



Antibacterial, Antifungal, Antimycetoma Activities of *Nigella Sativa*

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Abstract

There are many medicinal plants which are having therapeutic potentials. *Nigella sativa*, commonly known as 'Kalonji' or 'black cumin' is a herbaceous plant which grows in Mediterranean countries but has been cultivated into other parts of the world. In the religion of Islam, it is considered as the greatest forms of healing medicine available. Prophet Muhammad (Peace be upon him) once stated that the Kalonji (*Nigella sativa*) can treat every disease -- except death (Sahih Bukhari 71:592). There are many biological activities of *Nigella sativa* which are reported in recent years including antioxidant, anti-inflammatory, anticancer and antibacterial, anti-diabetic, antifungal and many more. Plethora of studies have been carried out by researchers by using different seed extracts from *Nigella sativa* for antibacterial, antifungal, anti-mycetoma activities. *Madurella mycetomatis* is the commonest causative organism causing Eumycetoma and *Streptomyces somaliensis* is the commonest organism causing actinomycetoma [2]. In general, the current treatment for mycetoma is expensive and unsatisfactory. It needs a long duration, and has many side effects [3]. If drugs not effective and bone is infected, amputate the limb or debride tissue and continue treatment up to years.

The present review is an effort to provide a detailed survey of the literature on scientific researches of anti-bacterial, anti-fungal and anti-mycetoma activities of the chloroform, ethanol and methanol extracts of *Nigella sativa* seed *in vitro* against bacterial strains of *Staphylococcus Aureus*, *Proteus Vulgaris*, *Escherichia coli*, Fungal strains of *Candida albicans*, *Aspergillus flavus* and the organism *Madurella mycetomatis* of mycetoma.

Keywords: *Nigella Sativa*; Black Cumin; Kalonji; Mycetoma

Introduction

Nigella sativa (*N. sativa*) which belongs to the Family of Ranunculaceae is a broadly used medicinal plant around the world. It is very famous in different traditional systems of medicine like Tibb and Unani, Siddha and Ayurved. *Nigella sativa* seeds have been broadly used in the treatment of various diseases and ailments. In Islam, it is considered as one of the greatest forms of healing medicine. It has been recommended for using daily in Tibbe Nabwi (Medicine of Prophet). Plethora of studies on *Nigella sativa* have been carried out by many researchers and a wide spectrum of its pharmacological actions have been explored which may include

anticancer, antidiabetic antimicrobial, anti-inflammatory, analgesic, spasmolytic, bronchodilator, renal protective, hepato- protective, antioxidant properties, gastro-protective etc. Due to its amazing power of healing, *Nigella sativa* has been placed among the top ranked evidence based herbal medicines. This is also revealed that most of the therapeutic properties of this plant are because of the presence of thymoquinone, which is major bioactive component of the essential oil of *Nigella sativa* [1].

Scientific classification

Kingdom: Plantae

Subkingdom: Tracheobionta

Superdivision: Spermatophyta

Phylum: Magnoliophyta

Class: Magnoliopsida

Order: Ranunculales

Family: Ranunculaceae

Genus: *Nigella*

Species: *N. sativa*

Names and Etymology

Botanical Name: *Nigella sativa* In English: it is called fennel flower, black caraway, nutmeg flower, Roman coriander, or black onion seed. Etymology: Nearly all names of *Nigella* plant contain an element which means black in reference to the unusually dark color of the seeds [4].

There is a lot of confusion about the names of this spice: In some English sources, Central Asia and Northern India, it is called black cumin, black caraway and black onion seed but there is no botanical relation between *Nigella sativa* and any of these plants (www.plantnames.unimelb.edu.au).

Species of *N. sativa* There are three Species of Black Seeds [4]:

1. *Nigella sativa* or small Fennel Flower.
2. *Nigella damascene* or Wild Fennel.
3. *Nigella arvensis* or Small Fennel



Figure 1: *Nigella sativa*.



Figure 2: *Nigella. Damascene*.



Figure 3: *Nigella arvensis*.



Figure 4: *Nigella* seeds.

Antibacterial activities of *N. sativa* Topozada, *et al.* [5] were the first to study the antibacterial activity of the phenolic fraction of *Nigella sativa* oil. El-Fatraty, *et al.* [6] isolated the component which is thymohydroquinone from the volatile oil of *Nigella sativa*, which was found to have high activity against gram-positive microorganisms, including *Staphylococcus aureus*. Diethyl ether extract of *Nigella sativa* was reported to have concentration dependent inhibitory effect on gram positive bacteria and gram negative bacteria represented by *Pseudomonas aeruginosa* and *Escherichia coli* [7]. It has also showed synergistic effect with streptomycin and gentamycin and additive effect with spectinomycin, erythromycin, tobramycin, doxycycline, chloramphenicol, nalidixic acid, ampicillin, lincomycin and co-trimoxazole and successfully eradicated a non fatal subcutaneous staphylococcal infection induced experimentally in mice when injected at the site of infection [7]. *N. sativa* extract has also showed almost identical results to topical mupirocin in the treatment of neonates with staphylococcal pustular skin infections without any side effects [8]. Microbial resistance of drugs is a common and very important issue. Studies of the effects of *Nigella sativa* extracts *in vitro* against resistant organisms, including resistant *Staphylococcus aureus* and *Pseudomonas aeruginosa*, showed promising and satisfactory results against plethora of multi-drug-resistant gram positive and gram negative bacteria [9-11].

Antifungal activities of *N. sativa* Hanafi and Hatem [7] were the first to demonstrate the inhibitory effect of the diethyl ether extract of *Nigella sativa* extract against *Candida albicans*. The ether extract of *Nigella sativa* was observed to inhibit the growth of *Candida* yeasts in several organs in experimental animal infections [12]. Thymoquinone was also shown to inhibit *in vitro* *Aspergillus niger* and *Fusarium solani* and the activity was found to be similar to amphotericin B [13-15]. It was studied to be more effective than amphotericin B and griseofulvin against *Scopulariopsis brevicaulis* growth *in vitro*. There was complete inhibition of the growth of *Scopulariopsis brevicaulis* with thymoquinone 1 mg/ml, but amphotericin-B 1 mg/ml inhibited only 70% growth. However, clotrimazole was more effective than the above mentioned drugs with Minimum Inhibitory Concentration of 0.03 mg/ml [15]. The ether extract of *Nigella sativa* was found to inhibit dermatophytes which were isolated from skin infection of sheep [16]. Thymoquinone was shown to have moderate activity against clinical isolates of the 3 main groups of dermatophytes viz Trichophyton, Epidermophyton and Microsporum and the ether extract of *Nigella*

sativa were also observed to be effective but in relatively higher concentrations [15]. The Minimum Inhibitory Concentration of thymoquinone against different dermatophytes were ranged from 0.125 to 0.25 mg/ml, while the ether extract inhibited 80 - 100% of the growth of most dermatophytes at 40 mg/ml. Proportionately, greater effectiveness of thymoquinone than *Nigella sativa* extract shows that the antifungal activity of *Nigella sativa* is mainly due to thymoquinone [15]. In one of the other study also, it is observed that thymoquinone, thymol and thymohydroquinone have antifungal effect against many clinical isolates, including dermatophytes, molds and yeasts at a concentration of 1 mg/ml [17]. By using broth microdilution assay, extract of *Nigella sativa* inhibited the growth of *Madurella mycetomatis* which is an important causative fungus of mycetoma at a concentration as low as 1 µg/ml [18].

Mycetoma

Mycetoma is a chronic suppurative and/or granulomatous inflammatory lesion of skin, subcutaneous tissue, fascia, and tendons caused by the traumatic inoculation of either fungal (eumycotic) or bacterial (actinomycotic) organisms present in the soil. The disease is characterized by triad of tumefaction, discharging sinuses, and grains.

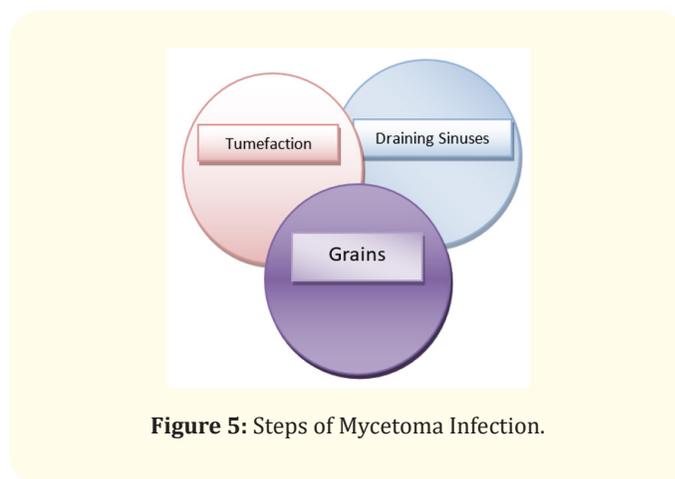


Figure 5: Steps of Mycetoma Infection.

Mycetoma can be caused by bacteria which is known as actinomycetoma or fungi which will be called as eumycetoma, typically affects poor communities in remote areas. It is an infection of subcutaneous tissues resulting in mass and sinus formation and a discharge that contains grains. The lesion is usually on the foot but all parts of the body can be affected. The causative microorganisms probably enter the body by a thorn prick or other lesions of the

skin. Mycetoma has a worldwide distribution but is restricted to specific climate zones. Microbiological diagnosis and characterisation of the exact organism causing mycetoma is difficult; no reliable serological test exists but molecular techniques to identify relevant antigens have shown promise. Actinomycetoma is treated with courses of antibiotics, which usually include co-trimoxazole and amikacin. Eumycetoma has no acceptable treatment at present; antifungals such as ketoconazole and itraconazole have been used but are unable to eradicate the fungus, need to be given for long periods, and are expensive. Amputations and recurrences in patients with eumycetoma are common [19].



Figure 6: Mycetoma infections.

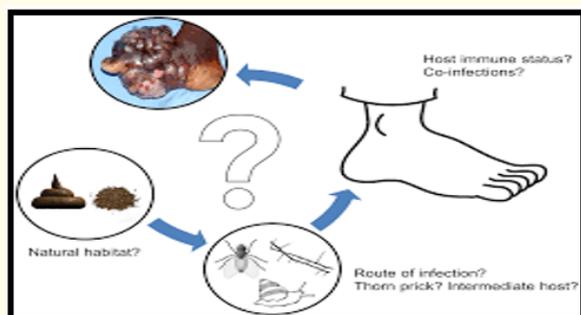


Figure 6: Routes of infection.

Conclusion

Medicinal plants are used for curative purpose since the starting of human civilization. They contain phytoconstituents that exhibit therapeutic potential. According to one of the studies, about 80% of the global population of the developing and underdeveloped countries relies primarily on medicinal plants. It is quite obvious that the *Nigella sativa* is broadly used in traditional medicinal systems and reported to have a number of pharmacological activities such as antifungal, antioxidant and also to check wound healing and antibacterial activities. The present review summa-

rizes plethora of important pharmacological studies on *Nigella sativa* and phytochemical findings and isolated principles which can be studied further to obtain novel molecules in the search of novel herbal drugs. This review showed that oil of *Nigella sativa* has antimycetoma activity against both fungal and bacterial types. And it has been used for a long time as food without any serious toxicity reported, it can be considered as a safe and affordable treatment for mycetoma.

Conflict of Interest

There is no conflict of interest.

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