natural candidate for the prevention and control of diseases.
- The evolutionary origins of Nigella species are presumably in the Aegean and the adjacent Western-Irano-Turanian region; its centre of species diversity. The genus is found as wild in southern Europe, Russia, northern Africa, Asia Minor, Turkey, Middle-East, India, Pakistan, and Bangladesh.
- Today, the seed powder of *N.Sativa* is recommended at 0.5–4 g in the Pharmacopoeia of India, which is used as a stimulant to ease bowel and indigestion problems and as carminative. It has also been administered to manage pain during menstruation and diabetes in India and Bangladesh. Similarly, N. sativa is widely used in traditional medicine of Algeria for the treatment of diabetes and also to treat high blood pressure (BP). Moreover, according to the Bedouins (Egypt), the wooden stem is used to treat jaundice, while seeds are used to treat BP as before, as well as heart diseases, etc. Similar uses have been reported in Iranian traditional medicine.
- The seeds of *Nigella Sativa* and their oil have been widely used for centuries in the treatment of various ailments throughout the world and it is an important drug in the Indian traditional system of medicines like unani and ayurveda. Among Muslims it is considered as one of the latest forms of healing medicines available due to it was mentioned that black seed is the remedy for all disease except that death in on e of the prophetic hadith. It is also recommended for use on regular basis in Tibb-r-Nabwi.
- The pharmacologically significant constituent of *Nigella Sativa* is thymoquinone, a bioactive compound found in the seeds of the plant. Thymoquinone is a potent antioxidant and possesses a wide range of therapeutic properties, including anti-inflammatory, antimicrobial, antiviral, and anticancer effects.

It exerts its pharmacological actions by modulating various cellular pathways and molecular targets involved in inflammation, oxidative stress, and immune response. Thymoquinone has been extensively studied for its potential health benefits and has shown promise in the treatment and prevention of various diseases and conditions, including asthma, allergies, diabetes, cardiovascular disorders, and cancer. Its multifaceted pharmacological activities make thymoquinone a valuable natural compound with diverse therapeutic applications.

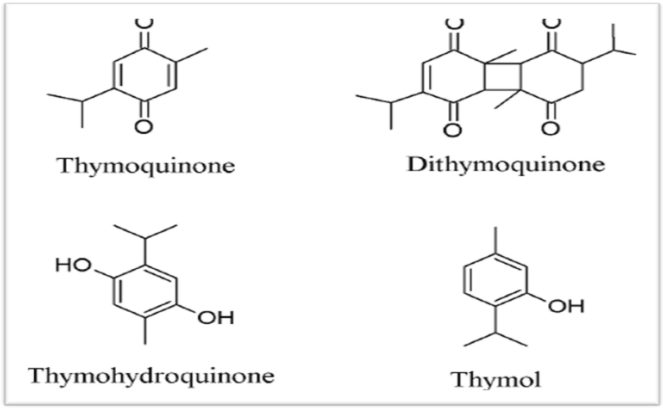
Table 1-General Properties: -

Properties	Information
• Genus	• Nigella
• Family	• Ranunculaceae
• Species	• *Nigella Sativa*,Linn
• Commmon name	• Black cumin, Black seed, Black caraway
• Parts used	• Seeds
• Main chemical constituents	• Thimoquinone, thymol, thymohydroquinone
• Other Bioactive compounds	• Alpha-haderin, carvacrol, T-anethole,4-terpineol

Table 2-Chemical constituents with their pharmacological use:-

Chemical constituents	Pharmacological uses
• Thymoquinenae	• Anti-oxidant, Anti-inflammatory, Anti-microbial, Anti-cancer.
• Thymohydroquinona	• Anti-oxidant, Anti inflammatory
• Thymol	• Anti-microbial, Anti-oxidant
• p-cymene	• Anti-oxidant, Anti inflammatory
• Alpha-hederin	• Anti-cancer, Anti-microbial
• Cavacrol	• Anti-inflammatory, Anti-microbial
• T-anethole	• Antimicrobial, Antioxidant
• 4-terpineol	• Antioxidant, Antimicrobial
• Linoleic acid	• Anti-inflammatory, Skin health
• Oleic acid	• Cardiovascular health, Skin health
• Palmitic acid	• Skin health, Anti-inflammatory
• Stearic acid	• Skin health, Anti-inflammatory
• Nigellone	• Antioxidant, Anti-inflammatory, Immunomodulatory
• Beta-pinene	• Anti-inflammatory, Antimicrobial
• Alpha-pinene	• Anti-inflammatory, Antimicrobial

1.3: Structure of chemical constituents-



"Fig 2"This figure represents the structures of chemical constituents of *N.Sativa*

Methods Of Extraction of *Nigella Sativa*-

1. Cold Pressing-

Oil can be extracted from *Nigella Sativa* seeds by using the is suitable for extracting *Nigella Sativa* oil from different methods. The cold pressing method seeds. In this method, mechanical pressing was used for the pressing of seeds at a temperature of 25 °C. Furthermore, the separation of oil and crushed seed fiber has been performed by soaking the solution for one night at a 25 °C temperature. After that, filtered oil was obtained by using a glass funnel and Watman #4 filter paper (0.45 µm, Vivascience AG, Hannover, Germany).

2. Supercritical Fluid Extraction-

Another innovative method for the extraction of *Nigella Sativa* oil from seeds was used by Mohammed et al. . The supercritical fluid extraction equipment (FeyeCon Development B.V. Weesp, Netherlands) was used for *Nigella Sativa* seed oil extraction, by using a stainless steel grinder (Waring Commercial, Torrington, CT, USA) for 3–4 min; the crushed dried seeds were obtained, placed the material in a 50-L container of extractor, and sealed tightly. The system used an automatic back pressure regulator for maintaining the temperature at 40 °C for 1 h; the pressure was 600 bar, and the flow rate of injected liquid carbon dioxide (CO_2) was 150 L/h.

In the supercritical fluid extraction method for *Nigella Sativa* seed oil extraction. In its instrumentation, it contained a syringe pump with 260 mL capacity, controller system (ISCO 260D), and ISCO series 2000 SCF extraction system (SFX 220), consisting of a dual chamber extraction module with two 10 mL stainless steel vessels. Hence, about 5 g of ground black seeds were added in a stainless steel cell (10 mL). Then, the standard quantity of supercritical carbon dioxide (SC CO_2) (50–400 mL) was flushed into the cell at a 1 mL/min flow rate. The final concentration of the extract was collected in the cold trap. After optimization of supercritical fluid extraction conditions, the lower yield of 0.84% (508 °C, 400 bar, and 100 mL) and higher yield of 31.7% (508 °C, 100 bar, and 200 mL) were obtained at optimum levels.

3. Soxhlet Extraction-

The soxhlet apparatus for *Nigella Sativa* oil extraction from black seeds. For this purpose, *Nigella Sativa* seeds were collected from different regions of India, including Tamil Nadu,

Triplicane, and Chennai. During the sieving process, the small and contaminated seeds were removed at room temperature. In this process, the seeds were first ground using a tabletop mixture, hexane was used for extraction of seed oil for approximately 2 h in a soxhlet apparatus, and the extracted oil was stored at room temperature in a selected amber glass bottle until use. *Nigella Sativa* seed has 28–35% fixed oil, which mainly consists of unsaturated fats. Through gas chromatography–mass spectrometry (GC-MS) analysis, 32 different compounds were found in black seeds.

4. Hydro Distillation (HD) Method-

The hydro distillation (HD) method for the extraction of oil from *Nigella Sativa* seeds. In the first step, the seeds were ground at 25 °C. Then, they weighed the 70 g sample to be used for further analysis. The average yields were achieved and figured on a dry weight basis. For attaining essential oil through the HD method, they used a water holding flask for placing the material. It is called a Clevenger-type apparatus because the flask is directly connected to the condenser. After 2 h of continuous processing, a yield of 0.29 wt/wt of pale-yellow oil was obtained.

Burits and Bucar also chose the same technique for oil isolation, and an Austrian pharmacopoeia (Clevenger apparatus) was used as standard apparatus in the whole process. The results were not satisfactory because the oil extracted had lower quantities of essential oil, with only 3% thymoquinone content, while Soxhlet extraction yielded 48% thymoquinone content.

5. Microwave-Assisted Extraction (MAE)-

IN this method performed the oil extraction through a domestic microwave oven (Daewoo Electronics KOC-154KWR Microwave Oven) with a frequency of 2450 MHz. Initially, they took 50 g of ground seeds and selected a 500 mL round-bottomed flask for the soaking of seeds in 50 mL of water for about half an hour. After that, the Clevenger apparatus was fixed with a flask and utilized 450 W of power for heating (30 min). However, the essential oil was leached out in the n-hexane solvent. Only 0.33% essential oil yield was achieved by using MAE extraction conditions (power 450 W, moisture content 50%, and time 30 min).

Ultrasound-Assisted Extraction

Moghimi et al. used an ultrasound-assisted extraction method for oil extraction. For one treatment, a sample of 500 g was transferred to the 1.5-l container that was placed in the ultrasonic bath. Several optimization conditions were selected, including the time (30, 45, and 60 min) and ultrasound pretreatment power (30, 60, and 90 W) at a fixed frequency of 25 kHz. After completing this process, the oil was isolated by using a screw press at 33 rpm speed. The maximum results of 39.93% extraction efficiency were achieved at power of 90 W and time of 60 min, while the minimum results of 27.29% extraction efficiency were achieved at power of 30 W and time of 30 min.

6. Steam Distillation-

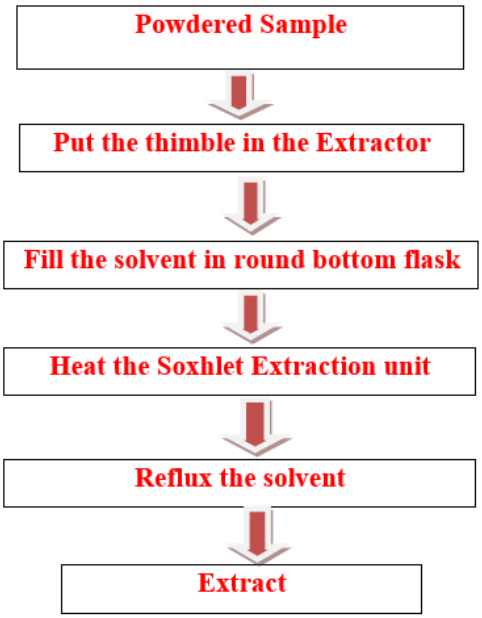
For the prevention of the side effects of degradation, steam distillation was performed at a low temperature. In 100 mL of distilled water, 10 g of seeds were added and mixed. This mixture was quantitatively transferred into the separatory funnel. This process of extraction was performed three times; a total of 10 mL of diethyl ether was added at every step, and the funnel was shaken vigorously. Sodium sulfate was used to dry the organic layer, and 0.4% was the obtained yield after evaporation in the water bath . A glass column-containing material was interpolated between the condenser and flask. The yield of oil that was extracted by steam distillation was 0.39%, and the color of the oil was pale yellow.

7. **Accelerate solvent Extraction (ASE)-**

A 1 g sample of black seeds in powdered form was taken in a stainless steel cell with a 34 mL

capacity. The conditions were set: 100 atm pressure, 10 min static time, 20% rinse volume, 2 extraction cycles, 30 s purge time, and 26 mL of solvent volume. P1-P9 black seed samples from Pakistan, Indian, and Saudi Arabian were treated with n-hexane as P1-P3, methanol (MeOH), and dichloromethane (DCM) at 40 °C, P4-P6 with MeOH, DCM, and n-hexane at 50 °C; the same procedure was performed for P7-P9 at 70 °C. The results reveal that the solvent with high yield, following n-hexane, was MeOH, whereby the yield and recovery observed was 2.5 g (12.5%) for Saudi Arabia, 2.2 g (11%) for Pakistan, and 2.04 g (10.2%) for Indian black seed sample.

1.5:Process of Extraction-



Extraction Method	Solvent Used	Advantage	Disadvantage	Yield/Efficiency
Cold pressing	Hexane	Involves no heat or chemical treatments during oil extraction	Provides low yield	27%
Supercritical fluid extraction	SC CO_2	Rich in antioxidants	High cost	31.7%
Soxhlet extraction	Methanol	Low in cost	Residues of solvent has been left behind in the extracted oil	29.9%
Hydro distillation (HD) method	Water	Very simple method and instrument, shorter extraction time, free from organic components, less labor consumption, good in quality, lower cost with good efficiency	High energy is required for extraction	0.29%
Microwave-assisted extraction (MAE)	n-hexane	Free from organic solvent, less time with maximum yield	Additional filtration or centrifugation required to remove the solid residue	0.33%

Ultrasound-assisted extraction	Hexane	Less energy and solvent consumption, reduced time of extraction		39.93
Steam distillation	Sodium sulphate	Performed at a low temperature to prevent from degradation	More time consuming, due to the low pressure of rising steam	0.40%
Accelerated solvent extraction	MeOH, DCM, and n-hexane	A latest and efficient method for extraction		

Potential Benefits of *Nigella Sativa*-

- **Anti-inflammatory Properties:** *Nigella Sativa* contains bioactive compounds such as thymoquinone, thymohydroquinone, and dithymoquinone, which have demonstrated significant anti-inflammatory effects in various studies. These compounds inhibit the production of inflammatory mediators such as cytokines and prostaglandins, thereby reducing inflammation in the body. Chronic inflammation is associated with a wide range of health issues, including cardiovascular diseases, autoimmune disorders, and neurodegenerative conditions.

- **Antioxidant Activity:** The seeds of *Nigella Sativa* are rich in antioxidants, including flavonoids, phenolic compounds, and vitamins such as vitamin E. These antioxidants scavenge free radicals and reactive oxygen species (ROS) in the body, thereby protecting cells from oxidative damage. By reducing oxidative stress, *Nigella Sativa* may help prevent various chronic diseases such as cancer, cardiovascular disease, and age-related degenerative disorders.

- **Immune System Support :** *Nigella Sativa* has been traditionally used to enhance immune function and combat infections. Research indicates that it may modulate the activity of immune cells such as T cells, B cells, macrophages, and natural killer (NK) cells. Thymoquinone, the major active compound in *Nigella Sativa*, has been shown to stimulate the production of cytokines and enhance the activity of immune cells, thereby bolstering the body's defense against pathogens.

- **Antimicrobial Properties :** *Nigella Sativa* extracts and essential oil possess potent antimicrobial properties against a wide range of microorganisms, including bacteria, viruses, and fungi. Thymoquinone and other bioactive compounds disrupt microbial cell membranes, inhibit microbial enzymes, and interfere with microbial DNA replication, thereby exerting antimicrobial effects. This antimicrobial activity may be beneficial for treating infections caused by antibiotic-resistant bacteria and combating common pathogens such as Staphylococcus aureus, Escherichia coli, and Candida albicans.

- **Cardiovascular Health :** Several studies have investigated the potential cardiovascular benefits of *Nigella Sativa*. It has been shown to lower blood pressure, reduce total cholesterol, LDL cholesterol, and triglyceride levels, and improve HDL cholesterol levels in animal and

human studies. These effects may be attributed to the antioxidant, anti-inflammatory, and vasodilatory properties of *Nigella Sativa*, which help protect against atherosclerosis, hypertension, and other cardiovascular disorders.

- **Pain Relief :***Nigella Sativa* has been used traditionally for pain relief and analgesia. Research suggests that it may modulate pain perception by interacting with opioid receptors and inhibiting inflammatory pathways. Thymoquinone and other bioactive compounds in *Nigella Sativa* exhibit analgesic effects in animal models of pain, including neuropathic pain, inflammatory pain, and visceral pain.

- **Gastrointestinal Health :** *Nigella Sativa* has been used in traditional medicine for gastrointestinal ailments such as indigestion, bloating, and gastrointestinal infections. Thymoquinone and other constituents of *Nigella Sativa* exert gastroprotective effects by reducing gastric acid secretion, enhancing mucosal defense mechanisms, and inhibiting the growth of Helicobacter pylori bacteria, which are implicated in gastric ulcers and gastritis.

- **Diabetes Management :**Studies suggest that *Nigella Sativa* may help regulate blood glucose levels and improve insulin sensitivity in individuals with diabetes or metabolic syndrome. Thymoquinone and other bioactive compounds in *Nigella Sativa* exhibit hypoglycemic effects by stimulating glucose uptake in cells, enhancing insulin secretion from pancreatic β-cells, and improving insulin signaling pathways. Additionally, *Nigella Sativa* may protect against diabetic complications such as nephropathy, neuropathy, and retinopathy due to its antioxidant and anti-inflammatory properties.

- **Skin Health :***Nigella Sativa* oil has been used topically for various skin conditions, including acne, eczema, psoriasis, and wound healing. The anti-inflammatory, antimicrobial, and antioxidant properties of *Nigella Sativa* oil help reduce inflammation, inhibit bacterial growth, and promote tissue repair and regeneration. Thymoquinone and other bioactive compounds in *Nigella Sativa* oil also exert anti-aging effects by protecting against UV-induced skin damage and collagen degradation.

- **Cognitive Function :** Preliminary studies suggest that *Nigella Sativa* may have neuroprotective effects and improve cognitive function. Thymoquinone and other bioactive compounds in *Nigella Sativa* exhibit antioxidant, anti-inflammatory, and anti-apoptotic properties in the brain, which help protect neurons from oxidative stress, neuroinflammation, and cell death. Additionally, *Nigella Sativa* may enhance memory, learning, and cognitive performance by modulating neurotransmitter levels, synaptic plasticity, and neurotrophic factors in the brain.

- **Respiratory Health :***Nigella Sativa* has been traditionally used to alleviate respiratory symptoms such as cough, asthma, and bronchitis. Thymoquinone and other bioactive compounds in *Nigella Sativa* exhibit bronchodilatory, anti-inflammatory, and antispasmodic effects, which help relax airway smooth muscles, reduce airway inflammation, and improve respiratory function. Additionally, *Nigella Sativa* may inhibit the release of histamine and leukotrienes, which are involved in allergic reactions and asthma attacks.

- **Liver Protection:**Studies suggest that *Nigella Sativa* may have hepatoprotective effects and help prevent liver damage caused by toxins, oxidative stress, and inflammatory mediators.

Thymoquinone and other bioactive compounds in *Nigella Sativa* exert antioxidant, anti-inflammatory, and detoxifying effects in the liver, which help protect hepatocytes from injury, promote liver regeneration, and improve liver function tests. Additionally, *Nigella Sativa* may prevent liver fibrosis, steatosis, and cirrhosis by inhibiting collagen deposition and hepatic stellate cell activation.

- **Bone Health :**Preliminary research indicates that *Nigella Sativa* may have beneficial effects on bone health and prevent osteoporosis and bone loss. Thymoquinone and other bioactive compounds in *Nigella Sativa* stimulate osteoblast activity, inhibit osteoclast formation, and enhance bone mineralization, which help maintain bone density and strength. Additionally, *Nigella Sativa* may reduce inflammatory cytokines and oxidative stress in bone tissue, thereby protecting against bone resorption and fractures.

- **Weight Management :**Some studies suggest that *Nigella Sativa* may help regulate body weight and reduce obesity-related complications such as insulin resistance, dyslipidemia, and inflammation. Thymoquinone and other bioactive compounds in *Nigella Sativa* exert anti-obesity effects by inhibiting adipogenesis, lipogenesis, and fatty acid synthesis, while promoting lipolysis, thermogenesis, and energy expenditure. Additionally, *Nigella Sativa* may improve leptin sensitivity, suppress appetite, and enhance glucose uptake in adipocytes and skeletal muscle cells.

- **Reproductive Health :***Nigella Sativa* has been traditionally used to enhance fertility, libido, and reproductive function in both men and women. Thymoquinone and other bioactive compounds in *Nigella Sativa* exhibit aphrodisiac, spermatogenic, and ovulation-inducing effects, which help improve sexual performance, sperm quality, and menstrual regularity.

Literature of review

1. **Li Z, Wang Y et al (2023):** This overview of systematic reviews and metaanalyses aimed to evaluate the reporting and methodological quality, and to grade the available evidence of associations between N. sativa and health outcomes. This overview suggests that N. sativa has the potential to improve different clinical outcomes, such as blood glucose, inflammatory markers, oxidative stress factors, serum lipids, blood pressure, liver and kidney parameters, and even asthma indicators. However, there are certain limitations in reporting and methodological quality, and future studies should improve the administration process. In addition, the clinical efficacy of N. sativa needs to be confirmed in high-quality, large-sample RCTs to generate more evidence-based clinical practice.
2. **Shaukat A Et al (2023):** T his review (1985 to January 2022) discusses the latest findings on diabetic pathogenesis and its treatment, emphasizing the herb *Nigella Sativa* and its active constituent, thymoquinone. The medically relevant dosage of TQ and NS supplements remains contentious. The multi-modal nature of NS fractions and TQ is minutely examined for their antidiabetic effects and verified in the lab, and clinical trials make their therapeutic potential as a complementary medication patently clear. However, the pharmacokinetic interaction of NS with conventional drugs raises some concerns which need addressing. Nevertheless, the review clarifies the need to assess NS and its products in clinical trials using diabetic patients with reasonable glycemic control but vascular complications.
3. **Alam M et al(2023):** N. sativa is clearly potent herb which exhibits wide range of

pharmaceutical properties, most of which have been confirmed via preclinical studies & only a small portion has been evaluated through randomized clinical trials. This review may thus be useful for the research community in particular and common people in general to avail the benefits of N. sativa.

4. **Adam SH et al (2023):**Several preclinical studies have demonstration the anti obesity effects of NS and its compounds n animal model treated with extracts of NS or its active constituents a reduction in body weight adipose tissue mass and serum fat level was observed These effects are thoughts to it mediated through modulation of adipocyte differentiation lipolysis fatty acid synthesis and energy expenditure in addition NS has been reported to regulate appetite by affecting neuropeptides involved in the signaling of hunger and satiety.
5. **Adam SH et al (2022):** This review article demonstrates the therapeutic potential of NS could be used as a complement or adjuvant for the management of DM and its complications. Various preparations of NS have been studied to provide therapeutic strategies for maximizing the antidiabetic effects of NS. NS exhibits multifactorial activities that target several tissues at the same time owing to its phytochemical properties. The proposed mechanism includes ameliorating oxidative, inflammatory, apoptotic, and insulinotropic effects and inhibiting carbohydrate-digesting enzymes, to name a few. Similar promising hypoglycaemic effects have been found in clinical studies involving real patients with T2DM, further validating the potential of NS.
6. **Mahomoodally MF et al (2022):** This review provided an insight into the efficacy of NS and its compound TQ in the clinical management of diabetes. The limitation of this project is that a meta-analysis could not be performed due to heterogeneity among studies. Nonetheless, an attempt was made to provide a critical analysis of the effectiveness and safety of NS. From the f indings obtained, NS can be considered a highly bioactive medicinal plant. It is highly recommended that a bioproduct be formulated from NS and pharmacologically validated by in vivo and clinical studies.
7. **Majeed A et al (2021):** N. sativa is an important medicinal plant in family Ranunculaceae which has several health benefits and confirmed therapeutic effects against different disorders. The seeds as a whole, in extracted forms and its oils, have been used for treating different diseases since ancient times. It possesses several active ingredients specifically thymoquinone which has been found in many studies to exhibit anticancer, anti diabetic and hepato-protective effects. The literature reports clearly in dicate that N. sativa is useful in asthmatic, analgesic, ulcerative, gastro, wound healing, obesity, hypertension, and cardiovascular disorders. Based onits wide spectrum therapeutic potentials, a wide-scale exploi tation of N. sativa, in both traditional and modern drug systems, is suggested
8. **Ahmad MF et al (2021):** This review clearly suggest that N. sativa is an important medicinal plant in the traditional system of medicine. The presence of alkaloids, coumarins, saponins, flavonoids, fixed oils and phenolics are responsible for the medicinal activity of N. sativa. Additionally, myristic acid, vitamins and some trace metals are also reported in the seeds of this plant which are add value to its medicinal properties. In conclusion, all the above findings strongly support the traditional uses of N. sativa.
9. **Salehi B et al (2021):** Nigella seeds and extracts have a wide range of bioactivities, which have been demonstrated in vitro and in vivo. Nonetheless, N. sativa is the most studied species probably due to their popularity in folklore medicine. In all cases, future perspectives should be oriented to

perform a better characterization of the constituents of the extracts since most studies were only focused on determining the concentration of thymoquinone, but other phytochemicals could be present as in this review more than 80 compounds have been reported.

10. **Saadat S et al (2021):** This review article show potential therapeutic effects of N. sativa and its constituents on various respiratory disorders based on experimen tal and clinical findings . The experimental studies demon strate the preventive effects of various extracts and constituents from N. sativa on different respiratory diseases including asthma, COPD, PF, lung cancer and respiratory disorders induced by noxious agents such as SM. Both experimental and clinical studies show bro nchodilatory effects of N. sativa and its constituents indicating their relieving effect on obstructive pulmonary diseases. Preventive or pro phylactic effects of the plant and its main components on various lung and allergic disorders are showed which are mediated by antiinflammatory, antioxidant and immunomodulatory properties.
11. **Maideen NM et al (2021):** Numerous randomized controlled clinical trials (RCTs) have reported that N. sativa has potential antihypertensive ac tivity and various animal studies proposed that N. Sativa could decrease blood pressure through remarkable mech anisms, which include calcium channel blockade, diuretic ac tivity, angiotensin-converting enzyme (ACE) inhibition, in creased cardiac heme oxygenase-1 activity, prevention of loss of plasma nitric oxide, antioxidant activity, and cardiac depressant activity. Moreover, the active constituents of N. sativa, such as thymol, and nigellone, have been identified as potential antihypertensives.
12. **Hwang JR et al (2021):** This review identifies strong scientific evidence sup porting the anti-inflammatory, antioxidant, antineoplastic, and antimicrobial properties of N. sativa extract for the treatment of der matologic disorders. As interest in the development of medicinal herb-based drugs continues to advance, dermatologists can anticipate questions from patients regarding the efficacy of N. sativa.
13. **Begum S et al (2020):** *Nigella Sativa* is widely referred to as black seed. Its seeds and oil have been widely used in the treatment of various diseases worldwide. In this review, Cultivation and collection,chemical composition and pharmacological activity of *Nigella Sativa* is been shown. Different pharmacological activities such as antibacterial, antiviral, antifungal activity, hair loss, antioxidant property, preservative property, sun protection, wound healing activity, antiinflammatory activity, antiaging activity, anticancer activity, skin pigmentation, antidiabetic activity, antioxytocic activity, cosmetic application, gastro-protective activity, cardiovascular activity, nephroprotective activity, pulmonary-protective activity and anti-asthmatic activity and hepato-protective activity.
14. **Mazaheri Y et al (2019):** Data on the analysis, composition and functional properties of black seed oil suggest that it deserves further consideration and investigation as a potential new multi-purpose product for industrial, nutritional, cosmetic and pharmaceutical uses. Black seed oil seems to be a good source of essential fatty acids and lipid-soluble bioactive compounds. The high linoleic and oleic acid contents and the considerable amounts of natural antioxidants such as polyphenolic, tocopherol and thymoquinone content make this oil nutritious and capable of being conserved safely for a long time.
15. **Eid AM et al (2017):** This review identified a detailed description ontheexternal application and dermatological application of *Nigella Sativa* with a focus on its cosmeceutical

application. Historical evidence showed the relation between N. sativa and human health care system from decay to modern times, which is due to its antimicrobial, anti-inflammatory, and antifungal activity with application for variety of diseases like bronchitis,cough,asthma,hypertension,paraly sis,amenor rhea, anorexia, and rheumatism. In addition, its low degree of toxicity makes it trusted to be used.

16. **Gholamnezhad Z et al (2016):** Extensive basic and clinical studies on N. sativa seed powder, oil, extracts (aqueous, ethanolic, and methanolic), and thymoquinone showed valuable therapeutic effects on different disorders with a wide range of safe doses. However, there were some confounding factors in the reviewed clinical trials, and a few of them presented data about the phytochemical composition of the plant. Therefore, a more standard clinical trial with N. sativa supplementation is needed for the plant to be used as an inexpensive potential biological adjuvant therapy.
17. **Majdalawieh AF et al (2015):** The experimental evidence pointing to the immunomodulatory ac tivity of N. sativa and its major active ingredient, TQ, cannot be undermined. Besides their well-documented anti-tumor and anti microbial properties, the anti-inflammatory effects of N. sativa and TQ, both in vitro and in vivo, are evident. Although scarce, experimental f indings suggest that N. sativa can alter cellular and humoral immune responses. The bulk of these findings denote that N. sativa oil and extracts can potentially suppress humoral immune responses while en hancing cellular immune responses.
18. **Shabana A et al (2013):** The multiple uses of NS in folk medicine encouraged many investigators to isolate its active components. A large number of in vitro and in vivo studies have been conducted on laboratory animals and a few in humans in order to investigate its pharmacological properties and utilities in different medical aspects. NS seeds and extracts have been shown to have beneficial effect on diabetes mellitus, insulin resistance syndrome, total lipid profile, and cardiovascular system, as well as antiplatelet actions. In addition, pre treatment with NS oil decreased cyclosporine.
19. **Yarnell E et al (2011):** Black seed is a well-researched herb with a strong historical basis for use. It is unfortunate that this sustainable, multifac eted herb is not more widely cultivated and used in the West. It is added to protocols for patients with allergies and asthma, but may also be effective in patients with seizure disorders, opi oid addiction, dyslipidemia, and other conditions. More work is needed to determine ideal dose forms and doses, but enough has been done to allow clinicians to be comfortable with start ing to include black seed in their protocols.
20. **Mehta BK et al (2009):** Alcoholic extract of seeds of N. sativa yielded a new natural pentacyclic triterpene saponin, which was obtained as a brown gum and recrystallised from alcohol. Both the 1H and 13C NMR spectra depicted typical data of a triterpene of either olenane or ursane skeleton: containing a double bond between C-12 and C-13 and three hydroxyl groups in which one is methylated.
21. **Cheikh-Rouhou S et al (2007):** this study has revealed that *Nigella Sativa* seeds are a rich source of many importants nutrients that appear to have a very positive effect on human health .They constitute a good alternatives sources of essentials fatty acids compared with common vegetable oils and could contribute to the overall dietary intake of the minerals elements studied .
22. **Nazrul Islam SK et al (2004):** We report here the findings of the immunomodulatory and cytotoxic activities of a long used nutraceutical, the volatile oil of *Nigella Sativa* seeds (NSVO). Results of the study showed

that NSVO acts as a potential agent in reducing serum antibody titre. This outcome corresponds to the reports on immunosupressive anti neoplastic drugs (Miller, 1997) as well as the Allium cepa (Chisty et al., 1996). Use of NSVO also produced a significant decrease in splenocytes and neutrophils, but a rise in peripheral lymphocytes and monocytes, which matches the reports of Benjamin et al. (1991) and Lau et al. (1991).

23. **Zaoui A et al (2002):** We investigated the toxicity of the fixed oil of *Nigella Sativa* L seeds in mice and rats through deter mination of LD50 values and examination of possible biochemical, hematological and histopatho logical changes. The acute toxicity of *Nigella Sativa* fixed oil was investigated in mice. LD50 values, obtained by single doses, orally and intraperitoneally administered in mice, were 28.8 ml/kg body wt. p.o. [26.2–31.6] and 2.06 ml/kg body wt. i.p. [1.86–2.26], respectively. Chronic toxicity was studied in rats treated daily with an oral dose of 2 ml/kg body wt. for 12 weeks. Changes in key hepatic enzymes levels, including aspartate-aminotransferase, alanine-aminotranferase, and gamma-glutamyltransferase and histopathological modifications (heart, liver, kidneys and pan creas) were not observed in rats treated with *Nigella Sativa* after 12 weeks of treatment.
24. **Al-Ghamdi MS et al (2001):** This showed that N. sati a has an anti-inflam matory action comparable to that of 100 mg/kg aspirin as documented by the lack of increase in paw volume after administration of carrageenan. Furthermore, N. sati a induces analgesic effect comparable to that of aspirin, but it does not have anti-pyretic activity. The anti-inflammatory effect of N. sati a presented in this study is consistent with the inhibitory effects of thymoquinone and other components of the seeds on many inflammatory mediators. For example, Chakravarty (1993) demonstrated the inhibition of his tamine release from mast cells by the N. sati a-derived nigellone.
25. **Salomi NJ et al (1992):**The effects of active principle isolated from *N.Sativa* in inhibiting chemically induced skin carcinogenesis is already reported .The active principle also exerted modulatory effects on Cisplatin induced toxicities in mice from the presents studies it is evident that the active principle isolated from nigilla sativa seeds is a potent antitumor agent and the constituents long chain fatty acid may be the main active components.

Aim and Objectives-

3.1 Aim: Chemical Characterization and Potential Health Benefits of *Nigella Sativa*.

3.2 Objectives:

- To collect the detailed information about *Nigella Sativa*.
- To know about the main chemical constituents nad therapeutic uses of *Nigella Sativa.*
- To know about the method of extraction.
- Investigating *Nigella Sativa* properties.
- Exploring Traditional knowledge.

Plan of Work-

- The review on *Nigella Sativa* will begin with a comprehensive literature search to gather relevant studies.

- **Key Aspects:**

1. Pharmacological Properties.
2. Bioactive compounds.
3. Therapeutic Potentials.
4. Safety profiles.
5. Method of Extraction.

DISCUSSION-

- In a review article focusing on the chemical characterization and potential health benefits of Nigella sativa (black seed), the discussion would encompass several key aspects. Firstly,

an examination of the chemical composition of Nigella sativa seeds, highlighting the presence of bioactive compounds such as thymoquinone, thymohydroquinone, and dithymoquinone, alongside other phytochemicals. This discussion would delve into the methods employed for extraction and characterization of these compounds. Following this, an exploration of the pharmacological properties of these bioactive compounds would ensue, detailing their antioxidant, anti-inflammatory, antimicrobial, and anticancer activities, elucidating the underlying mechanisms of action.

- Subsequently, attention would turn towards the potential health benefits of Nigella sativa, drawing from preclinical and clinical studies. This would involve evaluating its efficacy in managing various diseases and health conditions, including cardiovascular diseases, diabetes, neurological disorders, and gastrointestinal disorders.

CONCLUSSION

The comprehensive analysis of *Nigella Sativa* reveals a rich reservoir of bioactive compounds with promising therapeutic potential. Through elucidating its chemical composition, researchers have unveiled a myriad of health benefits ranging from antioxidant and anti-inflammatory properties to potential anti-cancer and antimicrobial effects. However, while the scientific evidence underscores its medicinal value, further clinical studies are imperative to validate its efficacy and safety for human use. By harnessing the power of *Nigella Sativa*, we may unlock new avenues for preventive and therapeutic interventions against various ailments. Thus, fostering continued exploration and collaboration in this field holds great promise for enhancing global health and wellbeing.".

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HOW TO CITE: Anmol thakur*, Ankit, Kiran thakur, Chemical Characterization and Potential Health Benifts of Nigella Sativa, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 4, 1036-1050. https://doi.org/10.5281/zenodo.15182585