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Black Cumin (Nigella sativa) A comprehensive review

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ABSTRACT:

Black cumin seeds (*Nigella sativa* L.) are small black seeds widely used in traditional medicine and culinary practices across the Middle East, South Asia, and Africa. They are rich in bioactive compounds, notably thymoquinone, along with alkaloids, flavonoids, fatty acids, and essential oils. Scientific studies have shown that black cumin seeds possess a broad range of pharmacological properties, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, immunomodulatory, and hepatoprotective effects. These health benefits are largely attributed to their ability to reduce oxidative stress, regulate immune responses, and modulate key metabolic pathways. In addition to their medicinal value, black cumin seeds are used as a functional food ingredient due to their nutritional content, including proteins, minerals, and unsaturated fatty acids. Overall, *Nigella sativa* represents a promising natural resource for the development of nutraceuticals and complementary therapies, although further clinical studies are needed to confirm efficacy and safety in humans.

Keywords: Nigella sativa, Black cumin, Black seed, Thymoquinone, Medicinal plant, Seed oil, Health benefits, Antimicrobial.

1. INTRODUCTION:

Black cumin, scientifically known as *Nigella sativa*, is a small flowering plant that belongs to the Ranunculaceae family. It is native to regions of South and Southwest Asia but is now cultivated in many parts of the world. The plant produces small, black seeds, commonly referred to as black seeds or kalonji, which have been valued for their medicinal and culinary properties for thousands of years. Historical records show that black cumin was used in ancient civilizations, including Egypt, Greece, and the Middle East, and it is often mentioned in traditional texts as a "blessed" or "miraculous" herb.[1]

The seeds of black cumin are rich in bioactive compounds such as thymoquinone, nigellone, alkaloids, and essential oils, which are responsible for their potent therapeutic properties. These compounds exhibit a wide range of biological activities, including antioxidant, anti-inflammatory, antimicrobial, and immunomodulatory effects. Due to these properties, black cumin has been traditionally used to treat various ailments, including digestive disorders, respiratory problems, infections, and general weakness.[2]

In addition to its medicinal uses, black cumin seeds are highly valued as a spice in culinary practices. They have a slightly bitter, pungent flavor and are used to enhance the taste of breads, curries, pickles, and other foods. The seeds are also a source of essential nutrients, including proteins, fatty acids, and minerals, making them a functional food ingredient that contributes to overall nutrition.[3]

Modern scientific research has increasingly focused on the health benefits of black cumin. Studies have shown its potential in managing chronic conditions such as diabetes, high blood pressure, and high cholesterol. Research also suggests that thymoquinone, the main active component in black cumin, may have anticancer, hepatoprotective, and neuroprotective effects. These findings support the traditional uses of the plant and highlight its importance as a natural therapeutic agent.[4]

Overall, black cumin is recognized not only for its culinary value but also for its significant medicinal potential. Its long history of traditional use, combined with growing scientific evidence, underscores its relevance in herbal medicine, nutraceuticals, and functional foods. With continued research, black cumin may offer new opportunities for developing natural treatments and preventive strategies for various health conditions.[5]

2. PLANT PROFILE:

2.1. Black cumin (*Nigella sativa* L.):[6]

Fig No. 1: Black cumin (*Nigella sativa* L.)

2.2. Taxonomical Classification:[7]

Kingdom	Plantae
Subkingdom	Tracheobionta (Vascular plants)
Superdivision	Spermatophyta (Seed plants)
Division	Magnoliophyta (Angiosperms)
Class	Magnoliopsida (Dicotyledons)
Order	Ranunculales
Family	Ranunculaceae
Genus	Nigella
Species	*Nigella sativa* L.

Table No. 1: Taxonomical Classification of Black cumin (*Nigella sativa* L.)

2.3. Vernacular Names:[8] **English:** Black cumin, Black seed **Hindi:** Kalonji

Urdu: Kalonji

Arabic: Habbatul Barakah / Habbat-ul-Sauda

Sanskrit: Krishna Jiraka **Tamil:** Karunjeeragam **Telugu:** Nalla Jeelakarra

Kannada: Krishna Jeerige **Malayalam:** Karinjeerakam **Bengali:** Kalo Jeera

Gujarati: Kalonji **Marathi:** Kalonji

Punjabi: Kalonji

2.4. Geographical Distribution of Black Cumin (*Nigella sativa* L.):

Black cumin (*Nigella sativa* L.) is native to the Mediterranean region and Southwest Asia. It is widely cultivated in North African countries such as Egypt, Morocco, and Tunisia. In South Asia, it is commonly grown in India, Pakistan, and Bangladesh. The plant is also distributed in West Asian countries including Iran, Iraq, and Saudi Arabia. Turkey is one of the leading producers of black cumin seeds. It grows well in warm, dry climates with moderate rainfall and well-drained soils.[9]

2.5. Morphology of Black Cumin (*Nigella sativa*):[10]

2.5.1. Plant Type: Annual herb.

2.5.2. Height: 20–30 cm.

2.5.3. Stem: Erect, branched, green, slender.

2.5.4. Leaves:

- Finely divided, feathery, thread-like.
- Alternate arrangement on stem.

2.5.5. Flowers:

- Solitary, axillary flowers.
- Color: Pale blue or white.
- Petals: 5–10, delicate.

2.5.6. Calyx & Sepals: Sepals often resemble petals; calyx persistent.

2.5.7. Fruits:

- Type: Capsule, many-celled.
- Shape: Ovoid or inflated.
- Splits open when mature to release seeds.

2.5.8. Seeds:

- Small, black, angular, aromatic.
- Used as spice and medicine.

2.5.9. Root: Taproot, moderately developed.

3. CHEMICAL COMPOSITION:

3.1. Fixed Oils (Fatty Acids):

Black cumin seeds contain 30–40% fixed oil, which is rich in fatty acids. The major fatty acids are linoleic acid (50–60%), oleic acid (20%), palmitic acid (15%), and stearic acid (3–4%). These oils are nutritionally important and contribute to the seeds' health benefits. They help reduce inflammation, support heart health, and provide essential fatty acids that the body cannot make on its own. Overall, the fixed oils are a key reason for the medicinal and dietary value of black cumin seeds.[11]

3.2. Essential Oil:

The essential oil in black cumin seeds makes up about 0.4–2.5% of the seed. Its main active compound is thymoquinone, which has antioxidant, anti-inflammatory, and anticancer effects. Other important constituents include p-cymene, α-pinene, thymol, carvacrol, and nigellone. These compounds together give black cumin seeds their medicinal and therapeutic properties.[11]

3.3. Proteins and Amino Acids:

Black cumin seeds have a protein content of 20–25%, making them a good source of plant-based protein. They are particularly rich in essential amino acids such as arginine, lysine, methionine, and leucine, which the body cannot produce on its own. These proteins support growth, tissue repair, and overall health, contributing to the seeds' nutritional value.[12]

3.4. Carbohydrates:

Black cumin seeds contain 30–35% carbohydrates, which provide a good source of energy. Their carbohydrates include dietary fibers, starch, and natural sugars, aiding in digestion and metabolism. The dietary fiber also helps in maintaining gut health and supports overall nutritional balance.[13]

3.5. Minerals:

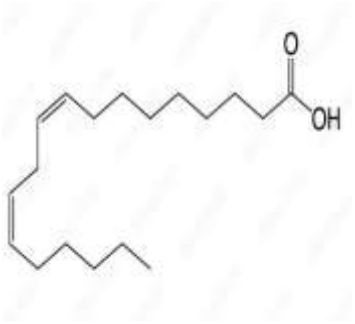
Black cumin seeds are rich in essential minerals that are important for overall health. They contain calcium for strong bones and teeth, iron for blood health, and potassium for proper nerve and muscle function. They also provide zinc, magnesium, and phosphorus, which support metabolism, immunity, and energy production. These minerals make black cumin seeds a valuable nutritional supplement in the diet.[14]

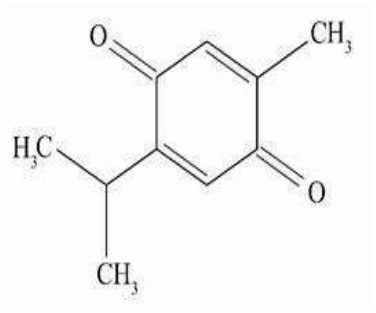
3.6. Vitamins:

Black cumin seeds contain various vitamins that support overall health. They are a source of B-complex vitamins like B1 (thiamine), B2 (riboflavin), B3 (niacin), and folic acid, which help in energy production and metabolism. They also have small amounts of vitamin C, which contributes to antioxidant protection and immune support.[15]

3.7. Other Bioactive Compounds:

Black cumin seeds contain bioactive compounds that enhance their medicinal properties. Saponins help in boosting immunity, while alkaloids like nigellidine and nigellicine provide therapeutic effects. They also have phenolic compounds, which are strong antioxidants that protect the body from free radical damage. These compounds together contribute to the seeds' health-promoting benefits.[15]





a) linoleic acid b) thymoquinone

4. MECHANISM OF ACTION:

Black cumin seeds exert their effects mainly through thymoquinone and other bioactive compounds. They act as powerful antioxidants, scavenging free radicals and protecting cells from oxidative damage. Their anti-inflammatory action involves inhibiting inflammatory mediators like prostaglandins and leukotrienes, reducing swelling and tissue injury. Black cumin also has immunomodulatory effects, enhancing T-cell and natural killer cell activity to strengthen the body's defenses. Its antimicrobial properties disrupt bacterial, fungal, and parasitic cell membranes, helping fight infections. Thymoquinone contributes to anticancer activity by inducing apoptosis and inhibiting tumor cell proliferation. The seeds' cardioprotective effects are due to lowering cholesterol, improving lipid profiles, and reducing blood pressure. Additionally, fatty acids support metabolic health, while phenolic compounds provide further antioxidant protection. Overall, black cumin seeds act through a combination of antioxidant, anti-inflammatory, immunomodulatory, antimicrobial, anticancer, and cardioprotective mechanisms, making them a potent natural therapeutic agent.[16]

Mechanism	**Action / Effect**
Antioxidant	Scavenges free radicals → protects cells from oxidative damage
Anti-inflammatory	Inhibits prostaglandins & leukotrienes → reduces swelling & tissue injury
Immunomodulatory	Enhances T-cell & NK cell activity → strengthens immunity
Antimicrobial	Disrupts bacterial, fungal, and parasitic cell

	membranes → fights infections
Anticancer	Thymoquinone induces apoptosis & inhibits tumor proliferation → anticancer effect
Cardioprotective	Lowers cholesterol, improves lipid profile, reduces blood pressure → heart health
Additional antioxidant support	Phenolic compounds & fatty acids → further cellular protection & metabolic support

Table No. 2: Mechanism of action of Black cumin

5. PHARMACOLOGICAL ACTIVITIES:

5.1. Antioxidant Activity:

Black cumin seeds are rich in thymoquinone, a potent antioxidant that helps protect cells from oxidative stress by neutralizing free radicals. This antioxidant action plays a key role in preventing tissue damage and reducing inflammation. It is particularly beneficial in managing chronic conditions like diabetes and cardiovascular diseases, where oxidative damage is a major contributor. Thymoquinone's ability to protect organs and improve overall health makes black cumin seeds a valuable natural remedy.[17]

5.2. Anti-inflammatory Effects:

Thymoquinone, along with other compounds in black cumin, effectively inhibits inflammatory markers like TNF-α, IL-6, and COX-2. This action reduces inflammation in the body, making it useful for treating conditions such as arthritis, autoimmune diseases, and inflammatory bowel disease (IBD). By lowering these inflammatory signals, black cumin helps alleviate pain and swelling, and supports overall immune function. These anti-inflammatory effects contribute to its therapeutic value in chronic inflammatory conditions.[18]

5.3. Anticancer Properties:

Black cumin seeds, particularly through thymoquinone, exhibit anticancer properties by promoting apoptosis (programmed cell death) in various cancer cells, including those of the lung, breast, prostate, and colon. Thymoquinone activates caspases, enzymes that play a central role in cell death. It also regulates Bcl-2 and other genes involved in cell survival, helping to overcome the mechanisms that cancer cells use to resist death. These actions make black cumin seeds a promising natural option in cancer therapy.[19]

5.4. Antimicrobial Activity:

Black cumin seeds demonstrate broad-spectrum antimicrobial activity, effectively targeting bacteria, fungi, and viruses. They inhibit the growth of both Gram-positive and Gram-negative bacteria, including E. coli and S. aureus. Additionally, black cumin shows antifungal effects against pathogens like Candida. This makes it a valuable natural remedy for managing a wide range of infections, from common bacterial to fungal ones. The seeds' antimicrobial properties contribute to their traditional use in treating various infectious diseases.[20]

5.5. Immune System Modulation:

Black cumin seeds boost the immune system by enhancing the activity of T-cells and natural killer (NK) cells, which are crucial for fighting infections. This immune-modulatory effect helps improve the body's overall immunity, making it more effective at combating diseases. It is especially beneficial in managing conditions like allergies and asthma, where immune responses are often dysregulated. By supporting immune function, black cumin seeds help reduce inflammation and improve resistance to infections.[21]

5.6. Hypoglycemic (Anti-diabetic) Effects:

Black cumin seeds help regulate blood sugar levels by boosting insulin secretion and enhancing insulin sensitivity. These effects make them particularly beneficial for managing type 2 diabetes. Some studies have shown that black cumin seeds improve glucose metabolism, leading to better control of blood sugar. Additionally, they have been linked to reduced HbA1c levels, a key marker for long-term blood sugar control. This makes black cumin an effective natural aid in diabetes management.[22]

5.7. Analgesic and Antipyretic Effects:

Black cumin seeds have shown significant analgesic (pain-relieving) and antipyretic (fever-reducing) properties. These effects help alleviate symptoms of conditions like headaches, muscle pain, and fever linked to infections. The seeds work by reducing inflammation and modulating pain pathways in the body. As a result, black cumin can provide relief from mild to moderate pain and help lower fever without the need for pharmaceutical drugs. This makes it a useful natural remedy for common ailments like colds and flu.[23]

5.8. Cardioprotective Effects:

Black cumin seeds are beneficial for heart health as they help lower blood pressure, cholesterol levels, and triglycerides, all of which protect the cardiovascular system. By reducing these risk factors, they contribute to the prevention of atherosclerosis (plaque buildup in arteries), which can lead to heart

disease. Additionally, black cumin seeds help improve overall heart function by promoting better blood circulation. Their cardioprotective properties make them an effective natural remedy for supporting heart health and reducing the risk of cardiovascular diseases.[24]

5.9. Hepatoprotective (Liver Protection):

Black cumin seeds offer significant liver protection by shielding it from toxic damage caused by chemicals, drugs, or environmental toxins. They help reduce liver inflammation and prevent fibrosis, a condition where scar tissue builds up in the liver. The seeds also improve liver enzyme function, which is crucial for proper liver metabolism and detoxification. By supporting the liver's natural detox processes, black cumin seeds enhance its ability to filter out harmful substances from the body. These protective and restorative effects make black cumin a valuable remedy for maintaining liver health and preventing liver damage.[25]

6. MEDICINAL USES:

Black cumin seeds (Nigella sativa) are celebrated for their wide range of medicinal benefits, including immune-boosting effects that enhance T-cell and natural killer (NK) cell activity, making them effective against infections and useful for managing allergies and autoimmune diseases. They also possess anti-inflammatory and analgesic properties, helping to reduce pain and inflammation in conditions like arthritis and IBD. Additionally, black cumin aids in blood sugar regulation and insulin sensitivity, making it beneficial for managing diabetes. Its antimicrobial effects help treat various infections, and it supports liver and kidney health by protecting these organs from toxicity.

These seeds also promote cardiovascular health by lowering blood pressure, cholesterol, and triglycerides, while preventing atherosclerosis. Black cumin has anticancer properties by inducing apoptosis in cancer cells and is beneficial for digestive and respiratory health, alleviating issues like indigestion, bloating, asthma, and bronchitis. Moreover, their antioxidant properties help protect the skin, reducing acne, eczema, and wrinkles. With their broad therapeutic effects, black cumin seeds are a powerful natural remedy for various health conditions.[26]

7. FUTURE PROSPECT:

The future of black cumin seeds (Nigella sativa) looks promising due to their wide range of therapeutic benefits and increasing scientific interest. Research is focused on understanding the mechanisms of thymoquinone to develop targeted therapies for conditions like cancer, diabetes, and autoimmune diseases. Clinical trials will help determine the optimal dosages and long-term safety of the seeds. As demand for natural remedies grows, black cumin could become a key adjunct in treating chronic

diseases. Future studies may explore novel delivery systems to improve compound effectiveness, and its role in personalized medicine for conditions like obesity and cardiovascular disease. Biotechnology could also help extract specific bioactive molecules for pharmaceutical use. With increasing evidence, black cumin is likely to become a major player in complementary and integrative medicine.

8. CONCLUSION:

Black cumin seeds (Nigella sativa) are a rich source of bioactive compounds, particularly thymoquinone, which is responsible for most of their pharmacological effects. They possess antioxidant, anti-inflammatory, antimicrobial, anticancer, and immunomodulatory properties. Studies indicate their potential in managing diabetes, hypertension, liver and kidney disorders, and enhancing immune function. Traditional medicine has used these seeds for centuries to treat various ailments, and modern research validates many of these therapeutic effects. Thymoquinone also helps in protecting organs from oxidative stress and inflammation. Despite promising experimental and clinical findings, further well-designed clinical trials are required to establish effective doses, long-term safety, and standardization. Overall, black cumin seeds are a valuable natural remedy with broad health benefits and significant therapeutic potential.

9. REFERENCES:

1. Datta, A. K., Saha, A., Bhattacharya, A., Mandal, A., Paul, R., & Sengupta, S. Black cumin (*Nigella sativa* L.) A review. *Journal of Plant Development Sciences, 4*(1), 1–43 (2012).

2. Dajani, E. Z., Shahwan, T. G., & Dajani, N. E. Overview of the preclinical pharmacological properties of *Nigella sativa* (black seeds): A complementary drug with historical and clinical significance. *Journal of Physiology and Pharmacology*, *67*(6), 801–817 (2016).

3. Thilakarathne, R. C. N., Madushanka, G. D. M. P., & Navaratne, S. B. Morphological characteristics of black cumin (*Nigella sativa*) seeds. *Chemistry Research Journal.* (2018).

4. Akter, S., Longhini, G. M., Haque, M. S., Farnell, Y. Z., & Sun, Y. *Black cumin (Nigella sativa) as a healthy feed additive for broiler production: A focused review*. Poultry, 4(4), Article 49 (2025).

5. Kaushik, N., Barmanray, A., & Kumar, R. *A study on black cumin (Nigella sativa L.) fortified processed products: Formulation and quality evaluation*. Journal of Nutrition and Food Security, 9(4) (2024).

6. Srinivasan, K., *Cumin (Cuminum cyminum) and black cumin (Nigella sativa) seeds: Traditional uses, chemical constituents, and nutraceutical effects*. Food Quality and Safety, 2(1), 1–16 (2018).

7. Qadir, M. I., & Shahzad, R. *Therapeutic properties of Nigella sativa (black cumin seeds): A review article*. Pakistan Journal of Pharmaceutical and Biological Sciences. (2025, October).

8. Zohary, D., & Hopf, M. *Domestication of plants in the Old World* (3rd ed.). Oxford University Press

(2000).

9. Paarakh, P. M. *Nigella sativa* Linn.: A comprehensive review. Indian Journal of Natural Products and Resources, 1(4), 409–429 (2010).

10. Margout, D., Kelly, M. T., Meunier, S., Auinger, D., Pelissier, Y., & Larroque, M. Morphological, microscopic and chemical comparison between *Nigella sativa* L. cv (black cumin) and *Nigella damascena* L. cv. *Journal of Food, Agriculture & Environment, 11*(1), 165–171 (2013).

11. Budak, B., Radácsi, P., & Çoban, F. *Evaluation of the chemical composition of Nigella sativa L. seeds grown in different locations*. Research in Agricultural Sciences, 57(1), 11–18 (2025).

12. Mariod, A. A., Edris, Y. A., Cheng, S. F., & Abdelwahab, S. I. Effect of germination periods and conditions on chemical composition, fatty acids and amino acids of two black cumin seeds. *Acta Scientiarum Polonorum Technologia Alimentaria, 11*(4), 401–410 (2012).

13. Albakry, Z., Karrar, E., Ahmed, I. A. M., Oz, E., Proestos, C., & Farag, A. Nutritional composition and volatile compounds of black cumin (*Nigella sativa* L.) seed, fatty acid composition and tocopherols, polyphenols, and antioxidant. *Horticulturae, 8*(7), 575. (2022).

14. Mamun, M. A., & Absar, N. Major nutritional compositions of black cumin seeds cultivated in Bangladesh and the physicochemical characteristics of its oil. *International Food Research Journal, 25*(6), 2634–2639 (2018).

15. Al-Jassir, M. S. Chemical composition and microflora of black cumin (*Nigella sativa* L.) seeds growing in Saudi Arabia. *Food Chemistry, 45*(4), 239–242 (1992).

16. Mengistu, F. G., & Tilahun, G. W. *Effects of ageing on seed viability and oil qualities of black cumin cultivars in Ethiopia: Seed viability and oil quality in black cumin*. *Journal of Oilseeds Research, 33*(2) (2025).

17. Asefa, L., & Gemede, H. F. *Nutritional and antioxidant activities of newly released black cumin (Nigella sativa) seed varieties: Suitability for food and industrial uses*. *Cogent Food & Agriculture, 10*(1) (2024).

18. Rashwan, H. K., Mahgoub, S., Abuelezz, N. Z., & Amin, H. K. Black cumin seed (*Nigella sativa*) in inflammatory disorders: Therapeutic potential and promising molecular mechanisms. *Drugs and Drug Candidates, 2*(2), 516–537 (2023).

19. Khan, A., Chen, H. C., Tania, M., & Zhang, D. Z. Anticancer activities of *Nigella sativa* (black cumin). *African Journal of Traditional, Complementary and Alternative Medicines, 8*(5S) (2011).

20. Hanafy, M. S. M., & Hatem, M. E. Studies on the antimicrobial activity of *Nigella sativa* seed (black cumin). *Journal of Ethnopharmacology, 34*(2–3), 275–278 (1991).

21. Salem, M. L. Immunomodulatory and therapeutic properties of the *Nigella sativa* L. seed. *International Immunopharmacology, 5*(13–14), 1749–1770 (2005).

22. Ghods, M., Karimi, S., Salari, S., Alem, E., Bahmani, P., Karimi, A., Anti-diabetic effect of a combination of black seed (*Nigella sativa*) and cumin (*Cuminum cyminum*): A two-step study from bench to bed. *Functional Food Science, 4*(2), 55–68 (2024).

23. Amin, B., & Hosseinzadeh, H. Black cumin (*Nigella sativa*) and its active constituent, thymoquinone: An overview on the analgesic and anti-inflammatory effects. *Planta Medica, 82*(01/02), 8–16(2016).

24. Shabana, A., El-Menyar, A., Asim, M., Al-Azzeh, H., & Al Thani, H. Cardiovascular benefits of black cumin (*Nigella sativa*). *Cardiovascular Toxicology, 13*(1), 9–21(2013).

25. Adam, G. O., Rahman, M. M., Lee, S.-J., Kim, G.-B., Kang, H.-S., & Jin., Hepatoprotective effects of *Nigella sativa* seed extract against acetaminophen-induced oxidative stress. *Asian Pacific Journal of Tropical Medicine, 9*(3), 221–227 (2016).

26. Balyan, P., Alim, H., & Ali, A. *Traditional uses, pharmacological properties, and other potential uses of black cumin seeds*. In Medicinal spice and condiment crops (pp. 155–167) (2024).