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Fatty acids, minerals contents, total phenol, antioxidant activity and proximate analyses of *Nigella sativa* seed cake and seed cake oil

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Abstract

The oil, crude protein, total phenol, antioxidant activity, flavonoid, fatty acid composition and mineral contents of black cumin seed cake are present in Table 1. Dominant fatty acids were palmitic (12.25%), oleic (24.74%) and linolenic acids (58.62%). Black cumin cake rich in both protein (23.95%) and oil (20.13%). Total phenol and flavonoid contents were 1458 (mgGAE/100g) and 351(mg CE/g dw), respectively. P and K had major elemnts of black cumin cake. According to results, black cumin cake serves as a potential nutrition and natural antioxidant sources, and may be useful in a balanced nutrition.

Keywords: black cumin cake, oil, fatty acid composition, minerals, antioxidant activity, total phenol, flavonoid, protein

1. Introduction

Black cumin (*Nigella sativa* L.) is an annual herbaceous plant belonging to the Ranunculaceae [1-4]. Black cumin seeds are used as spice in bakery products and other food applications [5]. Turkey are also used in the preparation of a traditional sweet dish, composed of black cumin paste, which is sweetened with honey or syrup, and in flavouring of foods, especially bakery products and cheese [4]. The fatty acid composition of *Nigella sativa* seeds of Turkish origin has been investigated [2,3,6]. Therefore, the aim of this study was to determine the necessary measurements to characterize seed cake and seed cake oil of *N.sativa seed* containing oil content, fatty acids, minerals and some proximate element contents of their seed cake and seed cake oil.

2.Material and Methods

2.1.Material

Black seed extracted by cold press, and then residue cake was dried in oven at 70 ^{o}C for 24 h. Dried cake was used for current analyses.

2.2.Methods

2.2.1.Determination of fatty acids. Fatty acid compositions for black cumin cake oil were determined using a fatty acid methyl ester method as

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described by Hışıl [7]. The oil was extracted three times for 2 g air-dried seed sample by homogenization with petroleum ether. The oil samples (50-100 mg) was converted to its fatty acid methyl esters (FAME). The methyl esters of the fatty acids (1 µl) were analysed in a gas chromotography (HP 6890) equipped with a flame ionising detector (FID), a fused silica capillary column (60 m x 0.25 mm i.d.; film thickness 0.20 micrometer). It was operated under the following conditions: oven temperature program. 175 ^{o}C for 7 min. Raised to 250 ^{o}C at a rate 5 ^{o}C/min and than kept at 250 ^{o}C for 15 min); injector and detector temperatures, 250 and 250 ^{o}C; respectively, carrier gas. nitrogen at flow rate of 1.51 ml/min; split ratio. 1/50 µl/min.

2.2.2.Determination of mineral. Provided cake flour sample were dried at 70 ^{o}C in a drying cabinet with air-circulation until they reached constant weight. Later, about 0.5 g dried and ground samples were digested by using 5ml of 65% HNO_3 and 2 ml of 35% H_2O_2 in a closed microwave system (Cem-MARS Xpress). The volumes of the digested flour samples were completed to 20 ml with ultra-deionized water, and mineral contents were determined by ICP AES (Varian-Vista, Australia). Measurements of mineral concentrations were checked using the certified values of related minerals in the reference samples received from the National Institute of Standards and Technology (NIST; Gaithersburg, MD, USA) [8].

Working conditions of ICP-AES:

Instrument :ICP-AES (Varian-Vista)

RF Power : 0.7-1.5 kw (1.2-1.3 kw for Axial)

Plasma gas flow rate (Ar) : 10.5-15 L/min. (radial) 15 “ (Axial)

Auxilary gas flow rate (Ar) :1.5 “

Viewing height : 5-12 mm

Copy and reading time :1-5 s (max.60 s)

Copy time : 3 s (max. 100 s)

2.2.3.Determination of Anthocyanins, Total Phenolic Contents, Flavonoids antioxidant activity and proximate analyses. Anthocyanins were analyzed according to the method of Ticconi et al. [9]. The phenols of the plant material were extracted with MeOH. Total phenolic content was assayed quantitatively by absorbance at 765 nm with Folin-Ciocalteau reagent according to the method of Madaan et al. [10]. Total flavonoids content was estimated according to Dewanto et al. [11]. The free radical scavenging activity of samples was determined using DPPH (1,1-diphenyl-2-picrylhydrazyl) according to Lee et al. [12]. Moisture, crude lipid, protein, fibre and ash were determined according to the standard AOAC [13] method. Protein content was established according to Dupon method. Crude protein was calculated by using a nitrogen conversion factor of 6.25. Protein content was determined by the Dumas Nitrogen Analyzer (DNA) (Velp NDA 701- Italy). Protein was calculated using the general factor (6.25). The average is calculated by analyzing the flours three times. Results of the research were analysed for statistical significance by analysis of variance [14].

3.Results and Discussion

The oil, crude protein, total phenol, antioxidant activity, flavonoid, fatty acid composition and mineral contents of black cumin seed cake are present in Table 1. Dominant fatty acid s were palmitic (12.25%), oleic (24.74%) and linolenic acids (58.62%). Black cumin cake rich in both protein (23.95%) and oil (20.13%). Total phanol and flavonoid contents were 1458 (mgGAE/100g) and 351(mg CE/g dw), respectively. P and K had major elemnts of black cumin cake. Micro element contents of cake were found low. Abbas Ali et al [4] reported that the moisture contents of black cumin and fenugreek contained 4.2% and 8.1%, respectively. Nigella seed varieties, having a Tunusian and Itanian origin contained 26.7 and 22.6% protein, 28.48 and 40.35% oil, 4.86 and 4.41% ash, respectively [15]. The ash content of *N.sativa* (3.66% to 4.22%) was close to reported values of 3.7% [2] and 4.2% [16]. Fibre results were higher than those of reported by Abbas Ali et al. [4], Sultan et al. [16] and Nazar and Tinay [17]. As it known that crude fibre has a number of beneficial effects related to its indigestibility in the small intestine [18]. Magnesium, phosphorus, zinc and manganese contents of *N.sativa* were found as 265.0 mg/100g, 543 mg/100g, 6.4 mg/100g , 8.5 mg/100 g, respectively ([16]. Cheikh-Rouhou et al. [15] reported that Tunusian and Iranian *N.sativa* seeds contained 783 and 708 mg/Kg K, 235

and 260 mg/Kg Mg, 572 and 564 mg/Kg Ca, 48.9 and 51.9 mg/Kg P, 20.8 and 18.5 mg/Kg Na, 8.65 and 9.42 mg/Kg Fe, 1.65 and 1.48 mg/Kg Cu, 8.04 and 7.03 mg/Kg Zn and 4.43 and 3.37 mg/Kg Mn. Atta [2] showed that the oils of black cumin varieties contained oleic and linoleic acids at relatively high levels (18.9-20.1 and 47.5-49.0, respectively).

The source of variability may be genetic, seed quality, oil processing variables, or accuracy of detection, lipid extraction method and quantitative techniques [1].

As a result, the contents of phenolic compounds, fatty acid composition and mineral contents were found differ compared with other seed cakes.

Table 1. Proximate analyses of black cumin cake

Fatty acids	Concentrations (%)	Minerals	Concentrations (mg/Kg)	Proximate	Concentrations
Myristic	0.15±0.01*	P	3956.67±1.0	Moisture (%)	6.97±0.83
Palmitic	12.25±0.17	K	1686.62±0.25	Crude protein (%)	23.95±1.17
Palmitoleic	0.180.03	Ca	0.0±0.0	Crude ash (%)	9.45±0.81
Margaric	0.07±0.01	Mg	0.0±0.0	Crude oil (%)	20.13±1.67
Stearic	3.30±0.07	S	3510.05±0.37	Fiber (%)	13.87±1.3-17
Oleic	24.74±0.58	Fe	1.85±1.0	Total phenol (mgGAE/100g)	1458±1.0
Linoleic	58.62±1.27	Zn	4.80±0.3	Flavonoid (mg CE/g dw)	351±0.4
Linolenic	0.37±0.09	B	4.04±1.0	Antioxidant activity (%)	23.06±1.63
Arachidic	0.22±0.03	Cu	1.0±0.29	Anthocyanin(µmol /g dw)	0.468±0.027
Behenic	0.03±0.01	Mo	3.20±0.68	Alcohol soluble extract (%)	0.22±0.03

*mean±standard deviation

The difference in the mineral composition of the cake could be caused by the species, variety, ecological factors and plant nutrition. Also, the harvest time and altitude could also affect the mineral, fatty acid composition, antioxidant activity and total phenol contents. Oil bearing seeds have various bioactive components with potential health benefits. Present study show that this seed cake appear to be strong antioxidant and has high level of omega-6 acid, total phenol, protein, fiber and mineral contents. The black cumin cake contained the lowest amount of heavy metals. According to results, black cumin cake serves as a potential nutrition and natural antioxidant sources, and may be useful in a balanced nutrition and food supplemts.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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