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## Nutrients Composition and Minerals Content of Three Different Samples of *Nigella sativa* L. Cultivated in Yemen

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**Abstract:** This study was carried out to investigate the nutrients composition of *Nigella sativa* seed and its minerals content, cultivated in three different regions in Yemen, namely Marib, Sadah and Taiz. Proximate analysis, Total Dietary Fiber (TDF), Insoluble Dietary Fiber (IDF) and Soluble Dietary Fiber (SDF) were determined using the Association of Official Analytical Chemists methods. Minerals content of *N. sativa* seeds was determined by the Atomic Absorption Spectrophotometry (AAS). The proximate analysis of *N. sativa* seeds showed that moisture content was  $6.8 \pm 0.3$ ,  $4.6 \pm 0.1$  and  $7.2 \pm 0.14\%$  for Marib, Sadah and Taiz samples, respectively. The seeds showed to have high content of TDF which was  $36.88 \pm 1.44$ ,  $26.50 \pm 1.05$ ,  $30.40 \pm 1.06\%$ , IDF  $27.10 \pm 0.55$ ,  $20.56 \pm 1.16$ ,  $22.40 \pm 1.40\%$  and SDF  $8.90 \pm 1.17$ ,  $6.50 \pm 0.60$ ,  $8.13 \pm 0.71\%$  for Marib, Sadah and Taiz samples, respectively. Minerals content analysis of *N. sativa* seeds showed the seeds to be a rich source of calcium, magnesium, potassium, phosphorus and iron. Present results revealed that *N. sativa* seeds contain several nutrients with potential value.

**Key words:** *N. sativa*, nutritional composition, fiber content, mineral content

## INTRODUCTION

*Nigella sativa* L. is commonly known as black seed which belongs to the botanical family of *Ranunculacea*. *N. sativa* seeds have been used for nutritional and medicinal purposes in many Middle Eastern countries and other parts of the world (Al-Gamadi, 2001; El-Dakhkhani *et al.*, 2000). *N. sativa* is considered a natural food additive and a condiment. It is typically consumed mixed with honey and in baking products or pastries. Also, it had been used for medicinal purposes as a natural remedy in many ancient cultures, such as those of Egypt, Greece and Rome (Al-Hader *et al.*, 1993). It is included in the list of the natural drugs of Al-Tibb Al-Nabawi as it was recommended by the prophet Mohammed (prayers and peace be upon him), the *N. sativa* is the medicine for every disease except death (Ghosheh *et al.*, 1999; Takruri, 2003). Seeds of *N. sativa* are frequently used in folk medicine in the Middle East and some Asian countries for acquiring good health and treating of many ailments including fever, common cold, headache, asthma, rheumatic diseases and various

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microbial infections and to expel worms from the intestines (Akhtar and Riffat, 1991; Al-Jassir, 1992; Al-Ghamdi, 2001).

Studies have shown that *N. sativa* seeds have high nutritional values: proteins from 20 to 27%, carbohydrates from 23.5 to 33.2%, moisture content ranged from 5.52 to 7.43% and ash from 3.77 to 4.92%. The seeds were shown to contain a fixed oil from 32 to 53%. It has been reported that minerals content ranged from 1.79 to 3.74% (Calcium, phosphorous, potassium, sodium and iron) and crude fiber content 5.5% (Al-Jassir, 1992; Al-Ghamdi, 2001; Atta, 2003; Nergiz and Otles, 1993).

Recently researchers paid a great interest to the seed in different forms, the seed itself, seed extract, its oil and its volatile substances. Many investigations have been carried out to isolate the possible active components and to conduct *in vivo* and *in vitro* studies on laboratory animals (Aqel and Shaheen, 1996) and human beings in order to understand its pharmacological actions. These include immune stimulation, anti-inflammatory (El-Dakhkhani *et al.*, 2000; Al-Ghamdi, 2001), anti-cancer, anti-microbial (Hanafi and Hatem, 1991), anti-parasitic, anti-oxidant (Houghton *et al.*, 1995), hypcholesterolemic effect and hypoglycemic effect (Al-Hader *et al.*, 1993).

The composition and nutritional values of different plants vary with the geographical origin of that plant. Since there was no study has been carried out to investigate the nutritional composition and the minerals content of *N. sativa* seeds cultivated in Yemen. Hence, the aim of the present study was to determine the nutrient composition of *N. sativa* seed and its fiber content, cultivated in three different regions in Yemen.

## MATERIALS AND METHODS

### Materials

*N. sativa* seeds were collected from three different regions in Yemen, namely Marib, Sadah and Taiz and were identified and authenticated by a plant taxonomist at the Department of Nutrition Sciences, University of Sana'a, Sana'a, Yemen. The seeds were cleaned and divided into small amounts and covered with plastic bags and aluminum foil and kept at 4°C in the Laboratory of Molecular Biomedicine, Institute of Bioscience, University Putra Malaysia, until use. Seeds analysis has been carried out between 2005-2007 at the Laboratory of Molecular Biomedicine, Institute of Bioscience, University Putra Malaysia, Malaysia.

### Methods

#### Chemical Analysis

Proximate nutrients compositions of *N. sativa* seeds used in this study including, moisture content, ash content, fat, proteins and total carbohydrates was determined by Association of Official Analytical Chemists methods (AOAC, 1997).

#### Total Dietary Fibers Analysis

The enzymatic-gravimetric assay of AOAC (1996) was used to analyze the TDF, IDF and SDF in the samples. For the fiber analysis, three different samples of *N. sativa* seeds from Taiz, Sadah and Marib were ground well and defatted using n-hexane at a ratio of 1:5. 100 g of each sample was soaked overnight in 500 mL hexane at room temperature and filtrated using Whatman paper number 1 to separate the seed molecules from the extracts. Samples residues were re-soaked with fresh solvents. This step was repeated three times. Defatted *N. sativa* samples were kept in plastic bags at 41°C to be analyzed for fibers content. For insoluble dietary fiber analysis, one g of each sample was incubated with heat stable  $\alpha$ -amylase at 95°C for 15 min and then digested with protease at 60°C for 30 min, following incubation with amyloglucosidase at 60°C for 30 min to digest the proteins and starch. Four volumes of 95% ethanol were added. Precipitation was allowed to form at room temperature overnight,

followed by filtration. The residue was then washed with 78% ethanol, 95% ethanol and acetone. The residue was oven-dried at 105°C overnight and weighed. For IDF similar procedures were used, but samples were filtrated without ethanol precipitation and water was used for washing. For SDF, the samples from IDF were precipitated using ethanol and filtrated using the same procedures as in TDF. Values obtained by the enzymatic method were then corrected by analyzing for proteins using Kjeldahl method and ashing at 525°C.

### Mineral Analysis

Mineral content was determined by Association of Official Analytical Chemists methods (AOAC, 1997) using the flame system of the Atomic Absorption Spectrophotometry (AAS), (GBC 908AA, USA). *N. sativa* seeds were ashed at 550°C overnight and the ash was dissolved in concentrated hydrochloric acid and filtered, diluted to 100 mL with distilled water and the absorbance of the samples was read directly on the AAS.

### Statistical Analysis

The data are presented as group Mean±SD. The calculations were performed using Microsoft Excel data sheet. The data were analyzed using SPSS window program version 11.0. Analysis of variance, one way ANOVA was used to compare the means of fiber content of the three different samples of *N. sativa* seeds from Marib, Sadah and Taiz.

## RESULTS

### Proximate Analysis of *N. sativa* Seeds

Proximate analysis of the three different samples of *N. sativa* L. is presented in Table 1, for comparison some of the values from literature are also included. Results obtained showed that the moisture content was 6.8±0.3, 4.6±0.1 and 7.2±0.14% in Marib, Sadah and Taiz samples, respectively. The three samples of *N. sativa* seeds were found to contain a high content of oil (37.7±1.5, 38.4±2.1 and 36.8±1.4%) in Marib, Sadah and Taiz samples, respectively. Proteins content was 20.0±0.7, 20.3±0.5 and 19.1±0.28%. Total carbohydrates content was 31.3±2.5, 31.7±2.6 and 33.1±0.98%, while the ash content was 3.8±0.5, 4.6±0.8 and 4.3±0.7%. These results are in agreement with the values reported by Abdel-Aal *et al.* (1993) and Atta (2003).

### Fiber Contents

The results show that *N. sativa* seeds have high content of TDF, IDF and SDF. Among the three different samples of *N. sativa* seeds, samples from Marib showed to have significantly higher of TDF and IDF content compared to samples from Sadah and Taiz. Samples from Marib and Taiz showed to have significantly higher content of SDF compared to samples from Sadah (Table 2).

Table 1: Chemical composition of three different samples of *N. sativa* seeds cultivated in Yemen and some results reported in the literature

Nutrients	Content (g/100 g)					
	<i>N. sativa</i> seeds from Yemen			Values reported in the literature		
	Marib	Sadah	Taiz	From Egypt 1	From Saudi Arabia 2	From Turkey 3
Moisture	6.8±0.3	4.6±0.10	7.2±0.14	7.0±0.50	4.6±0.45	4.2±0.5
Proteins	20.0±0.7	20.3±0.50	19.1±0.28	20.8±1.10	20.9±1.35	20.7±1.2
Fat	37.7±0.1	38.4±2.10	36.8±1.40	34.8±1.90	38.2±2.20	40.6±1.4
Carbohydrates	31.3±2.5	31.2±2.60	33.1±0.98	33.7±0.50	31.9±2.56	28.5±0.7
Ash	3.8±0.1	4.6±0.07	4.3±0.07	3.7±0.70	4.4±0.23	4.4±0.3

Method of AOAC (1996) was used. Each value represents the mean of three replications±SD. 1: Atta (2003), 2: Al-Jassir (1992), 3: Nergiz and Otles (1993)

Table 2: Fiber content of three different samples of *N. sativa* seeds

Samples	Fiber content (g/100 g)		
	TDF	IDF	SDF
Marib	36.88±1.44 <sup>a</sup>	27.10±0.55 <sup>a</sup>	8.90±1.17 <sup>a</sup>
Sadah	26.50±1.05 <sup>b</sup>	20.56±1.16 <sup>b</sup>	6.50±0.60 <sup>b</sup>
Taiz	30.40±1.06 <sup>c</sup>	22.40±1.40 <sup>b</sup>	8.13±0.71 <sup>a</sup>

Each value represents the mean of three replications±SD. TDF: Total Dietary Fiber, SDF: Soluble Dietary Fiber and IDF: Insoluble Dietary Fiber. Within a column, values with the same superscript letter(s) are not significantly different from each other

Table 3: Minerals content of three different samples of *N. sativa* seeds cultivated in Yemen and some values reported in the literature

Elements	Content (g/100 g)					
	<i>N. sativa</i> seeds from Yemen			Values reported in the literature		
	Marib	Sadah	Taiz	From Syria 1	From Saudi Arabia 2	From Turkey 3
Iron	8.60±0.68	10.70±0.49	56.60±3.33	9.3	0.15	57.5
Calcium	544.00±30.53	755.00±27.51	811.00±22.18	200.5	0.04	188.5
Magnesium	219.00±31.34	260.00±7.00	234.00±21.13	-	0.03	-
Sodium	44.00±4.6	73.00±4.51	80.70±3.51	53.5	0.75	85.3
Potassium	447.30±7.9	476.70±10	563.00±31.1	560.6	7.60	1180.0
Phosphorous	65.00±4.1	54.20±2.8	77.40±4.1	569.9	1.80	526.7
Copper	1.60±0.4	1.40±0.3	1.30±0.3	1.7	0.02	1.8
Zinc	1.84±0.12	1.90±0.02	2.50±0.2	5.9	0.06	5.6
Cadmium	0.01±0.0	0.01±0.00	0.01±0.00	-	-	-
Lead	-	-	-	-	-	-

Method of AOAC (1996) was used to analyze the hydrochloric acid solution of the ash samples using the flame system of the Atomic Absorption Spectrophotometry (AAS), (GBC, 908AA, USA). Each value represents the mean of three replications±SD. 1: Abdel-Aal *et al.* (1993), 2: Al-Jassir (1992), 3: Nergiz and Otles (1993)

### Minerals Content

Mineral composition of the three different samples of *N. sativa* seeds are shown in Table 3, for comparison of the results obtained with the literature some values are also included. Nine different elements (macro and micro) were determined. The average results indicate that 100 g of seeds contained calcium, 544±30.53, 755±27.51 and 811±22.18 mg in Marib, Sadah and Taiz samples, respectively. Results also show that *N. sativa* seeds are rich in potassium, 447.3±7.9, 476.7±10 and 563±31.1 mg/100 g in Marib, Sadah and Taiz samples, respectively. The contents were found to be different in some elements from what has been reported in the literature, like phosphorus (65±4.1, 54.2±2.8 and 77.4±4.1 mg/100 g in Marib, Sadah and Taiz samples respectively). While Copper content was 1.6±0.4, 1.4±0.3 and 1.3±0.3 mg/100 g in Marib, Sadah and Taiz samples, respectively. Samples from Taiz showed to have the highest content of iron compared to the other two groups (8.6±0.68, 10.7±0.49 and 56.6±3.33 mg/100 g in Marib, Sadah and Taiz, respectively). These seeds are also rich in sodium (73±4.51, 80.7±3.51 and 44±4.6 mg/100 g in Marib, Sadah and Taiz samples, respectively).

### DISCUSSION

The results obtained from this study showed that *N. sativa* seeds contain a considerable amount of oil and proteins. The crude fat represents the major component in the seeds, followed by total carbohydrates, then crude proteins. Slight difference in proximate nutrient contents were found among the three different samples of *N. sativa* seeds from three different regions in Yemen, namely Marib, Sadah and Taiz and those from other published studies (Babayan *et al.*, 1978). This was expected since it was reported that the composition and nutritional values vary with the country of origin, stage of

maturity, growth and subsequent storage conditions (Maccance and Widdowson's, 1992). These results differed slightly in moisture, proteins, carbohydrates and ash contents among the three different samples from Marib, Sadah and Taiz. These differences may be related to the variations of the cultivated regions or due to the analytical techniques used. The results showed that the three samples of *N. sativa* seeds contain high oil content as compared to seeds from other plants such as figs (23.5), pears (14.1), soybean (18-23) and papaya seeds (30.7) (Salunkhe *et al.*, 1992).

*N. sativa* seeds showed to have high content of TDF, IDF and SDF. These values are higher than those reported by Al-Jassir (1992), who reported that *N. sativa* seeds contain crude fiber within the range of 5.5-9.7%. The fiber content analysis of *N. sativa* seeds grown in Yemen were observed to contain a high amount of fiber, which helps in the maintenance of healthy lower intestines, however, it may be beneficial to open new idea of thinking for future research and studies in this field.

Data of minerals analysis revealed that the seeds contain an abundant amount of calcium, magnesium, potassium, phosphorus and iron. From the results, it becomes evident that *N. sativa* seeds provide an abundance of many minerals and could be considered as a good source of calcium which was higher than that reported by Nergiz and Otlis (1993) and Al-Jassir (1992). *N. sativa* seeds were found to contain a significant amount of iron and the results were similar to those reported by Nergiz and Otlis (1993) and Al-Jassir (1992). Samples from Taiz showed to have a higher amount of iron as compared to samples from Marib and Sadah that could be attributed to the location of Taiz, which is close to the Red Sea. Magnesium content was observed to be higher in the seeds cultivated in Yemen as compared to that cultivated in other places such as Saudi Arabia, which was reported as 0.03 mg/100 g (Al-Jassir, 1992). Among the three different samples, samples from Sadah showed to have higher content of magnesium than other samples.

Present results showed that the seeds content of sodium was found to be in agreement with those reported by Nergiz and Otlis (1993), which were  $85.3 \pm 16.07$  mg/100 g. On the other hand, these values were found to be much higher than those reported by Al-Jassir (1992), who reported it as 0.75 mg/100 g. Samples from Taiz showed to have the highest content of sodium followed by the samples from Sadah and Marib. High zinc content was also observed in *N. sativa* seeds, which suggests that the seeds are high in antioxidant contents. In comparison with that in the literature, current results showed lower content of zinc than that reported by Nergiz and Otlis (1993) which was reported to be 5.6 mg/100 g, however higher than that reported by Al-Jassir (1992).

Meanwhile, *N. sativa* seeds can also be considered as a rich source of copper. Among the three different samples, samples from Taiz had higher content of copper compared to samples from Marib and Sadah. Heavy metals such as cadmium and lead were absent from the *N. sativa* seeds. Therefore, there was no apparent toxicity effect of consuming the seeds. These findings support that reported by Le *et al.* (2004), who found that rats received petroleum ether extract of *N. sativa* seeds at a dose equivalent to  $2 \text{ g kg}^{-1}$  b.wt of the original seed powder for 4 weeks did not show any physical or behavioral signs of toxicity. In addition, petroleum ether extract of *N. sativa* seeds was found to be non-toxic towards isolated hepatocytes *in vitro* (Le *et al.*, 2004) as also previously reported the lack of *in vivo* toxicity of *N. sativa* fixed oil in mice (Zaoui *et al.*, 2002).

## CONCLUSION

The results obtained in this study demonstrated that seeds of *N. sativa* cultivated in Yemen are an important source of proteins and crude fibre, which help in maintenance of healthy lower intestines. *N. sativa* seeds are good source of oil, proteins and fiber content. Some further studies are recommended to investigate the possibility of using Yemeni black cummin seeds as a potential source for commercial production of oil.

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