Alexandria University
Faculty of Agriculture. (Saba-Basha)

A STUDY OF THE NUTRITIONAL AND TECHNOLOGICAL PROPERTIES OF BLACK CUMIN SEEDS (*NIGELLA SATIVA*, L.)

BY

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مقدمة من

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CONTENTS

Lest of Tables

CHAPTER 1
INTRODUCTION

Nigella Sativa is an adicotyledon of the *Ranunculaceae* family, and it is annual herbaceous plant, this plant attains about 40 to 60 cm height, it bears alternate, compound leaves which are innately and it flowers during March-June. It tastes slightly bitter and peppery with a crunchy texture. Seeds are angular, of generally small size (1-5mg), dark grey or black color. It grows mainly in the areas around the Mediterranean Sea, and western Asia. It is cultivated in different areas of Egypt for the purpose of its seeds **(Al-Gaby, 1998b).**

Many reports and articles have been introduced indicating the significant role of black cumin seed oil in increasing immunity and maintaining good health. It constitutes a very popular additive to the traditional diet, and is often mixed with either bread or honey **(Al-Saleh et al. 2006)**.

Nigella Sativa seeds are used almost entirely for edible and medical purpose. Commercial use of these seeds has recently been extended to many products including shampoos, oils, soaps, etc. It was used by Egyptians as a diuretic, carminative and flavoring agent, by Syrians for cheese flavoring and by the Armenians for bakery products, and cookies **(El-Komey, 1996).**

(**Abd-El-Maksoud et al. 1996)** mentioned that in Arabian folk medicine the whole seeds alone or in combination with honey or garlic purposes such as treatment of asthma, antibacterial and antifungal **(Islam et al. 1989, and Üstun et al. 1990).**

Recently, many medical properties have been attributed to the black cumin seeds and oil, including antibacterial and antifungal effects **(Salomi et al., 1992; Erkan et al., 2008).**

Therefore this work aimed to study the nutritional and the technological properties of black cumin seeds.

- The present work generates special data on the characteristics of black cumin seeds cultivated in Egypt and their oil properties, fatty acid composition, protein isolate, amino acid composition and minerals contents, obtained by two different conditions (control without any heat treatment and seeds subjected to dry heat at 85ºc for 20 min, before defatting).

- Study the effect of adding black cumin seeds and their products of some bakery products (Kaiser Bread and Petit four) and sensory evaluation of these products.

- Study the inhibitory effects of fresh oil and essential oil extracts of black cumin against, yeast, molds and bacteria.

- Study the effect of treatment of minced meat with essential oil of methanol extract on the shelf life during storage at4 ºC.

- Finally study the effect of treatment with essential oil of methanol extract on the colour and odour of minced meat stored at 4 ºC.

CHAPTER 2
REVIEW OF LITERATURE

2.1. Chemical composition of *Nigella sativa* seeds:

Chemical composition of *Nigella sativa* seeds reveled that it consists of both primary and secondary metabolites, which have pharmacological effect.

2.1.1. Moisture:

Al- Jassir (1992) found that moisture content of *Nigella sativa* seeds grown in Saudi Arabia reached only 4.6% while **Nergiz and Otles (1993)** found that moisture content of *Nigella sativa* seeds grown in Turkey reached 6.4%.

Abdel Aal and Attia (1993) found that moisture content of two different cultivars was 6.1 and 6.6%, content of *Nigella sativa* seeds grown in Egypt.

El-Badrawy (1996) reported that black cumin seeds moisture in other samples (7.75%). **Daw and Abdel-Moein (1996)** found that black cumin seeds moisture was (4.82%). **Hassanin and Hassan (1997)** reported that *Nigella sativa* seeds moisture per 100g dry weight was (5.5%) while **Takruri and Dameh (1998)** found that *Nigella sativa* seeds moisture of five samples from five different sources was 8.8, 8.2, 9.4, 10.2, 8.8, and 9.3%, respectively. The average values of moisture content were 8.3.

El-Nemr *et al* (2002) studied two different samples of black cumin seeds which were grown in two countries, (Syria and Egypt) found that black cumin seeds moisture was 6.59, 6.98%, respectively.

Tater *et al* (2003) reported that *Nigella sativa* seeds moisture was 9.4%. While **Atta (2003)** showed that the moisture content ranged from 5.52 to 7.43%.

Cheikh-Rouhou *et al* (2007) found that *Nigella sativa* seeds moisture of Tunisian was (8.65%).

2.1.2. Total proteins and amino acids:

Al- Jassir (1992) indicated that protein content of *Nigella sativa* seeds grown in Saudi Arabia was found to be 20.9%.

Nergiz and Otles (1993) who found such content was 20.2%; similar results was obtained by **Abdel-Aal and Attia (1993)** who showed that *Nigella sativa* seeds contained 20.6% protein.

El-Badrawy (1996) found that the protein content of *Nigella sativa* seeds only 22.4% ,on dry weight , and its amino acids composition was aspartic , glutamic , serine , glycine , histidine , arginine , threonine , alanine , proline , tyrosine , valine , methionine , cysteine , isoleucine , leucine , phenylalanine , lysine , in amounts of 0.633 , 3.192 , 0.067 , 0.463 , 2.491 , 1.442 , 1.021 , 0.512 , 0.576 , 0.815 , 0.747 , 0.460 , 0.059 , 0.267 , 0.950 , 0.574 and 0.521% , respectively.

Takruri and Dameh (1998) found that the protein content of *Nigella sativa* seeds was on dry matter basis were 21.6%. The protein quality of black cumin seeds was evaluated using net protein utilization (NPU), protein efficiency ratio (PER) and net dietary protein energy percent (NDPE %) for 2 samples imported from Syria and Turkey, while PER was determined for the Syrian sample only. The results indicated that the standardized NPU of Turkish black cumin seeds was higher than the Syrian ($p<0.05$). The mean results (±SD) were 54.6±2.72 for the Syrian type and 63.1±3.74 for the Turkish type. The NDPE% means results were 5.3±0.79 and 5.6±0.26 for the Syrian and Turkey samples, respectively. The PER adjusted value for the Syrian samples were 1.9.

El-Nemr *et al* (2002) found that the inorganic nitrogen contents of black cumin seeds were found to be 0.31% for Syrian sample and 0.32% for Egyptian sample. Black cumin seeds proteins contained higher amounts of lysine, methionine, thrionine, phenylalanine and tryptophan. But the amino acids composition of protein in wheat flour and composed flour with (1% black cumin seeds) raised the amounts of lysine, methionine, and cysteine. These findings had higher levels of most of the essential amino acids tryptophan, lysine, phenylalanine, thrionine, and valine.

Atta (2003) indicated that protein content of *Nigella sativa* seeds was (20.8%). While **Cheikh-Rouhou *et al* (2007)** found that protein content of *Nigella sativa* seeds from Tunisian and Iranian were 26.7% and 22.6%, respectively.

2.1.3. Ash and minerals:

Al-Jassir (1992) found that ash content in *Nigella sativa* seeds grown in Saudi Arabia was 4.4%, and their mineral elements of potassium , phosphorous , sodium , iron , zinc , calcium , magnesium , manganese , copper and cadmium were 7.1 , 1.8 , 0.75 , 0.15 , 0.23 , 0.06 , 0.04 , 0.09 , 0.03 , 0.02 , mg/100g , respectively.

Abdel Aal and Attia (1993) reported that ash content of two different cultivars of seeds was in the range of 4.73-4.92%, and the mineral content of phosphorous , calcium , potassium , magnesium , sodium , iron , zinc, manganese and copper were 637.5 , 197.8 , 165.8 , 46.1 , 31.7 , 6.2 , 5.2 , 2.2 , and 1.2 mg/100g from one cultivar , while those of the second cultivar were 642 , 209.2 , 157.8 , 42.1 , 33.7 , 5.4 , 5.8 , 1.9 , and1.2 mg/100g respectively.

Nergiz and Otles (1993) reported that *Nigella sativa* seeds contained minerals content of the seeds were calcium (182), iron (57.5), sodium (85.3) and potassium (11.8) as mg/100gm. Furthermore **Daw and Abdel-Moein (1996)** reported that the mineral content of black cumin seeds was as follows: the ash (4.81%) , sodium (252.99) , potassium (336.68) , manganese (2.29), copper (2.68) , magnesium (5.67) , iron (67.9) , zinc (2.46) , phosphorous (200.07) , calcium (141.72), as mg/100gm.

Takruri and Dameh (1998) estimated the nutritional value of black cumin seeds from 5 different sources available in the local market and they found that the ash content was 4.5%. Mineral analysis showed that black cumin seeds contained Fe 105, Cu 18, Zn 60, P 527, Ca 1860, mg/kg.

El-Nemr *et al* (2002) found that the ash content of black cumin seeds was 4.50% for Syrian seeds and 5.92% for Egyptian seeds. Mineral analysis showed that black cumin seeds contained Fe (8) , Zn (4.7) ,Ca (880.8) , Na (560.6) , Mn (0.45) , Mg (340.8) , K (102.9) , P (765.2) , Cu (1.3) , mg/100g for Syrian seeds , But the Egyptian seeds contented Fe (7.4) , Zn (4.8) , Ca (838.3) , Na (766.1) , Mn (0.5) , Mg (372.2) , K (98.95) ,P (780.6) , Cu (1.21) , mg/100g.

Cheikh-Rouhou *et al* (2007) found that the mineral constituents (Ca, Na, K, Mg, Fe, Zn, Cu and Mn) of two *Nigella seed* of Tunisian and Iranian seeds.

2.1.4. Carbohydrats:

Babayan *et al* (1978) performed a proximate analysis of *Nigella sativa* seeds, indicating the total carbohydrate content was (33.96%).

Al-Jassir (1992) estimated the total carbohydrates content in *Nigella sativa* seeds by difference: 100 - (% moisture + % crude protein + % crude fat + % ash). He found that the total carbohydrates were (31% ± 2.56), but **Nergiz and Otles (1993)** reported that *Nigella sativa* seeds contained total carbohydrates (34.4±0.87) as percentage. While **Daw and Abdel-Moein (1996)** reported that *Nigella sativa* seeds contained total carbohydrates (19.24%).

Hassanin and Hassan (1997) performed approximate analysis of *Nigella sativa* seeds, indicating the total carbohydrate content was (30.45%).

El-Nemr *et al* (2002) found that the total carbohydrates content in the analyzed samples were 25.20 and 27.61% in Syrian and Egyptian cultivars, respectively.

Tater *et al* (2003) reported that the *Nigella sativa* seeds total carbohydrates from Denizli region of Turkey was (21.2%). But **Atta (2003)** found that *Nigella sativa* seeds contained total carbohydrates (33.7%).

Cheikh-Rouhou *et al* (2007) reported that *Nigella sativa* seeds total carbohydrates from Tunisian and Iranian were 40.0 and 32.7%, respectively.

2.1.5. Crude fibers:

Al-Jassir (1992) performed a proximate analysis of black cumin seeds and showed a composition of crude fiber (7.94%). But **Nergiz and Otles (1993)** reported that *Nigella sativa* seeds contained crude fiber (6.6%).

Daw and Abdel-Moein (1996) found that crude fiber of *Nigella sativa* seeds was (9.35%), also **Hassanin and Hassan (1997)** found that crude fiber of *Nigella sativa* seeds was (5.5%).

Takruri and Dameh (1998) estimated the nutritional value of *Nigella sativa* seeds from 5 different sources available in the local market and they started that the average crude fiber content was 8.4%.

El-Nemr *et al* (2002) found that the crude fiber content was 8.8 and 8.73% for Syrian and Egyptian seeds, respectively. But **Tater *et al* (2003)** studied the crude fiber content for *Nigella sativa* seeds from the Denizli region of Turkey was 6.7%. Furthermore **Atta (2003)** found that the crude fiber of *Nigella sativa* seeds was (10%).

2.1.6. Lipids:

Nigella sativa seeds have rich content of fixed oil ranging from 28.25 to 39.21%.

Babayan *et al* (1978) found the specific gravity and refractive index were 0.9201 and 1.4728, respectively. Saponification value, Iodine value and free fatty acids content were 189.4, 124.63 and 0.55, respectively.

Menounas *et al* (1985) found that the total lipids were 38%.While **Üstun *et al* (1990)** studied the seeds of three cultivars of *Nigella sativa* grown in Turkey and one cultivar from each India and Egypt plus tow cultivars from Czechoslovakia; they found that their lipid content, were very closed, hence they ranged only from 29.4 to 29.7%. While the corresponding value recorded by **El-Badrawy (1996)** was 29.26%.

Bhakary *et al* (1993) analyzed the lipid composition of *Nigella sativa* seeds and found that total lipid, neutral lipid, glycolipids and phospholipids were 31.84, 87.2, 6.7, and 6.3%, respectively.

El-Sayed *et al*., (1994) studied the oil characteristics; they found that refractive index, specific gravity, saponification value and acid value were 1.472, 0.925, 176.8 and 12.95%, respectively.

Cheikh-Rouhou *et al* (2007) reported that physicochemical properties of the oils for Tunisian and Iranian varieties, respectively, include: saponification number 211 and 217, peroxide value 5.65 and 4.37, iodine value 120 and 101, and an acidity of 22.7% and 18.6%.

A. Fatty acid contents:

Concerning fatty acids content of *Nigella sativa* seeds oil, it was known that major components of its fatty acids are linoleic and oleic acids. *Nigella sativa* seeds oil