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Kalonji (*Nigella sativa*): Examining the features and medical benefits of natural traditional medicine

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ABSTRACT

The flowering plant kalonji, occasionally referred to as *Nigella Sativa* or black seed, had an extensive record of application in conventional medicine. Kalonji, a plant having origins in the southwest of Asia, the Near East, and Southern Europe, has been historically valued for its strong chemical compounds and medicinal properties. Additional oil, protein, alkaloid compounds, saponin, and essential oil all have been present. Research indicating the seeds' healthcare effectiveness is particularly rare since very few investigations have been carried out in other nations of the world due to the importance of these seeds in Muslim countries' religious practices. This review examines the kalonji's active components, chemical makeup, culinary applications social significance through history, and uses in medicine. This abstract also explores the several health benefits of kalonji, highlighting the importance of both clinical validation and scientific research in optimizing the benefits of kalonji and ensuring its moral diversity in the world of medicine.

Capsule Summary: The review explores the historical significance, chemical composition, and medicinal uses of kalonji, also known as *Nigella Sativa* or black seed, emphasizing its potential health benefits and the importance of scientific research for validating its therapeutic properties and ensuring cultural diversity in medicine.

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INTRODUCTION

For thousands of years, therapists and professionals in the field of conventional medicine have been intrigued by certain kinds of natural cures. Kalonji, also known as black seed or *Nigella sativa* in research, is one of these widely loved plants. Over the years, it has traveled across numerous cultures, leaving its mark as a powerful cure (Ahmad et al., 2017). Research indicates several biologically active compounds that can be found in *N. sativa* seed, but thymoquinone is undoubtedly the most significant. Sterols and saponins, phenolic compounds and alkaloid compounds, unique lipid components and fatty acids, volatile oil molecules with a variety of compositions, and unexpected lipid constituents and saturated fats are some of the other major phytochemicals found in several kinds of *N. sativa* (Botnick et al., 2012). Many medicinal properties of *N. sativa* have been noted, comprising powerful antioxidants such as antihepatotoxicity, anti-interference, cancer prevention, antihyperglycemic, antimicrobial properties, anesthetic and anti-allergic, anti-

nociceptive, peptic ulcer, and medicament (Tembhurne et al., 2014).

Active compounds in Kalonji

Kalonji is a treasure for potential therapeutic properties because it is overflowing with an array of bioactive compounds. Thymoquinone, thymohydroquinone, and thymol, which have demonstrated a variety of medicinal properties, are a few of the notable components. The anti-inflammatory, antioxidant, immune-modulating, and antibacterial effects of the seed, among others, are thought to be caused by these chemicals (Forouzanfar et al., 2014).

Chemical constituents of Kalonji

Beta-sitosterol, cycloeucalenol, cycloartenol, lipid esters, and steroid glucosides are present in the fixed oil in addition to unsaturated fatty acids such as arachidonic, eicosadienoic, linoleic, linolenic, oleic, palmitoleic, palmitic, stearic, along with myristic acid, to name a few (Tembhurne et al., 2014). Vitamins as well as dietary fibre, mineral substances, fatty acids, and protein molecules with eight or nine essential amino acids make up the dietary composition of *N. sativa*. Whole *N. sativa* seeds are separated into fractions using sodium dodecyl sulfate-polyacrylamide (PA) gel electrophoresis (SDS-PAGE) revealing their nutritional as well as molecular weight (Hassanien, 2007).

***Nigella stavia* oil**

Carvacrol, p-cymene, and compounds such as thymoquinone (TQ), are found. besides them are phenolic substances found in NS essential oil. The three elementary fatty acids in fixed-oil products are the following: palmitic acid, oleic acid, and linoleic acid, respectively. In both the fixed and essential oils of kalonji, TQ has been the most active component (Balbaa et al., 2020). Several of the medicinal properties of *N. sativa* oil consist of antimicrobial, antioxidant, anti-inflammatory, anti-cancer, anti-parasitic, anti-neurodegenerative, antibabesial, diuretic medication, hepatoprotective, antidiabetic, anti-hypertensive substances, antidiarrheal, a pain reliever and antibacterial fertility-enhancing activity (Alagawany et al., 2020). To guarantee proper usage of this plant's ability to treat cancer and other diseases, yet, additional research and clinical trials are still necessary (Ali et al., 2022)

Kalonji as a culinary experience in India

Kalonji is gaining a reputation as a culinary wonder among food lovers all around the world. Seeds are a common ingredient in Indian cuisine due to their earthy and peppery flavor, which gives a variety of dishes depth and character. Kalonji has blended its essence into a variety of cuisines, enriching the overall cooking experience. This includes spicy curries and vegetable stir-fries as well as scented rice dishes, pickles, and traditional flatbreads. Along with coffee, tea, bread, preserved foods, wine, and vinegar, seeds are also used in these products. Furthermore, the vital oil of *N. sativa* can be used as a form of food preservation due to the reality that it includes certain powerful anti-oxidants (such as thymoquinone) and lends to the plant's unique flavor (Toshi, 2023).

Kalonji and Islam

The scholar of Islam Prophet Muhammad (S.A.W.W) has given Kalonji great significance. According to him, Shoonez (Black seeds) have cures for every disease except death. This defines how important Kalonji are in Islam. Ibn-e-Hajar has defined his Hdith in such a way that even though the black seed is believed to be an effective treatment for all diseases, ranging only to certain disorders that can be managed using it, instead, it may be used on my own or in mixture with other treatments, the ground up or in drinks or food, nose drops, a minimize, or in other forms. It was argued that the expression "every disease" simply meant that it could be used to treat any medical condition (Haider, 2021).

Kalonji in the healthcare field

The plant *Nigella sativa* (*N. sativa*), which belongs to the Ranunculaceae family, has been used as treatment throughout the world. Several traditional medical systems, particularly Unani medicine, Tibb, Ayurveda, and Siddha Yoga use it significantly. Oil and seeds have a centuries-old tradition of mythological use in many kinds of food and health practices. To provide relief from a variety of diseases and illnesses, *N. sativa* seeds have been historically utilized (Begum & Mannan, 2020). In the fields of medicine, they are used as antioxidants, antidiabetics, cholesterol control, and many more.

Kalonji used as an antioxidant

This miniature, black seed is an effective shield against harmful free radicals and cellular oxidative damage due to its high level of antioxidants. Anti-inflammatory characteristics of kalonji have been identified; such characteristics could assist in reducing the chance of developing long-term medical conditions which include cardiovascular disease and cancer. Its antimicrobial and antifungal properties have also been demonstrated that making it effective in the remediation of infections (Yimer et al., 2019). Kalonji helps in protection against different types of chronic diseases. Several compounds are found in kalonji such as carvacrol, and 4-Trepenol which help its antioxidant properties. In some studies, kalonji essential oil acts as an antioxidant (Ajmera, 2023). Similar to this, the ingestion of thymoquinone and oil of *N. sativa* substantially lowered the detrimental impact of the drug cisplatin on the gastrointestinal mucosa's enzyme and nonenzymatic

antioxidant protection mechanism. Thus, *N. sativa* and thymoquinone, which are employed to provide essential nutrients for life that encourage health and prevent sickness, have high antioxidant activity (Shahid et al., 2018).

Acting as antidiabetic and antifungal

Aflatoxin-producing fungal organisms, pathogenic varieties of yeast, skin algae, and non-dermatophytic filamentous molds are all known to be somewhat suppressed by essential oils of *N. sativa* from different places. The physical characteristics of these toxic fungi showed that the *N. sativa* treatments mainly impacted the cell's nucleus and mitochondria as well as the outer layer of the cell, the membrane of the plasma cell, and membrane organelles (Shokri, 2016). Besides this Kalonji has a major role acting in the treatment of diabetes. In a clinical study, scientists looked at the way *N. sativa* oil improved different clinical and chemical signs of resistance to insulin condition. Among those suffering from insulin resistance syndrome, *N. sativa* oil has already been proven to be beneficial when utilized in combination with different kinds of treatment. Patients who have diabetes and elevated cholesterol levels benefit significantly from *N. sativa* oil due to the presence of bioactive components in the oil (Najmi et al., 2008).

Acting as anti-oxytocic

In a few initial studies, *N. Sativa's* anti-oxytocic consequences are mentioned. The endometrial smooth contraction of muscles carried on by oxytocin stimulus is hindered by *N. sativa* seeds. The oxytocin-stimulated contracts of rat and guinea pig smooth muscle mass as well as the uncontrolled movements of those muscles were both restricted by *N. sativa* seeds' unstable oil composition indicating that these seeds might possess anti-oxytocic characteristics (Aqel & Shaheen, 1996).

Fig. 1: Treatment of cancer through apoptosis (Abdallah, 2017)

Treating cancer

N. sativa's essential anti-cancer capability has already been thoroughly proven through inside and outside lab research applied to several experimental animals. One of the first research investigations indicating the possibility of treating cancer cell properties of *N. sativa* explains that both an *N. sativa* plants' water-based extract and ethyl acetate in an analytical part generated significant cytotoxic consequences on different types of cancer cells, but not contrary to umbilical stem cells taken from sound, free of cancer humans called endothelial cells (Swamy and Ta, 2000).

The alleged *N. Sativa's* capability to create significant anti-proliferative, pro-apoptotic, anti-oxidant, anti-mutagenic, and anti-metastatic actions has been mainly attributed to its anti-cancer features. Furthermore, *N. Sativa's* interest in reducing inflammation and having immune-boosting benefits has been connected to its ability to guard against cancer start, growth, and development (Majdalawieh and Fayyad, 2016).

Neuropharmacology and Kalonji

It is considered to be one of the most successful therapeutic methods according to Islamic Holy Scripture. It is frequently employed to treat neurological conditions that include pain, neurological damage, impairment of memory, and seizures. The presence of thymoquinone (TQ), an important pharmacological element in the essential oil, is the main cause of the majority of the plant's therapeutic capabilities (Beheshti et al., 2016). The black seeds help in signaling pathways of neurons and show positive effects. The potential positive of black seeds can fight against diseases like depression, anxiety, and drug addiction (Clark, 2022).

Thymoquinone (TQ) has characteristics that include anticonvulsants, antianxiety, antidepressants, and antipsychotics. In addition to helping individuals who have memory and deficits in cognition, it could be used to treat abuse of drugs or dependence. TQ protects against oxidative stress in the cerebral cortex, which is especially prevalent in regions related to memory. The reality that TQ exhibits anti neurotoxin characteristics indicates that it could have a role in treating neurodegenerative diseases which include Parkinson's and Alzheimer's. TQ's anti-inflammatory and anti-oxidant properties protect brain cells from swelling and oxidative stress. By disturbing the cell's mitochondria and generating reactive oxygen species (ROS), glutamate possesses the capacity to cause cell death. TQ's effects on neuroinflammation can be explained by a reduction in the production of ROS, which scavenges the free radicals. By decreasing dysfunctional mitochondria, TQ may decrease the effects of glutamate on apoptosis (Pottoo et al., 2022).

Anti-inflammatory activity of Kalonji

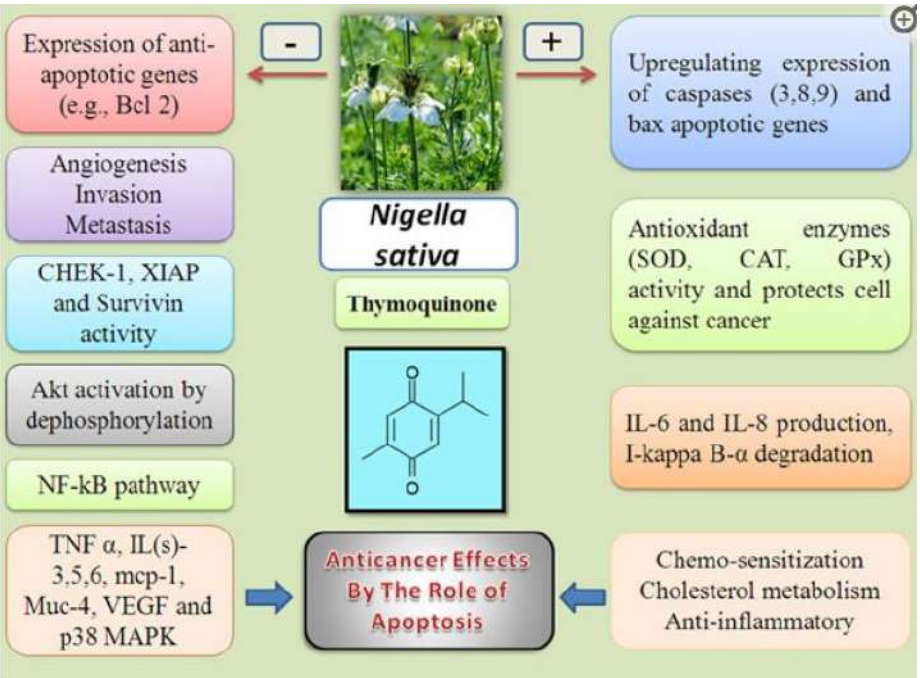

Fig. 2: Treatment of cancer through apoptosis (Mollazadeh et al., 2017)

Many medical conditions, including those with cystic fibrosis, rheumatoid arthritis (RA), cartilage degeneration, allergies, asthma, and cancer, which are all associated with acute or chronic pain, include inflammation in one manner or another. The presently accessible anti-inflammatory drugs frequently belong to medication classes that, with long-term use, may lead to serious adverse reactions that involve ulcers in the stomach, bone marrow dysfunction depressive disorders, retention of water, and salt accumulation (Das et al., 2014). Inflammation that lasts a long time has been scientifically related to an array of chronic diseases, such as tumors, heart failure, Alzheimer's illness, diabetes, epileptic seizures, a condition known as amyotrophic lateral sclerosis rheumatoid arthritis (RA), and asthma, resulting in gradually and permanent harm to the cells and neurons, in addition to an array of infectious conditions. Therefore, the significant anti-inflammatory effects found in multiple *N. sativa* formulations and TQ could act as a starting point for the development of a new class of anti-inflammatory medications to treat these varied diseases (Yimer et al., 2019).

Infertility treatment

Infertility can be described as a couple's inability to become pregnant after 12 months of sexual activity without the use of contraceptives. Men experience impotence with greater regularity than women do. Infertility among men affects approximately one in twenty males and causes about 50% of unproductive relationships. The remaining 50% is due to of problems with women, problems with both men and women and unknown infertile variables (Gurunath et al., 2011). Human sperm can suffer peroxidation of lipids and damage to the DNA as a consequence of a rise in free radicals. *Nigella sativa* (NS), for instance, has antioxidant elements that have been experimentally shown to improve sperm production and steroid production. Through the enhancement of antioxidant protection, NS and TQ produced through NS may improve specific elements of male fertility (Mahdavi et al., 2015). The consumption of *N. sativa* in medication has boosted sex levels of hormones, namely testosterone and progesterone, the corpus luteum, Leydig cell measure, graph follicles measure, and parameters related to sperm in men and women respectively (Durand et al., 2020). The various parts of kalonji are abundant in polyphenolic elements (isoflavones and flavonoids, amongst other substances) that are favorable to women's reproductive health. Additionally, these plants can be used in traditional medicine or in pharmaceutical companies as safe compounds in menopause implantation because of their cancer prevention, antioxidants, and depressive disorders qualities. The treatment of female ovarian conditions includes the condition polycystic ovary syndrome (PCOS), preterm ovarian failure (POF), the condition hyperprolactinemia, and the hypothalamus malfunction (akbaribazm et., 2021).

Kalonji's potential in medicine in the future: Unveiling the promising horizon

Nigella sativa, also known as kalonji, boasts an exciting future ahead of it with potential developments in an array of domains, particularly those of healthcare, diet, and

fitness. Many subjects are interested in the examination, even though continued investigation is necessary for achieving its full potential. The ongoing investigation into the biologically active elements of kalonji, especially thymoquinone, and thymohydroquinone, could contribute to the identification of novel uses in medicine. Its strong antioxidant, anti-inflammatory, and immune-modulating features raise the possibility of addressing persistent inflammation, and autoimmune conditions, and maybe further the study of cancer. Furthermore, if the seriousness of metabolic issues rises, more consideration might be given to kalonji's ability to impact the sensitivity of insulin and control of weight. Scientists are also intrigued to learn about topics such as the alteration of the microbes in the intestines, helping with development, and antimicrobial features.

Table 1: Nutritional aspects of kalonji (Bashir et al., 2018)

Protein	26.7%
Carbohydrate	24.9%
Fat	28.5%
Crude Fiber	8.40%
Total ash	4.80%
Saturated fatty acids	30% or less

CONCLUSIONS

Kalonji's switch from traditional medical treatment to present-day inquiry into science illustrates its ability to adapt and possibilities in a variety of fields associated with wellness and physical health. The broad range of bioactive compounds present in kalonji can decrease inflammatory processes, improve neurological wellness, and potentially help with reproduction issues. Furthermore, its interest is its culinary attractiveness in distinct cuisines. Despite Kalonji's chances for the future being intriguing, it is of the utmost importance to use precaution and seek guidance that is founded on solid evidence before using it. The significant historical context and increasing understanding of science emphasize the requirement for additional research to comprehend the possible medicinal benefits of kalonji. The endless possibilities of kalonji to contribute in the fields of holistic health, nutrition and medication remains an intriguing and exciting field to explore as we approach the coming years.

DECLARATION OF COMPETING INTEREST

The authors declare no competing financial interest.

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