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Phytochemical Screening and Comparative Study of Antioxidant Activity of *Cuminum Cyminum* L. and *Nigella Sativa* L.

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ABSTRACT:

Herbal medicines are useful in healing and curing a variety of diseases from the ancient period. The phytochemicals present in the medicinal plants possess a defence mechanism against various diseases. Phytochemicals are chemical compounds that occur naturally in plant source. Spices are building blocks of flavour in foods. This study is focused on two important spices, cumin and black cumin. Cumin and black cumin are recognized for their antioxidant properties. So, this study is designed to evaluate the chemical composition and antioxidant activity of cumin (*Cuminum cyminum*) and black cumin (*Nigella sativa*). Cumin and black cumin seeds are extracted to examine antioxidant properties and qualitative screening. Cumin extract shows presence of alkaloids, flavonoids, saponins, steroids, terpenoids phenol, tannin and absence of protein, glycoside, cardiac glycoside, fixed oil, fats and carbohydrates. It is identified by qualitative screening. Antioxidant properties are assayed using DPPH free radical scavenging. The DPPH method shows highest antioxidant activity for cumin seed followed by black cumin. This study suggests that both cumin and black cumin can be used as potential sources of natural antioxidant.

KEY WORDS: Phytochemical, Medicinal plant, Antioxidant, DPPH

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INTRODUCTION:

The medicinal value of these plants laid some chemical substances that produce a definite physiological action on the human body¹. Traditional medicines using extracts continue to provide health coverage for over 80% of the world's population, especially in the developing world². Medicinal plants are considered to be very rich source of metabolites³. The Medicinal plants are used for healing as well curing the human disease because of the presence of some significant phytochemical constituents.

Phytochemistry is the study of chemicals which are derived from plants. In other words, the terms are often used to describe the large number of primary and secondary metabolic compounds found in plants⁵. Phytochemicals have been classified into six major categories based on their chemical structure and characteristics. These categories include carbohydrate, lipids, phenolics, terpenoids and alkaloids and other nitrogen-containing compounds⁶. Phytochemicals are biologically active, naturally occurring compounds found in plants, which provide health benefits to humans, further than those attribute to macronutrients and micronutrients⁶. In general, the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attacks are called as phytochemicals^{7,8}. More than 4,000 phytochemicals have been cataloged and are classified by protective function, physical characteristics⁹ and about 150 phytochemicals have been studied in detail. Phytochemicals are found in vegetables, fruits, legumes, whole grains, nuts, seeds, fungi, herbs and spices¹⁰. Phytochemicals accumulate in different parts of the plant, such as the root, stem, leaves, flowers, fruits or seeds¹¹.

Free radicals and other reactive oxygen species (ROS) are continuously produced in our body, as by-product of various essential processes like energy generation, phagocytosis and detoxification reaction¹². The oxidative damage caused by ROS, oxidative stress is one of the major etiological factors for diseases like cancer, heart ailments, alzheimer disease, nutritional deficiencies, bacterial, viral infection¹³. Reactive oxidant species are strong source of natural antioxidants, which are known to protect tissue/cell from oxidative stress. They are generally considered to be a cause of mutation and leads to cancer¹⁴. The antioxidant effect of plants products could be mainly described to phenolic compounds, such as flavonoids, phenolic acids, tannins and phenolic diterpenes¹⁵. In plants, antioxidant compounds prevent lipid peroxidation and oxidative modification of low density lipoprotein due to their antioxidant activity¹⁶.

MATERIAL:

Plant material: - *Cuminum cyminum* (jeera) (seed)



Fig. 4 *Cuminum cyminum* plant and seed (source: <http://www.angelbotanicals.com/product/cumin-seeds/> retrieved on: 7th march, 2019)

Taxonomic classification:-(According to Bentham And Hooker)

Kingdom:-Angiosperm

Class: - Dicotyledons

Sub Class: - polypetalae

Series:-calyciflorie

Order: - umbelles

Family:- (Apiaceae)umbelliferae

Genus:-Cuminum

Species:-cyminum

The plant is delicate glabrous annual, obtaining 10 to 50 cm height. The stem is bifurcated at the base glabrous. The leaves are glabrous and finely pinnatifid with oblong – liner tips or the lower are mostly doubly trifoliate. The flowers are in umbels radiating in group of 3 to 5. The petals are white or red oblong or deeply bordered with a long indented tip¹⁷.

plant material: - *Nigella sativa* (kalonji) (seed)



Fig. 4 *Nigella sativa* plant and seed(source: <http://www.mpbd.info/plants/nigella-sativa.php>, retrieved on :- 10th march 2019)

Taxonomic classification:- (According to Bentham And Hooker)

Kingdom: - Angiosperm

Class:-Dicotyledons

Sub class: - polypetalae

Series: - Thalamiflorae

Order: - Ranales

Family: - Ranunculaceae

Genus: - Nigella

Spices: - sativa

The black cumin (*Nigella sativa*) belongs to the family ranunculaceae. In Southwest Asia, it is commonly known as karayal and black cumin. It is small prostrate herb about 45 cm high, 2-3 slender leaves, 2-4 cm long cut into linear segment, segment oblong. The fruit is a large and inflated capsule composed of 3-7 united follicles, each containing numerous seeds¹⁸.

Nigella sativa seeds as nutritional and medicinal seeds have traditionally been used for thousands of years of folk medicine and some of its active compounds were reported against many ailment¹⁹. Different pharmacological effects such as gastric ulcer healing²⁰, anti-microbial effect²¹, anti-cancer activity²², cardio vascular disorder²³, gastroprotective and antioxidant activity²³.

Phytochemistry:

Qualitative phytochemical analysis conducted on the cumin seeds extract revealed that the presence of phytochemicals which are known to exhibit medicinal as well as physiological activities. The results revealed the presence of bioactive compounds in cumin seed extract. It could be seen that, proteins, glycosides, oils and fats, phenolics compounds and tannins are present in the cumin seed extract. However, saponins are absent in the extract^{24,25}.

Hydroalcoholic extract from four herbal seeds namely, thyme, fennel, cumin and fenugreek were prepared using soxhlet apparatus. The qualitative phytochemical analysis of above four seed extracts revealed the presence of tannin, phenol, steroids, terpenoids, amino acids, glycosides and cardiac glycosides. Saponins and flavonoids are present in all seed extract except cumin while hydrolysable tannins are present only in cumin. Volatile oil are present in thyme and fenugreek seed extract²⁶.

The study was carried out to find in vitro anti-bacterial activity of *Nigella sativa* extracts against seven clinical isolates identified by ribotyping. Crude extracts of *Nigella sativa* in eight organic solvents (aqueous, methanol, ethanol, chloroform, butanol, diethyl ether, n-hexane and acetone) were evaluated 5 different concentrations by using disk diffusion method against human pathogenic bacterial strains including gram-negative and gram-positive bacteria. *Nigella sativa* extracts with minimum concentration of 5mg/ml showed effective growth inhibition against the tested bacterial strains. Out of eight extracts methanolic, ethanolic, chloroform-hexane and acetonetic extracts showed maximum antibacterial activity. *Nigella sativa* extracts were screened for qualitative detection of secondary metabolites and it showed that steroids, tannin, flavonoids, coumarins, cardiac glycosides, saponins and diterpenes were present in methanolic and ethanolic extract of *Nigella sativa*²⁷.

Black seed is an annual flowering plant from ranunculaceae family, native to Southwest Asia. This study provided a comprehensive review on the scientific reports that had been published about *Nigella sativa*. *Nigella sativa* and its compounds, particularly type of extracts have many biological effects such as anti-inflammatory, anti-hyperlipemic, anti-microbial, anti-cancer, antioxidant, anti-diabetic, and anti-hypertensive and wound healing activities. In addition to that, it includes effects on reproductive, digestive, immune and central nervous systems, such as anticonvulsant and analgesic activities. The plant composition and medicinal properties necessitate further research on the useful and unknown futures, so it can be used as a plant derived medicine to treat various diseases²⁸.

Antioxidant activity:

Solvent extracts of five Indian spices, turmeric, cinnamon, cumin, ginger and garlic were examined for their antioxidant activity. The antioxidant capacity of the spice extracts were found in descending order cumin>garlic>cinnamon>turmeric>ginger by DPPH method, garlic>cumin>turmeric>ginger>cinnamon by FRAP method and turmeric>cinnamon>garlic>cumin>ginger by TPS method. Cinnamon had a highest antimicrobial effect (12mm) as maximum concentration on the growth of bacterial strains *Vibrio vulnificus* and *Micrococcus lutes* followed by cumin (9mm), garlic (8mm), ginger (8mm) and turmeric (7mm). This result indicated that the spice extract supplement is promising as a prophylactic for fish health improvement²⁹.

In Anita Dua's experiment, seeds were extracted in 80% methanol to examine antioxidant properties and potent antioxidant compound. Antioxidant property of cumin seed was assayed using DPPH free radical scavenging, inhibition of metal induced oxidation of protein and lipids and protection of DNA against H₂O₂ – induced stress and reported that cumin extract had polyphenols as major antioxidant principal, Gallic acid, quercetin and kaempferol and other antioxidant compounds ascorbate, tocopherols and riboflavin were present in very low amount. The result of this study indicates that polyphenol rich methanolic extract of cumin has efficient free radical scavenging and metal chelating activity to protect biomolecules like proteins, lipids and DNA against oxidative stress³⁰.

Cumin is one of the commonly used spices in food preparation. It is also used in traditional medicine as a stimulant. In this study, they characterized the antioxidant activity of three commercially available cumin varieties, viz., cumin (*Cuminum cyminum*), black cumin (*Nigella sativa*) and bitter cumin (*Cuminum nigrum*). The antioxidant capacity of cumin varieties was tested on Fe⁺² ascorbate induced rat liver microsomal lipid peroxidation, soybean lipoxygenase dependent lipid peroxidation and 1-1-diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging methods. The total phenolic content of methanolic extracts of cumin varieties ranged from 4.1 to 53.6 mg.g⁻¹ dry weights. Methanolic extracts of the three varieties of cumin showed higher antioxidant activity compared to that aqueous extracts. Aqueous extracts of cumin varieties showed relatively less phenolic content compared to 50% methanolic extracts. Bitter cumin showed higher phenolic content compared to cumin and black cumin. The phenolic acid content of cumin varieties decreased in this order bitter cumin>cumin>black cumin in both aqueous and methanolic extracts³¹.

Ginger and cumin both are recognized for their antioxidant properties. So the study was designed to evaluate the chemical composition and antioxidant activity of ginger (*Zingiber officinale*) and cumin (*Cuminum cyminum*). The highest yield for volatile oil obtained by the cumin sample was 2.52±0.11%, while the fresh ginger showed the lowest yield (0.31±0.08%). The analysis of volatile oils of fresh and dried ginger showed camphene, p-cineole, α-terpineol, Zingiberene, pentadecanoic acid as a major component, while the major components in cumin volatile oil were cumyl, γ-terpinene, and pinocarveol. In non-volatile extracts the highest yield was obtained by methanol extract of cumin (4.08±0.17% w/w), while the n-hexane extract of fresh ginger showed the lowest yield (0.52 ± 0.17% w/w), maximum total phenolic content was observed in methanolic extracts of fresh ginger (95.2 mg/g dry extract) followed by the hexane extract of fresh ginger (87.5 mg/g dry extract). The hexane extract of cumin showed the lowest total phenolic content (10.6 mg/g dry extract). The DPPH method showed the highest antioxidant activity for cumin essential oil (85.44 ± 0.50%) followed by dried ginger essential oil (83.87 ± 0.50%) and fresh ginger essential oil

(83.03 ± 0.54%). The FRAP of essential oils showed almost comparative results with DPPH. Cumin essential oil was found best in reducing Fe³⁺ ions, followed by dried and fresh ginger. These results suggest that both ginger and cumin can be used as potential source of natural antioxidant in foods³². Bessedik Amina investigated the toxicity and anti-oxidant activity of essential oil of *Nigella sativa*. The result of antioxidant activity of *Nigella sativa* against the DPPH radical has been evaluated by spectrophotometry. The results showed an antioxidant power with an IC₅₀ of 0.056 mg/ml. This activity is mainly due to the combined action of various endogenous antioxidants contained in the essential oil³³.

CONCLUSION:

This review discusses the chemical constitute, and antioxidant activity of *Cuminum cyminum* and *Nigella sativa*. The increasing interest gained by antioxidant is due to the health benefits provided mainly by natural source (endogenous) anti-oxidant compound. Cumin is the second most popular spices in the world, after black pepper, and used as a medicinal plant for aromatherapy and various illness. For this reason the standardization of this plant material from cultivation to harvest is too important.

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