International Scholars Journals

International Journal of Agricultural Economics and Extension ISSN 2329-9797 Vol. 8 (4), pp. 001-004, April, 2020. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

A comparative study on fatty acid composition of black cumin obtained from different regions of Turkey, Iran and Syria

Eray Tulukcu

Technical Vocational School of Higher Education, Program of Medical Aromatic Plants, Selcuk University, 42500 Cumra /Konya, Turkey. E-mail: eraytulukcu@selcuk.edu.tr. Tel: +90.352.4475621-36. Fax: +90.3523425.

Accepted 16 December, 2019

The present study was carried out to determine the fatty acid composition of the black cumin (*Nigella sativa* L.) samples obtained from total ten different regions of Turkey, Iran and Syria and the comparison of variations in species. The fatty acid compositions of black cumin samples were determined by gas chromatography (GC). The main fatty acids of the fixed oil were linoleic acid, oleic acid and palmitic acid. The lowest linoleic acid content (54.32%) is found to be in Kutahya Tavsanli. Additionally, the highest linoleic acid content (70.81%) is found to be in Iran. Palmitic acid is mostly found in samples obtained from Konya Karakaya and Konya Seydisehir and the palmitic acid, contributing approximately 8.23 to 13.34% to the total palmitic acid content. According to the results, fatty acid composition of the black cumin is significantly varied depending on each species. Black cumin oil or extract has protective and curative actions. Black cumin oil is considered as one among newer sources of edible oils, thanks to its important role in human nutrition and health. In this study, terms of fatty acids from some of the local varieties has come to the fore. For example, omega-6 Iran (70.81%), Omega-9 and palmitic acid Karakaya of Konya, saturated fatty acid (SFA); 27.87% for Tavsanli of Kutahya local varieties can be considered. These results indicated that the black cumin oil is a functional food because of the high unsaturated fatty acid values and could be used as natural agents in animal and human nutrition.

Key words: Black cumin, fatty acid composition, gas chromatography.

INTRODUCTION

Eastern Mediterranean, Southern Europe and West Asian origin of the black cumin *Nigella sativa* L.) has been spread to other countries in the world. Although the genus *Nigella* is an annual herbaceous plant (*Ranunculaceae*) includes about 20 species (e.g. *N. sativa* L., *Nigella damascena* L. and *Nigella arvensis* L.) distributed from the Mediterranean regions to West Asia (Atta, 2003; Cheikh-Rouhou et al., 2007; Kokdil et al., 2006). *N. sativa* a spicy plant is most important species cultivated in various parts of the world (Ali and Blunden, 2003; Kokdil et al., 2005; Kokdil et al., 2006). The seeds of *N. sativa* have been known also as black cumin or black caraway in English and corek otu in Turkish, and used as spice and culinary purposes such as pityriasis, leucoderma, antimicrobial, ringworm, eczema, chest congestion, migraine, paralysis, rheumatism and diuretic for the century (Ali and Blunden, 2003; Arici et al., 2005; Kokdil et al., 2005; Kokdil et al., 2006).

Bioactivity of black cumin depends on the amount of the thymoquinone the major component of the essential oil, which is also present in the fixed oil (Ali and Blunden, 2003). Black cumin contains 30 to 40% oil and 20 to 30% protein with antioxidants lignans such as saponin, melantin (Ustun et al., 1990; Akgul, 1993; Ali and Blunden, 2003; Kaya et al., 2003; Cheikh-Rouhou et al., 2007).

Mature seeds of *N. sativa* are consumed for edible and medical purposes. Black cumin was used as a food additive (spice) and flavor in production of bread, butter and some cheese types (Atta, 2003; Tarakci et al., 2005) in many countries including Turkey. Black cumin contains variable amount of oil with linolenic generally recognized

Table 1. Fatty acid compositions (%) of black cumin (*N. sativa*) varieties.

Black cumin varieties	C10:0	C14:0	C16:0	C18:1n9	C18:2n6
Konya Karakaya	-	-	13.34	24.15	62.49
Konya Seydisehir	-	-	12.60	24.03	63.36
Kutahya Tavsanlı	5.43	12.97	9.47	17.79	54.32
Mersin Tarsus	-	-	12.41	23.07	64.51
Kayseri Kocasinan	-	3.97	10.40	19.67	65.93
Bartin Terkehaliller	-	-	11.59	21.09	67.31
Iran	-	-	9.65	19.52	70.81
Syria	-	-	11.06	22.47	66.46
Kahramanmaras Afsin	-	7.76	8.23	15.17	68.81
Konya Aksehir	-	13.23	8.95	16.76	61.04

- : not detectable.

as the more abundant fatty acid; relevant amounts of saturated acids such as palmitic, myristic and stearic were found in some cases, as well as the presence of unusual unsaturated C:20 (PUFA) acids (Ustun et al., 1990; D'Antuono, 2002; Toncer and Kızıl, 2004).

In general, black cumin contains about 24.6% oleic acid (C18:1), 56% linoleic acid (C18:2), 12% palmitic acid (C16:0), 0.7% linolenic acid (C18:3) and 6.7% other fatty acid. Fatty acid contents were significantly influenced by genotypic factors, years, various physiological, geographical, ecological and cultural factors (Kaya et al., 2003; Nickavar et al., 2003; Cheikh-Rouhou et al., 2007). However, there is no detailed study about the fatty acid composition of determinacy character (Uzun et al., 2002; Kaya et al., 2003; Karaca and Aytac, 2007).

According to literature information, fatty acid composition of black cumin obtained from different regions has not been investigated. The aim of this study was to determine the fatty acid compositions black cumin samples obtained from different countries such as Turkey, Syria and Iran and to compare species.

MATERIALS AND METHODS

Collection of samples

Total ten black cumin samples were collected from Turkey (Eight samples), Iran (One sample) and Syria (One sample). The samples from Turkey include eight varieties such as Konya Karakaya, Konya Seydisehir, Kutahya Tavsanli, Mersin Tarsus, Kayseri Kocasinan, Bartin Terkehaliller, Kahramanmaras Afsin and Konya Aksehir.

Fatty acid analysis

Total lipid was extracted from the black cumin samples by the method (Folch et al., 1957). 4 g samples of black cumin were homogenized with 80 ml of a 2:1 (v/v) mixture of chloroform-methanol, then 4 ml of 0.88% NaCl was added. The liquid was mixed and left to stand for 2 h to allow phase separation. The chloroform/methanol extract was evaporated to dryness in a water bath at 50°C under nitrogen flow. The fatty acids were converted to their methyl esters using standard Boron Trifluoride-Methanol method (Moss et al., 1974) . The resultant fatty acid methyl esters were separated and stored at -20°C. Fatty acid compositions were analyzed by a gas chromatography (GC) (Agilent 6890, USA) equipped with a FID and a 100 m x 0.25 mm ID HP-88 column. Injector temperature was 250°C. The oven temperature was kept at 103°C for 1 min, then programmed from 103 to 170°C at 6.5°C/min, from 170 to 215°C for 12 min at 2.75°C/min, finally, 230°C for 5 min. The carrier gas was helium with a flow rate of 2 ml/min; split rate was 1/50. FA was identified by comparison of retention times to known standards. The results were expressed as g fatty acid/100 g total fatty acids (%). Each of the experiments was repeated three times.

RESULTS AND DISCUSSION

The nutritional value of a fat depends, in some respects, on the amount of free fatty acids (e.g., butyric acid in butter) which develop. The fatty acid compositions of black cumin samples for each region are presented in Table 1. Five fatty acids was identified for the black cumin samples and evaluated their compositions for different samples.

The fatty acid composition of the seed oils investigated revealed oleic acid as the predominant monounsaturated fatty acid (MUFA) 15.17 to 24.15%. The highest fatty acid ratios are as follows; oleic acid 18:1; 24.15% for Karakaya of Konya, 24.03% for Seydisehir of Konya, 23.07% for Tarsus in Mersin.

The fatty acid composition of the seed oils investigated revealed linoleic acid as the predominant polyunsaturated fatty acid (PUFA) 54.32 to 70.81%. The highest fatty acid ratios are as follows; linoleic acid (18:2); 70.81% for Iran, 68.81% for Afsin of Kahramanmaras, 67.31% for Terkehaliller of Bartin. This preliminary study shows that black cumin oils contain high relative percentages of linoleic acid. Linoleic acid, undoubtedly one of the most important polyunsaturated fatty acids in human food because of its prevention of distinct heart vascular diseases is present in all the seed oils (Ajayi et al., 2006). Oleic and linoleic acids are the most abundant

monounsaturated and polyunsaturated fatty acids in all samples, respectively. The total MUFA composition of the studied species is assigned between 15.17 to 24.15% while PUFA composition is 54.32 to 70.81%.

In a previous study, while it is stated that the most –3 fatty acid was found in salvia (63.8%) and flaxseed (57.5%), the most –6 fatty acid was found in saffron flower (70%) and sunflower (65%). While these fatty acids to human health have preserved against some diseases such as heart and infection, –6 and –3 fatty acids have an efficient role in lowering hemorrhage, antithrombotic, antirhythmic and vasodilator (Celik and Demirel, 2004).

Especially palmitic acid (C16:0) and stearic acid (C18:0) are the most popular and important saturated fatty acids in herbal oils. As saturated fatty acids can be synthesized in human body, even oil is never consumed these kinds of fatty acids can be synthesized by molecules consisting of carbohydrate metabolism (Ayerza, 1995; Karaca and Aytac, 2007).

The fatty acid composition of the seed oils investigated revealed palmitic acid as the predominant saturated fatty acid (SFA) 8.23 to 13.34%. The highest fatty acid ratios are as follows palmitic acid 16:0; 13.34% for Karakaya of Konya, 12.60% for Seydisehir of Konya, 12.41% for Tarsus of Mersin. Average palmitic acid rate is 10.77% in all local varieties.

Capric acid is found only one sample Kutahya Tavsanli (5.43%) in all species. Myristic acid is found in samples obtained from Kutahya Tavsanli (12.97%), Kayseri Kocasinan (3.97%), Kahramanmaras Afsin (7.76 %) and Konya Aksehir (13.23%). The fatty acid composition of the seed oils investigated revealed total saturated fatty acid (SFA) 9.65% to 27.87%. The highest fatty acid ratios are as follows saturated fatty acid (SFA); 27.87% for Tavsanli of Kutahya, 22.18% for Aksehir of Konya, 15.99% for Afsin of Kahramanmaras. While the most important local variety in terms of SFA/PUFA rate has been Tavsanli of Kutahya, second important local variety is Aksehir of Konya.

The level of MUFA depends on level of oleic acid. The greatest proportion of oleic acid is found in Konya Karakaya. EC reported that erucic acid 22:1 in vegetable oils had to be found at a maximum value of 5.0% for the human health (Anonymous, 1980). In this study, erucic acid was not found in any varieties. Such variation in oil concentrations among species and varieties may be related to the variations of cultivated regions, storage conditions and maturity stage. It may also be due to geographical and climatic differences where black cumin had been grown (Cheikh-Rouhou et al., 2007). The long chain -3 and -6 fatty acids commonly are called PUFAs. Long- chain 3 PUFAs cannot be readily synthesized by human bodies and mostly are obtained through the diet, and ratios of -3/ -6 are considered to be important (Pigott and Tucker, 1987; Alasalvar et al., 2002). In the ratio of -3/ -6 PUFA increased the availability of -3 PUFAs, which are beneficial for human health (Dyerberg, 1986). The lowest linoleic acid content (54.32%) is found to be in Kutahya Tavsanli. The highest linoleic acid content (70.81%) is found to be in Iran. Average linoleic acid rate is 64.50% in all local varieties Nutritionists suggested that -3 fatty acids had to be found more in human diet. Therefore, they reported that -6/ -3 ratio had to be values below 4.0 for the human health (HMSO, 1994). In addition, a number of reports have been published on the antimicrobial properties of *N. sativa* extracts or its oil. The oil was more effective against Gram positive than Gram negative organisms (Ali and Blunden, 2003; Arici et al., 2005; Kokdil et al., 2006). Daily 30 mg/kg black cumin consumption is beneficial to the immune system (Kaya et al., 2003). Black cumin seed oils are very stable and could be conserved safely for a long time due to their considerable polyphenolic content (Cheikh-Rouhou et al., 2007).

In this study, fatty acids of -3 from some of the local varieties have come to the fore. For example, -6 Iran (70.81%), -9 and palmitic acid Karakaya of Konya, saturated fatty acid (SFA); 27.87% for Tavsanli of Kutahya local varieties can be considered. The amount of unsaturated fatty acids (SFA) in cultivation in warm regions is affected more than the amount in tropical regions. The amount of fatty acids on the genotypic factor is one of the most influential factor (Uzun et al., 2002). These results indicated that the black cumin oil is a functional food because of the high unsaturated fatty acid values and could be used as natural agents in animal and human nutrition.

REFERENCES

Ajayi IA, Oderinde RA, Kajogbola DO, Uponi JI (2006). Oil content and fatty acid composition of some underutilized legumes from Nigeria. Food Chem., 99: 115-120.

Akgul A (1993). Spices Science and Technology, Gida Teknolojisi Dernegi Ankara-Turkey.

Alasalvar C, Taylor KDA, Zubcov E, Shahidi F, Alexis M (2002). Differentiation of cultured and wild sea bass (*Dicentrarhus labrax*): Total lipid content, fatty acid and trace mineral composition. Food Chem., 79(2): 145-150.

Ali BH, Blunden G. (2003). Pharmacological and toxicological properties of *Nigella Sativa*. Phytother. Res., 17: 299-305.

Anonymous (1980). EC, Council Directive 80/891/EEC. Official J. L, p. 254.

Arici M, Sagdic O, Gecgel U (2005). Antibacterial effect of Turkish black cumin (*Nigella sativa* L.) oils. Grasas y Aceites, 56 (4): 259-262.

Atta MB (2003). Some characteristics of *Nigella* (*Nigella sativa* L.) seed cultivated in Egypt and its lipid profile. Food Chem., 83(1): 63-68

Ayerza R (1995). Oil content and fatty acid composition of Chia (*Salvia hispanica* L.) from five Northwestern locations in Argentina. J. Am. Oil Chem. Soc., 72: 1079-1081.

Celik S, Demirel M (2004). Importance of -3 fatty acids and conjugated linoleic acid for human and animal healthy. Yuzuncu Yil Uviversity, Fen Bilimleri Enstitusu Dergisi, 1: 25-35.

Cheikh-Rouhou S, Besbes S, Hentati B, Blecker C, Deroanne C, Attia H (2007). *N. sativa* L.: Chemical composition and physicochemical characteristics of lipid fraction. Food Chem., 101(2): 673-681.

D'Antuono L, Moretti FA, Lovato AFS (2002). Seed yield, yield components, oil content and essential oil content and composition of

Nigella sativa L. and *Nigella damascena* L. Indian. Crops Prod., 15: 59-69
Dyerberg J (1986). Linolenate-derived polyunsaturated fatty acids and prevention of atheroscl erosis. Nutr. Rev., 44: 125-134.
Folch J, Lees M, Stanley GHS (1957). A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem., 226(1): 497-509.
HMSO (1994). Nutritional aspects of cardiovascular disease (report on health and social subjects No. 46), London-UK.
Karaca E, Aytac S (2007). The factors affecting on fatty acid composition of oil crops. J. Faculty. Agric. OMU, 22(1): 123-131.
Kaya MS, Kara M, Ozbek H (2003). Seed of corek otu (*Nigella sativa*) effect human cell and immunity system CD3+, CD4+, CD8+ Cells and effect a number of total leucocytes. J. General Med., 13(3): 109-112.
Kokdil G, Delialioglu N, Ozbilgin B, Emekdas G (2005). Antibacterial Activity Screening of *Nigella* L. Species Growing in Turkey. J. Fac. Pharm. Ankara, 34(3): 183-190
Kokdil G, lcim A, Ozbilgin B, Uygun C (2006). Morphology and stem anatomy of some species of genus *Nigella* L. in Turkey. J. Fac. Pharm. Ankara, 35(1): 19-41.
Moss CW, Lambert MA, Merwin WH (1974). Comparison of rapid methods for analysis of bacterial fatty acids. App. Microbiol., 28(1): 80-85.
Nickavar B, Mojab F, Javidnia K, Amoli MAR (2003). Chemical composition of the fixed and volatile oils of *Nigella sativa* L. from Iran. Zeitschrift fur Naturforschung, 58c: 629-631.
Pigott GM, Tucker BW (1987). Science opens new horizons for marine lipids in human nutrition. Food Rev. Int., 3(1/2): 105-138.
Tarakci Z, Ekici K, Sagdic, O, Kucukoner E (2005). The effect of black cumin on ripening of Tulum cheese. Archiv fur Lebensmittelhygiene, 56(6): 135-139.
Toncer O, Kızıl S (2004). Effect of seed rate on agronomic and technologic characters of *Nigella sativa* L. Int. J. Agric. Biol., 6(3): 529-532.
Ustun G, Kent L, Cekin N, Civelekoglu H (1990). Investigation of the technological properties of *Nigeria sativa* (black cumin) seed oil. J. Am. Oil Chem. Soc., 67(12): 958-960.
Uzun B, Ulger S, Cagirgan IM (2002). Comparison of determinate and indeterminate types of sesame for oil content and fatty acid composition. Turkish J. Agric. For., 26: 269-274.