

Black Cumin: A High Value Seed Spice with medicinal potential

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ARTICLE ID: 004

Abstract

Nigella sativa, also known as black cumin, black seeds, and kalonji, is a Ranunculaceae family seed spice crop grown in the Indian subcontinent during the Rabi season. *Nigella sativa* is a native to the Eurasian continent, especially in Mediterranean Europe and East Asia. The seeds of nigella and its oil were extensively used for centuries in the treatment of various ailments throughout the world. Black cumin, a spice that has been used for thousands of years, has a wide range of pharmacological activities and is widely used in traditional medicine as an antimicrobial, anti-inflammatory, anti-diabetic, anti-hypertensive, anti-histamine, analgesic, immunogogue, galactogogue, hepatoprotective, and renal protective agent. The major active constituents are Thymoquinone (30-48%), thymohydroquinone (THQ), dithymoquinone, p-cymene (7-15%), carvacrol (6-12%), 4-terpineol (2-7%), t-anethol (1-4%), sesquiterpene longifolene (1-8%), α -pinene and thymol etc. *Nigella* seeds are widely used in many Indian cuisines. Seeds are utilised as insect repellents in linen and wool fabrics, and essential oils are employed in a variety of beauty items in addition to their use in food preparation. Because of its low toxicity, *Nigella* seeds are frequently used in food as a flavouring, an addition in breads, and pickles. Because of the high quantity of lipids, proteins, and minerals in the seeds, nigella is a good candidate for research as a source of these nutrients. The presence of thymoquinone and its isomers, which are the main active chemical components of the essential oil, is responsible for the majority of the herb's medicinal capabilities.

Introduction

Medicinal plants have been used for treating diseases for several decades in various

indigenous and traditional systems of medicine. Among the various potential medicinal plants, *N. sativa* a dicotyledonous miraculous herb with a strong historical and religious background (Ahmad *et al.*, 2013). The seeds of *N. sativa* are the sources of the active ingredient which have been utilized for thousand years as a spice and food preservative, as well as a defending and therapeutic remedy for several disorders (Sultana *et al.*, 2015). Historical use of *N. sativa* has been mentioned in various religious and ethnic books (Tembhure *et al.*, 2014). The seeds of, *Nigella sativa* L. 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* seeds have been used for flavouring foods, baking cookies and bread, and cooking since ancient times. Salads, soups, and other foods were seasoned with herbs. Soap and perfumes are made from *Nigella sativa* essential oil, which has a distinct raspberry scent. Top nine spice producer countries in the world were India which produces about 1,939,000 tonnes followed by Turkey (199,018 tonnes), Bangladesh (180,993 tonnes), China (113,359 tonnes), Indonesia (110,387 tonnes), Pakistan (73,472 tonnes) and Ethiopia, about 36,754 tonnes (FAOSTAT 2019). *Nigella* is widely cultivated in parts of Asia, Africa, Europe and Americas of the globe. The major producing countries are India, Sri Lanka, Bangladesh, Afghanistan, Pakistan, Egypt, Iran, Iraq, Syria, Turkey and Ethiopia. In India, it is grown in many parts, particularly in Madhya Pradesh, Bihar, Punjab, Assam, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Rajasthan, West Bengal and Tamil Nadu (Sultana *et al.*, 2018), 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. Today, one of the main objectives of pharmacognosy is the development of parameters for the cultivation of medicinal plants used in pharmaceuticals.

The most investigated species of the family are: *Nigella arvensis* L., *Nigella carpatha* Strid., *Nigella damascena* L., *Nigella degenii* Vierh., *Nigella elata* Boiss., *Nigella fumariifolia* Kotschy, *Nigella glandulifera* Freyn & Sint., *Nigella hispanica* L., *Nigella latisecta*, *Nigella nigella strum* (L.) Willk., *Nigella orientalis* L., *Nigella oxypetala* Boiss., *Nigella segetalis* M. Bieb., *Nigella stricta* Strid., *Nigella unguicularis* (Poir) Spenn., *Nigella papilosa* G. Lopez, *Nigella sativa* L. Three species of the abovementioned grow in southern Ukraine. In 1985,

Nigella sativa L. was cultivated in Ukraine for the first time as an ornamental, medicinal and ether-bearing plant. *Nigella* has been utilised as a natural cure for a variety of ailments by many cultures for over two thousand years. *Nigella* oil bottle was discovered in King Tutankhamen's tomb, items entombed with a king were carefully selected to assist him in the afterlife. *Nigella* seeds decoction has a vasodilatory action. The infusion of *Nigella* plants enhances the immune system and improves heart function. In homoeopathy, nigella seeds are used to treat gastrointestinal, gallbladder, and liver problems. In many countries, herbal remedies are the major source of primary health care. Approximately 80% of the world's population relies on traditional medicines in some capacity (Ali and Blunden 2003).

Plant and floral morphology: *Nigella sativa* is a hermaphrodite, erect, annual herb, with a more or less branched stem, pinnately dissected leaves; plant height 35-45 cm with determinate flowering patterns. The flower terminates the main shoot and ends with the flowers on the lowermost branches. The leaves are 2.5-5.0 cm in length, linear to lanceolate in shape; flowers are delicate, usually pale blue and white in colour, 2.0-2.5 cm across, solitary and peduncular. The seed bearing capsule is 1-1.5 cm long. The perianth is differentiated into an outer whorl of five, 15–20 mm long, whitish, petaloid sepals and an inner whorl of eight, 7–8 mm long, nectariferous petals. The flowers are protandrous with 5 to 10 petals and characterized by the presence of nectaries. The androecium comprises a large number of stamens, which shed their pollens as the filament curves outward during the male phase (Dubey *et al.*, 2016). The male phase is initiated a few days before the stigmas become receptive; however, the maturing styles often become twisted around the last dehiscing anthers, which results in self-pollination; delayed selfing. Being entomophilous, cross pollination occurs through insects. Seeds are flat, oblong, angular, funnel shaped, size 0.20-0.25 cm long and 0.1-0.15 cm wide, dark black in colour, generally small (1- 5 mg) dark grey or black. The fruit is large and its inflated capsule contains numerous seeds. It is cultivated as a winter crop with flowering and fruiting from January to April (Lloyd 1987).

Customary uses: *Nigella* seeds are used as spice, condiments, pepper substitute, pickles, baked goods, confectionary, pharmaceuticals and perfume industries. The dried seeds are used in Asian countries as a spice and condiment. The major processed products from nigella seeds is essential oil and fixed oil. These are used as adjuncts for flavouring foods, preservatives in confectionaries, pharmaceutical industries and stabilizing agents for edible

fats. It is also used in foods such as aromatic additives in breads and pickles because their toxicity is very low (Al-Ali *et al.*, 2008). *Nigella* has been used as a folklore medicine in India and Mediterranean countries. The dried seeds are used as astringent, bitter, diuretic, emmenagogue; stimulant and anthelmintic. Its decoction is useful in paralysis, jaundice, intermittent fever, dyspepsia, piles and skin diseases (Paarakh, 2010 and Ali *et al.*, 2003). Black seed has also been used externally where it is applied directly to abscesses, nasal ulcers, orchitis, eczema, and swollen joints (Rathore *et al.*, 2013 and Kurion 2003).

Pharmacologically active principles present in *Nigella* seeds

The seeds have little bouquet, though when they are rubbed they give off an aroma. These seeds give slightly bitter and peppery flavour with a crunchy texture. The most important active compounds are thymoquinone (30-48%), thymohydroquinone, dithymoquinone, p-cymene (7-15%), carvacrol (6-12%), 4-terpineol (2-7%), t-anethol (1-4%), longifolene (1-8%), α -pinene and thymol, etc. (Begum and Mannan, 2020). *Glucosides*, *melanthin*, and *melanthingenin*, bitter compounds, and a crystalline active principle *Nigellone*, essential oils, fixed oil, resins, and tannins are among the various chemical constituents identified in *Nigella* seed. *Cysteine*, *lysine*, *aspartic acid*, *glutamic acid*, *alanine*, and *tryptophan* are among the amino acids found in dormant seeds. *Myristic*, *palmitic*, *stearic*, *oleic*, and *linoleic* fatty acids are included in the oil. *Trillinolein*, *oleodilinolein*, *dioleolinolein*, *palmito-oleo-linolein*, and *stearo-oleo-linolein* are the oil's component *glycerides*. In limited amounts, *glycerides* of various volatile acids can be found in the oil. Omega 6 and omega 3 should be in a 3:1 ratio in the body to achieve optimal balance. Prostaglandin E1 is produced by *Nigella sativa* oil, which helps to maintain this ratio.

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

Nutrient	Quantity
Moisture	4-5%
Protein	13-22%
Fat	38-41%
Carbohydrate	17-32%
Fibre	8%
Ash	3.7-4%
Mineral & Vitamins content per kg seeds	
Potassium (mg)	500-1000
Calcium (mg)	500-1860

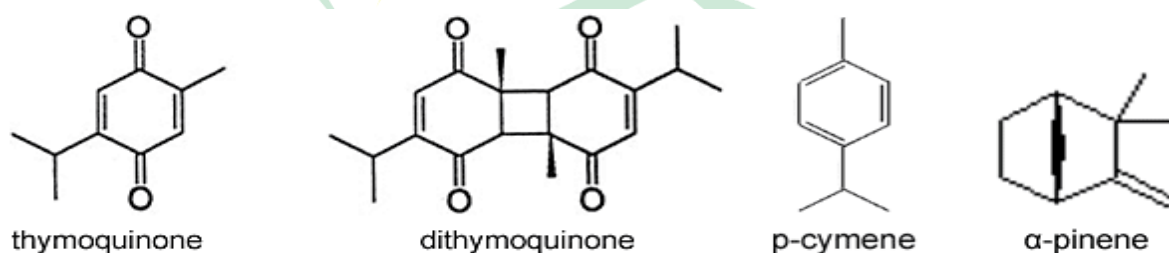
Phosphorous (mg)	325-527
Iron (mg)	10-105
Thiamine (mg)	2.5-15.4
Niacin (mg)	9.7-57
Pyridoxine (mg)	0.7-5.0
Tocopherol (mg)	34
Folic acid (mg)	90-160

(Cheikh-Rouhoua *et al.*, 2007; Dubey *et al.*, 2016)**Table 2: Chemical composition of *N. sativa* oil**

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

(Malhotra *et al.*, 2004)**Essential components of *Nigella sativa* oil**

Nigella seeds contain *Thymoquinone* (30-48%), *P-cymene* (7-15%), *T-anethole* (1-4%) and *Sequiterpene longifolene* (1-8%). *Thymoquinone* and its derivatives *Dithymoquinone*, *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 that prevents the development of harmful prostaglandins, is anti-inflammatory, and relieves pain. It has a choleric action (increases bile production) and is beneficial to fat metabolism and detoxification. It has a broncho-dilating action, making it useful in preventing asthma attacks. It has been claimed that it

reduces histamine output, making it a viable option to cortisone-based therapy for some allergy sufferers. Thymoquinone has been shown to be a natural, very effective anti-oxidant. When oxygen isn't broken down completely in the cell membrane, which might happen as a result of alcohol, drugs, a poor diet, or pollution, free radicals arise. This can cause cataracts, heart disease, a weaker immune system, Parkinson's disease, rheumatoid arthritis, Alzheimer's disease, cardiovascular disease, diabetes, and cancer.

Non oily components

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

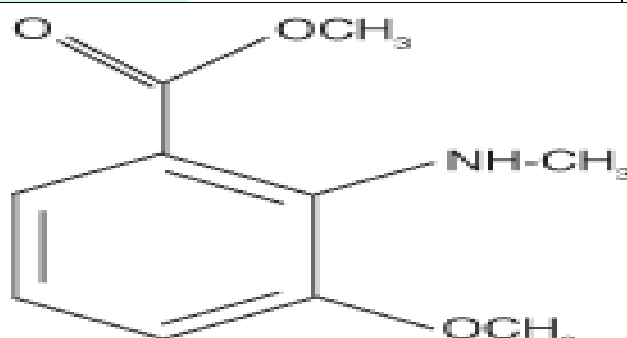


Fig 3: Chemical structure of Nigellone

According to several studies, the total sterol concentration of nigella seed oil is between 18 and 42 percent of the unsaponified substance and tocopherol, as well as -tocotrienol, are among the most well-known tocopherols found in black cumin seeds (Matthaus *et al.*, 2011). Steroidal glycosides of new and known structures have been isolated from *N.* seeds. Moreover, alkaloids of diverse types have been isolated from the seeds of *nigella*, which include novel Dolabellane-type diterpene alkaloids: *nigellamines* A1, A2, B1, and B2 and *nigellamines* A3, A4, A5, and C (Morikawa *et al.*, 2011a and Morikawa *et al.*, 2011b) possessing lipid metabolizing property, and indazole class of alkaloids: nigellidine, nigellicine (Atta-ur-Rahman *et al.*, 1992 & Atta-ur-Rahman *et al.*, 1995), and nigellidine-4-O-sulfite (Ali *et al.*, 2008).

Glycerides of certain volatile acids, as well as tannins, resins, proteins, reducing sugars, cystine, lysine, aspartic acid, and leucine, are found in small amounts in the oil, although asparagines have not been identified. (Prajapati *et al.*, 2003).

The overall lipid concentration was found to be 31.8 percent, with neutral lipids being the most prevalent. Glycolipids (monogalactosyl diglyceride, digalactosyl diglyceride, acylated-sterylgalactoside, and sterylgalactoside) and phospholipids made up the minor lipids (phosphatidylcholine, phosphatidyl ethanolamine, phosphatidyl inositol, candiolipin and phosphatidyl glycerol) (Abdel-Ghany *et al.*, 1998).

Some of the native Indian medical preparations as reviewed by Nadkarni (2001) are given in following points

- ✓ 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.
- ✓ The Food Safety and Standards Authority of India (FSSAI) and as per The Gazette of India 465/ dated 26/12/2016, an adult except pregnant women can intake 5-10g of *nigella* seeds per day. As *nigella* seed contains 10-20% oil, 1-2ml of seed oil can be consumed/day/adult (Saxena *et al.*, 2020)

Specification for black seed

Nigella seed quality is primarily determined by its appearance: matt-black seeds with an oily white inside that are approximately spherical and 1.5–3 mm long, as well as

consistency in size, shape, and texture. When *Nigella* seeds are crushed, they emit a strawberry-like odour. It smells like oregano or carrots, according to some authors. 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 percent by weight.
- Total ash = not more than 6 percent by weight.
- Ash insoluble in acid = not more than 1 percent by weight.
- Organic extraneous matters = not more than 3 percent by weight.
- Inorganic extraneous matters = not more than 2 percent by weight.
- Volatile oil = not less than 1 percent (v/w).
- Ether extract (crude oil) = not less than 35 percent (v/w).
- Alcoholic acidity as oleic acid = not more than 7 percent (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

In a way that no other single, naturally occurring ingredient has ever been known to do, the complex synergy of over a hundred compounds found in black seed work together to increase and strengthen the body's immune system. With frequent consumption of super foods, we can progressively enhance the status of our cellular nutrition, and as a result, our health will improve, though vigour will often improve quickly. "Every disease except death is cured by black seed." Traditional remedies and phytotherapy are also promoted by the World Health Organization. According to the latest export figures for India's Ayush and herbal products, India is the world's second largest exporter, accounting for ₹1 318.69 crore in 2010-11, trailing only China (<http://pharmabiz.com>). Antioxidants, minerals, and multivitamins are all found in herbs and spices. Spices are thermogenic, which means they naturally raise

metabolism, because they are food concentrations. Spices can be used to treat a variety of ailments. Several researchers researched *Nigella sativa* in depth since it is one of India's most important seed spice crops, with tremendous therapeutic benefits and is grown in many regions of the world, including a significant area in India (Datta *et al.*, 2012 and Aftab *et al.*, 2013).

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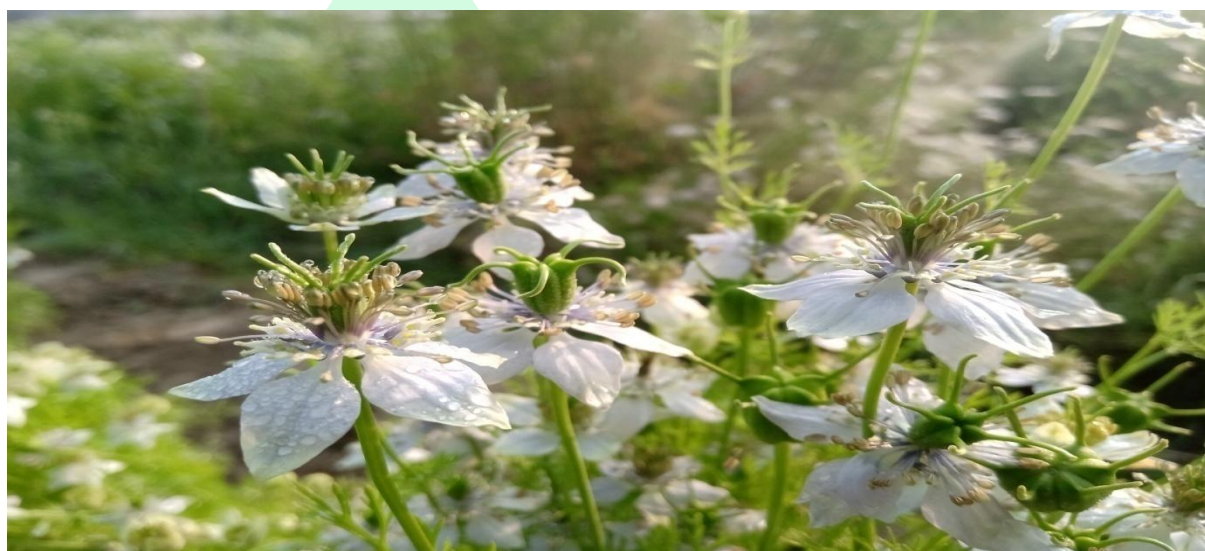


Fig: - *Nigella sativa* siliqua (fruit)



Fig:- Pollination in *Nigella sativa*