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## The black seed *Nigella sativa*: A wonder seed

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**Abstract**

*Nigella sativa* (*N. sativa*) (Family Ranunculaceae) a spice used since from many years has a broad spectrum of pharmacological activities and widely used in traditional medicine as anti-microbial, anti-inflammatory, anti-diabetic, anti-hypertensive, anti-histamine, analgesic, immunogogue, galactogogue, hepatoprotective and renal protective properties. The active components in *N. sativa* are thymoquinone (30-48 per cent), P-cymene (7-15 per cent), T-anethole (1-4 per cent), sesquiterpene longifolene (1-8 per cent), nigellicimine and nigellicimine N-oxide,  $\alpha$ -pinene and thymol. *N. sativa* seeds are widely used in many Indian cuisines. Apart from use in food processing seeds are also used as insect repellents in linen and wool cloths and also the essential oils are being used in range of beauty products. The present review provides a detailed summary of scientific researches regarding health benefits of *Nigella sativa* and its constituents.

**Keywords:** *Nigella sativa*, thymoquinone, medicinal value, nutritional value

**Introduction**

The seeds of, *Nigella sativa* Linn. commonly known as Black Cumin/Kalonji/Kalajira) is an annual herbaceous plant belonging to the Ranunculaceae family. The species was first named by Swedish botanist Carl Linnaeus in 1753. *Nigella* seeds are used for edible and medicinal purposes in many countries. *Nigella* is widely cultivated throughout South Europe, Syria, Egypt, Saudi Arabia, Iran, Pakistan, India and Turkey. In India it is cultivated commercially in West Bengal, Punjab, Jharkhand, Himachal Pradesh, Bihar and Assam. Small scale cultivation is also taken at Uttar Pradesh, Rajasthan, Madhya Pradesh and Tamil Nadu states. It has been used as herbal medicine for more than 2000 years. Also used as a food additive and flavoring agent in many countries. The oil of *Nigella sativa* is so beneficial due to its content of over a hundred active components. Two thousand years ago the *Nigella sativa* has been traditionally used by various cultures as a natural remedy to treat numerous diseases. *Nigella* oil bottle was discovered in King Tutankhamen's tomb, items entombed with a king were carefully selected to assist him in the afterlife. This review paper describes the seed, its chemical components and popular uses in traditional medicine. The paper also discusses the medicinal potential and therapeutic values of some of the individual components present in the extracts of the seeds.

**Plant Description and Spice Description**

*Nigella sativa* plant grows to 20–30 cm (7.9–12 in) tall, with finely divided, linear leaves. The flowers are delicate, and usually colored pale blue and white, with 5–10 petals. The fruit is a large and inflated capsule composed of 3–7 united follicles, each containing numerous seeds. *Nigella* seeds are small, black grains with a rough surface and an oily white interior. They are roughly triangulate, 1 1/2 - 3 mm (1/16 to 1/8 inch) long and resembles to onion seeds. The seeds have little bouquet, though when they are rubbed they give off an aroma. These seeds give slightly bitter and peppery flavor with a crunchy texture.

*Nigella* occurs wild in India and has been used as a condiment from ancient times. *Nigella* is quoted as black cumin in many texts and, because of similarity in common names, may be confused with other spices of family Apiaceae, viz. Siah Zira (literally black cumin – *Carum carvi* L.), Kala Zira (literally black cumin – *Bunium persicum* Bioss. Botanically and structurally, *Nigella* seed is altogether different from the above seed spices and belongs to a different family. To avoid such confusion, it is most appropriate to call the spice *Nigella*. The seeds of *Nigella* have been used as spices from ancient times in India when preparing pickles, as one of the ingredients, has the properties of a preservative. India is known to be the largest producer of *Nigella* in the world. The other producing countries are Sri Lanka, Bangladesh, Nepal, Egypt, Iraq and Pakistan.

In India, it is commercially cultivated in Punjab, Himachal Pradesh, Madhya Pradesh, Bihar, Jharkhand, Assam, West Bengal and Andhra Pradesh, Exact information on its area, production and productivity is not available, but it is estimated to be produced in an area of about 9000 ha area, with production of about 7000–8000 tons in India.



Source: [https://en.wikipedia.org/wiki/Nigella\\_sativa](https://en.wikipedia.org/wiki/Nigella_sativa)

Fig 1: Seeds of *Nigella sativa*.

### Chemical constituents and active principles in *N. sativa* seeds

Millions of people in the Mediterranean region and on the Indian subcontinent use the oil from the seed of *N. sativa* daily as a natural protective and curative remedy (Gali-Muhtasib *et al.*, 2006)<sup>[9]</sup>. They contain amino acids, proteins, carbohydrates, fixed and volatile oils (Khan, 1999)<sup>[16]</sup>.

Table 1: Nutritional composition of *Nigella seed* (per 100 grams)

| Nutrient         | Quantity |
|------------------|----------|
| Moisture (g)     | 4        |
| Protein (g)      | 22       |
| Fat (g)          | 41       |
| Carbohydrate (g) | 17       |
| Fibre (g)        | 8        |
| Ash (g)          | 4.5      |
| Potassium (g)    | 0.5      |
| Calcium (g)      | 1.0      |
| Phosphorous (g)  | 0.5      |
| Iron (mg)        | 10       |
| Thiamine (mg)    | 1.5      |
| Niacin (mg)      | 6        |
| Pyridoxine (mg)  | 0.7      |
| Tocopherol (mg)  | 34       |

Table 2: Chemical composition of *N. sativa* oil (Malhotra *et al.*, 2004)<sup>[21]</sup>

| Constituent       | Range (w/w) |
|-------------------|-------------|
| Linoleic acid     | 44.7-56     |
| Oleic acid        | 20.7-24.6   |
| Linolenic acid    | 0.6-1.8     |
| Arachidonic acid  | 2-3         |
| Palmitoleic acid  | 3           |
| Eicosadienic acid | 2-2.5       |
| Palmitic acid     | 12-14.3     |
| Myristic acid     | 2.7-3       |
| Stearic acid      | 0.16        |
| Sterols           | 0.5         |

### Pharmacologically active principles present in *Nigella sativa* seeds

*Nigella* seeds contain 0.5 per cent volatile oils and seven main constituents of volatile oil (approx.) are *p*-cymene 31 per cent,

thymoquinone 25 per cent, ethyl linoleate per cent,  $\alpha$ -pinene per cent, ethyl hexa-decanoate 3 per cent, ethyloleate per cent and  $\beta$ -pinene 2 per cent. The other chemical constituents found in *Nigella* seed are glucosides, melanthin and melanthingenin, bitter substances and a crystalline active principle nigellone, essential oils, fixed oil, resins and tannins. The amino acids present in dormant seeds are cystine, lysine, aspartic acid, glutamic acid, alanine and tryptophan. The fatty acids of the oil present are myristic, palmitic, stearic, oleic and linoleic. The component glycerides of the oil are trillinolein, oleodilinolein, dioleolinolein, palmito-oleo-linolein and stearo-oleo-linolein. Glycerides of some volatile acids are present in the oil in small quantities. The perfect balance in the body the omega 6 and omega 3 should be in a ratio of 3:1 respectively. *Nigella sativa* oil helps maintain this ratio through the production of Prostaglandin E1.

As early as Chopra *et al.* 1956<sup>[6]</sup>, found that thymoquinone (TQ) is the main active constituent of the volatile oil of the black seed. Mahfouz (1960)<sup>[18]</sup> and El-Dakhkhny (1963)<sup>[8]</sup> were the first to report on the isolation of 'nigellone' from the oil of *N. sativa* seed, using Girard's reagent. Nigellone was later found to possess anti-histaminic properties in relatively low concentrations (Mahfouz *et al.*, 1965)<sup>[19]</sup>. El-Dakhkhny (1963)<sup>[8]</sup> was able to isolate the constitutive components of *N. sativa* seeds from its essential oil, among which TQ was later shown to be the main constituent of the volatile oil (Houghton *et al.*, 1995)<sup>[14]</sup>. In addition, El-Dakhkhny (1963)<sup>[8]</sup> determined that the 'nigellone' isolated earlier was a dimer of TQ, which was later named dithymoquinone (TQ2) (Figure 2). The latter compound was shown to be formed via photo dimerization of TQ as a consequence of exposure to sunlight during separation and extraction of the quinones from the seed.

### Essential components of *Nigella sativa* oil

*Nigella sativa* seeds contain Thymoquinone (30-48 per cent), *p*-cymene (7-15 per cent), *T*-anethole (1-4 per cent), Sesquiterpene longifolene (1-8 per cent). Thymoquinone and its derivatives Dithymo quinone, Thymo hydroquinone and Thymol are most putative pharmacologically active constituents.

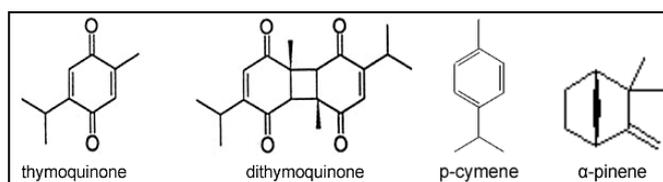


Fig 2: Chemical structures of some major essential components isolated from *Nigella sativa*.

Thymoquinone is an antioxidant, which inhibits the formation of undesirable prostaglandins, is anti-inflammatory and has a pain killing effect. It has a choleric effect (stimulates the production of bile) and is good for fat metabolism and detoxification. It has a broncho-dilating effect and is thereby protective against asthma attacks. It has been reported that it inhibits the secretion of histamines and could be a true alternative to cortisone based therapies for certain allergy sufferers.

Thymoquinone is proven to be a natural, very potent anti-oxidant. When oxygen isn't broken down completely in the cell membrane, which can be due to alcohol intake, drugs, bad diet and environmental pollution, the formation of free radicals results. This can lead to a number of diseases

including: cataract, heart disease, weakened immune system, Parkinson's disease, rheumatoid arthritis, Alzheimer's disease, cardiovascular diseases, diabetes and cancer.

### Non oily components

|                  |  |
|------------------|--|
| Saponins         | Glycoside, hederin, Melanthin                          |
| Alkaloids        | Indazole nigelicine, Isoquinoline nigellimine, N-oxide |
| Bitter component | Nigellone  |

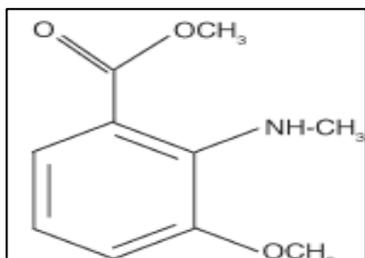


Fig 3: Chemical structure of nigellone

### Nigella in health promotion

*Nigella Sativa* has been studied extensively especially in Islamic world for its biological activities, which justifies its broad traditional therapeutic value. *N. sativa* found to act as an analgesic (Salem *et al.*, 2000) [26] and anthelmintic (Gilani *et al.*, 2004) [11]. Also it acts as anti-pyretic (also known as febrifuge) by exhibiting a 'cooling action', useful in fever reduction. Active component of nigella seeds inhibit the prostaglandin production around the body by blocking the cyclooxygenase enzymes (Gilani *et al.*, 2004) [11]. It also acts as carminative, its consumption stimulates digestion and induces the expulsion of gas from the stomach and the intestines. Essential components of nigella breakup the gastric foam thus reduce the gastric distention. Phenolics and flavonoids in *N. sativa* induce profuse sweating thus helps in perspiration during fever to cool and stimulate the release of toxins. It is also acts as a diuretic by stimulating the urination to relieve bloating and rid the body of any excess water. Thymoquinone an active component of nigella promotes urine formation thus the kidneys ability to reabsorb sodium is inhibited (Abul Nasr, 2001) [3]. Nigella seeds also proved to be effective against kidney stones (Hadjzadeh *et al.*, 2008) [12], anthelmintic property is due to thymoquinone, dithymoquinone and pipene, cymene in nigella seeds. *Nigella sativa* helps as an emmenagogue by stimulates menstrual flow and activity by increasing the prostaglandin production. It also acts as Galactagogue by stimulating the action of milk in new mothers by increasing the dopamine secretion which helps in secretion of prolactin.

### Anti-Inflammatory

Arachidonic acid is poly unsaturated fatty acid present in phospholipids of membranes of body's cells, and is abundant in brain and muscles. Involved in cellular signaling as a lipid second messenger in regulation of signaling enzymes and is key inflammatory intermediate.

Nigella seeds reduces inflammation by breaking the chain of prostaglandin and thromboxane's production by hindering the cyclooxygenase enzyme production thus acts as anti-inflammatory. (Abdallah *et al.*, 2017) [1].

### Anti-Microbial

*N. sativa* seeds destroys or inhibits the growth of destructive microorganisms. Active components acts against many

harmful micro-organisms such as *Staphylococcus aureus*, *Escheria coli*, *Candida albicans*, *Salmonella typhimurium*, *Listeria monocytogenes* and many other harmful microbes (Islam *et al.*, 1989) [15] (Abdulelah, 2007) [2]. The effect of *N. sativa* seed (0%, 1%, 2% and 3% of diet) on performance, intestinal *Escherichia coli* (*E. coli*) colonization and jejunal morphology in laying hens was evaluated. The results showed that ileal *E. coli* numeration reduced with 1% *N. sativa*. However, the best intestinal health indices were obtained following administration of 2% *N. sativa* (Boka *et al.*, 2014) [5].

### Antioxidant

*N. sativa* extract increases the activity of antioxidant enzymes (catalase, glutathione peroxidase, and glutathione-s-transferase) and acts as a free radical scavenger. As an anti-cancer agent, its effects such as modulation of the activities of molecular targets including p53, p73, PTEN, STAT3, PPAR- $\gamma$ , activation of caspases, and generation of ROS have been demonstrated. The antioxidant and anti-arthritis activity of thymoquinone in Wistar rat by collagen induced arthritis was evaluated. Oral administration of thymoquinone significantly reduced the levels of pro-inflammatory mediators [IL-1 $\beta$ , IL-6, TNF- $\alpha$ , IFN- $\gamma$  and PGE (2)] and increased level of IL-10. Prevents or delays the damaging oxidation of the body's cells - particularly useful against free radicals. Thymoquinone, carvacrol, selenium, tocopherol, thymol are active components in *Nigella* which acts as antioxidants. (Umar *et al.*, 2012) [28].

### Anti-tumour

*N. sativa* counteracts or prevents the formation of malignant tumors. Alkaloids inhibit biosynthesis of nucleic acids leading to proliferative tumor Cell death thus nigella acts as anti-tumor agent (Salem *et al.*, 2011) [25]. *In vitro* and *In vivo* anti-cancer effects of *Nigella sativa* L. seed extracts was evaluated by Mbarek *et al.*, 2007. In the study the essential oil and ethyl acetate extracts were showed more cytotoxic effects against the p815 cell line than the butanol extracts. Extracts showed comparable cytotoxic effects against the P815 cell line than the butanol extract.

Colorectal cancers (development of cancer in the colon or rectum) start as a polyp – a growth that starts in the inner lining of the colon or rectum and progresses toward the center. The preventive effect of *N. sativa* oil on rat colon cancer induced by 1,2-dimethylhydrazine was investigated. The animals were divided into four groups: Group 1 served as control; Group 2 received oil at post-initiation stage; Group 3 received oil at the initiation stage and Group 4 received 0.9% saline and oil from the beginning until the end of the study. The results of this study showed that *N. sativa* oil significantly reduced the total number of aberrant crypt foci in the post-initiation stage (group 2) whereas it showed no significant inhibitory effect on initiation stage (group 3). The results indicated that *N. sativa* oil has potent preventive effect on colon carcinogenesis in the post-initiation stage (Salim and Fukushima, 2003) [27].

### Hypotensive, hypocholesterolemic and hypoglycemic

*N. sativa* consumption reduces excess blood pressure. *Nigella sativa* inhibits the angiotensin converting enzymes production thus blood pressure will be maintained. It also has hypocholesterolemic and hypoglycemic properties. (Bhatti *et al.*, 2009) [4] (Gargari *et al.*, 2009) [10] (Hawsawi *et al.*, 2001) [13]. The study was conducted to determine the effects of *N. sativa* seed ethanol extract on insulin secretion in INS832/13 and  $\beta$

TC-tet lines of pancreatic  $\beta$ -cells and on glucose disposal by C2C12 skeletal muscle cells and 3T3-L1 adipocytes. Treatment with *N. sativa* amplified glucose-stimulated insulin secretion by more than 35% without affecting sensitivity to glucose. *N. sativa* treatment also accelerated  $\beta$ -cell proliferation. *N. sativa* increased basal glucose uptake by 55% in muscle cells and approximately 400% in adipocytes. Finally, *N. sativa* administration of pre-adipocytes undergoing differentiation accelerated triglyceride accumulation comparably with treatment with 10  $\mu$  M rosiglitazone. It is concluded that *in vivo*. Hypoglycemic effects of *N. sativa* seed extract are attributable to a combination of therapeutically relevant insulinotropic and insulin-like properties (Zaoui *et al.*, 2002)<sup>[29]</sup>.

### Immunomodulation

*N. sativa* suppresses or strengthens immune system activity as needed for optimum balance. Recent research has shown an effect on the inflammation that accompanies asthma flare ups. A 2017 randomized, placebo-controlled study by researchers associated with English and Saudi Arabian institutions found enough promise that future, longer-term trials with asthma sufferers was recommended (Koshak *et al.*, 2018)<sup>[17]</sup>.

### Gastro-protective

The effects of *N. sativa* oil (0.88 g/kg, orally) on gastric secretion and ethanol-induced ulcer in adult male rats were assayed. The results showed that *N. sativa* oil increased gastric mucin content, free acidity and glutathione level, and decreased gastric mucosal histamine content. It is concluded that *N. sativa* oil has a protective effect on ethanol-induced ulcer (El-Dakhakhny *et al.*, 2000)<sup>[7]</sup>. The gastro protective and anti-secretory effects of *N. sativa* seed powder (1.0, 1.5 and 2.0 g/kg, oral), aqueous and ethanolic extracts of *N. sativa* seed powder (2.0 g/kg, oral), and *N. sativa* ethanol-ethyl acetate fraction (2.0 g/kg, oral) were investigated in indomethacin-treated rats. The results showed that *N. sativa* seed powder decreased indomethacin-induced gastric lesions in a dose-dependent manner. Ethanolic extract of *N. sativa* significantly reduced gastric secretion volume, pH, acid-output and ulcer index, whereas aqueous extract only decreased gastric acid-output (Rifat-uz-Zaman and Khan, 2004)<sup>[24]</sup>.

*Nigella* seeds also acts as a laxative. *Nigella*'s mucilaginous fibre causes looseness or relaxation of the bowels. *Nigella* seed oil or extract has protective and curative actions and is considered as one among newer sources of edible oils.

*Nigella sativa* (Black Seed) oil contains over 100 therapeutic components which work together synergistically. When we include this healing product in our everyday diet we are supplied with an endless list of components that are required for vitality and good health.

### Main uses in food processing

The dried seeds are the only commercially important product and the essential oil is of minor importance. *Nigella* seeds are used in India and the Middle East as a spice and condiment and occasionally in Europe as both a pepper substitute and a spice. They are widely used in Indian cuisines, particularly in mildly braised lamb dishes such as korma. *Nigella* is also added to vegetable and dhal (lentil) dishes as well as in chutneys. The seeds are sprinkled onto naan bread before baking. *Nigella* is an ingredient of some garam masalas and is one of the five spices in *panchphoran* which is a famous Bengali origin spice mix consists of equal parts of five spices

such as cumin, fennel, mustard, fenugreek and *Nigella* seeds mixed together without roasting or grinding. In the Middle East *Nigella* is added to bread dough and is an essential constituent of the Middle East choereg rolls. The dried seeds of *Nigella* are the major commercial product being used in foods, pickles, baked goods, confectionery, pharmaceutical and perfumery industry. Owing to preservative qualities, the seeds of *Nigella* have been used as a spice from ancient times in the preparation of pickles. The major processed products from *Nigella* seed are *Nigella* oil and fixed oils.

### Other uses

Apart from use in food processing, seeds are scattered between folds of linen and wool to stop insect attack. Essential oil extracts are being used in range of beauty products like hair oil, body oil, soaps and shampoos.

### Some of the native Indian medical preparations as reviewed by Nadkarni (2001)<sup>[23]</sup> are given below

- In intermittent fever *Nigella* seeds slightly roasted are recommended to be given in two drachm doses with the addition of an equal quantity of treacle.
- In doses of 10–20 grains, *Nigella* seeds have a well-marked emmenagogue effect, useful in dysmenorrhea and in large doses may induce abortion.
- In loss of appetite and distaste for food, a confection made of *Nigella* seeds, cumin seeds, black pepper, raisins, tamarind pulp, pomegranate juice and sonchal salt with honey is said to be very useful.
- In the after-pains of puerperal women, the administration of *Nigella* seeds with the addition of long-pepper and wine has proved useful.
- In puerperal diseases such as fever, loss of appetite and disordered secretions after delivery, the following preparation called *panchajirakapaka* is used. It consists of seeds of *Nigella*, cumin, anise, ajowain, carum, *Anethumsowa*, fenugreek, coriander, ginger, long pepper, long pepper root, plumbago root, habusha (an aromatic substance), dried pulp of *Ziziphus jujuba*, root of *Aplotaxis auriculate* and Kamala powder. To each 10 g, add treacle 1000 g, milk one seer (about 1 litre), butter 40 g. Boil them together and prepare a confection. Dose is about a drachm every morning.

### Specification for whole seed

The quality of *Nigella* seed mainly depends on appearance: matt-black seeds, oily white interior and roughly triangulate, 1.5–3 mm long, and uniformity in size, shape and texture. The odour in *Nigella* seeds when crushed resembles strawberry. Some authors have mentioned its smell is similar to oregano or carrots.

The Indian AGMARK grade specifications for *Nigella* seeds with minimum specific quality indices as laid down under the Prevention of Food Adulteration Indian Act (PFA standards) for *Nigella* seeds is given below:

- Seed moisture = not more than 11 per cent by weight.
- Total ash = not more than 6 per cent by weight.
- Ash insoluble in acid = not more than 1 per cent by weight.
- Organic extraneous matters = not more than 3 per cent by weight.
- Inorganic extraneous matters = not more than 2 per cent by weight.
- Volatile oil = not less than 1 per cent (v/w).
- Ether extract (crude oil) = not less than 35 per cent (v/w).

- Alcoholic acidity as oleic acid = not more than 7 per cent (v/w).

#### The physiological properties of *Nigella* oil are given below

- Specific gravity at 15 °C = 0.875 to 0.886.
- Refractive index at 20 °C = 1.4836 to 1.4844.
- Optical rotation at 20 °C = +1.43 to +2.86.
- Acid value = up to 1.9.

#### Conclusion

The complex synergy of over hundred chemicals contained in black seed work together to enhance and strengthen the body's immune system in a way no other singular, naturally occurring substance has ever been known to do. With regular consumption of super foods we can gradually improve the state of our cellular nutrition, and in turn health will gradually improve, although improvements in vitality can often occur quickly. "Black Seed heals every disease except for death." The Prophet Mohammed proclaimed over fourteen hundred years ago and this statement is proved by many researchers.

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