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Comparison of physico-chemical properties of Indian and Ethiopian origin Black cumin (*Nigella sativa*) seed cake

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Abstract
Ethiopian and Indian origin two types of Nigella seeds were subjected to cold pressing and thereafter seed cake was subjected to proximate analysis. Results revealed that moisture, crude protein, fat, fiber, carbohydrate and ash contents of Indian *Nigella sativa* seed cake were 4.56%, 18.44%, 15.69%, 7.69%, 5.31% and 28.16% respectively. Respect to Ethiopian type results were 4.37%, 19.29% 16.13%, 6.03%, 4.30%, 23.13% respectively. These proximate values pertaining to the two types were significantly different to each other ($p<0.05$). While moisture, crude protein and total carbohydrates are higher in Indian type fat and fiber are higher in Ethiopian type. Results suggested that seed cake having considerable amount of protein that can be utilized for further types of food application even as an animal feed.

Keywords: Ethiopian black cumin, Indian black cumin, *Nigella sativa*, proximate, seed cake

Introduction
Black cumin or *Nigella sativa* is a valuable medicinal plant commonly used in traditional medicine and this flowering plant often called as fennel flower native to South Asia. It belongs to Ranunculaceae family and blue colour flower holds small black caraway type seeds [1]. In spite of medicinal importance of *Nigella sativa*, it is well known for its functional cosmetics and dietary properties. In fact, this spicy plant has occupied a special place for its applications in oil industry with many health benefits [2]. Traditionally, *Nigella sativa* is used as diuretic, diaphoretic, stomachic, liver tonic and digestive remedy [3]. Although most common oil plants namely sunflower, rape and pumpkin are used worldwide still Nigella and flax seeds are not much popular [4]. Hence it is needed to investigate more on Nigella seeds, seed oil and cake. Oil cake taken as by product after extraction of oil which usually used as animal feed presently. However, after cold pressing the seed, oil is taken as the major product but seed cake does not have any significant application yet. Some findings show that residues of the oil even possess bioactive compounds which can be used as antioxidants. Segregation of such compounds can be used as value added products too [5]. But there is very little evidence found in seed cake on this purpose. Hence the main focus of this study is to explore the chemical composition of the seed cake with a view to search market opportunities.

Materials and method
Plant material
Seed cake of *Nigella sativa* samples were collected from a reputed oil extractor in Sri Lankan and two types were characterized as Indian and Ethiopian and ground them separately for 2 minutes using a laboratory scale grinder which had a stainless-steel blade. Thereafter, these ground products were sieved by using a 1mm diameter aperture size sieve. During grinding, care was taken to avoid undue heat buildup. Grounded seed cake samples were stored in dry stopper containers at -20^0C for the subsequence analysis of the study. A.O.A.C 17th edition 2000, Official Method 920.164 was followed in Preparing of Test samples.

Analytical methods
General
All analytical determinations were performed according to method of Association of Official Analytical Chemists17th edition 2000, test methods for spices and values were expressed as the mean standard deviations of triplicates. The collected data were statistically analyzed according to parametric ANOVA using MINITAB R 17 with a view to determine whether there is a significance difference between seed cake of both Indian and Ethiopian types at 95% confidence level.

Moisture content
Moisture content of ground black cumin seed cake samples was estimated according to Dean and Stark Toluene Distillation Method A.O.A.C 17th edition 2000 Official Method 986.21, Moisture in Spices. The water content is determined by distilling the material with an organic liquid not miscible with water and collecting the distillate in a graduated tube of Moisture Distillation Apparatus.

Fat content
Total fat content of seed cake was determined following the Majonnier Ether Extraction method as mentioned in Association of Official Analytical Chemists (AOAC method, 922. 06). Oil was extracted from 2g of black cumin seed cake powder in a Majonnier flask by using diethyl ether and

petroleum ether. Result was expressed as a percentage of total fat in dry basis.

Protein Content

Micro kjeldhal method was followed to determine protein content in Ethiopian and Indian Black cumin seed cake according to the AOAC method 960.52. Therein, 30 mg of black cumin seed cake powder sample was digested in Kjeldhal kit (VELP SCIENTIFICA – UDK 129) for nearly 3 hours and neutralization was done in the Kjeldhal instrument itself. The released condensed fume was trapped in to 4% Boric acid solution which was used to titrate against with 1 M HCl. Protein content was determined using nitrogen conversion factor 6.25 according to Al-Gaby, 1998[6] and data were expressed as a percentage of dry weight.

Fiber

I.S Specification No I.S 1797 – 1985 Methods of Test for Spices and Condiments was followed to determine fiber content in black cumin seed cake. Therein, they were defatted by using soxhelt extraction and defatted samples were digested by boiling Sulphuric acid and sodium hydroxide solutions in a flask connected to a water-cooled reflux condenser. After washing the digested samples, they were kept in the oven at 105±1°C for 3 hours for drying and incinerated in a muffle furnace at 550±25°C until all carbonaceous matter is burnt. Final weight difference was used to calculate fiber content and expressed it as percent of dry weight.

Ash and mineral content

Organic matter in seed cake sample was removed by igniting and then incinerating powdered 2g of seed cake samples placed in the muffle furnace (Wise Therm) at 550^0C for 3-4 hours. Ash content was determined as mentioned in A.O.A.C Method 941.12

Carbohydrate content

Carbohydrate content was estimated by difference of mean values: 100 – (Total fat + Crude protein + Crude Fibre + Total ash)

Results

Nigella seed cake of both Indian and Ethiopian origin black cumin seeds were analyzed for their proximate compositions and mineral content. Moisture, crude protein, fat, crude fiber, carbohydrate & ash contents are illustrated in table 1.

Table 1: Proximate and mineral composition of *Nigella sativa* seeds of Indian and Ethiopian origin

Characteristics	Ethiopian (%)	Indian (%)
Moisture content	$4.37^a \pm 0.11$	$4.56^b \pm 0.15$
Crude protein	$19.29^a \pm 0.25$	$18.44^b \pm 0.67$
Fat	$16.13^a \pm 0.36$	$15.69^b \pm 0.15$
Fiber	$6.03^a \pm 0.15$	$7.69^b \pm 0.10$
Total carbohydrate	$23.13^a \pm 0.20$	$28.16^b \pm 0.25$
Ash	$4.98^a \pm 0.17$	$5.31^b \pm 0.20$

*Data presented as mean values for triplicates ± S.D (n=3) in same raw are significantly different at ($p < 0.05$) level.

Protein and carbohydrate contents are the major components in both type of black cumin seed cake, followed by fat and fiber as shown in the table 1. This fact exhibits that black cumin residue is a good source of protein and carbohydrate; hence there is a potential which can be utilized as an animal feed. In addition, there is some amount of fiber also in the seed cake. Although high amount of fat is removed by the cold pressed method, still there was a considerable amount of fat retaining to the residue of black cumin. Furthermore, some mechanisms should be developed in order to get the fat is still intact with the seed cake. Proximate analysis of Indian origin. *Nigella* seed cake indicates that moisture content, crude protein and total carbohydrate were considerably higher than that of Ethiopian type whereas fat and fiber contents were higher in the Ethiopian origin. According to the statistical analysis at 95% confidence level these values were significantly different to each other ($p<0.05$). So the oil cake can be developed further as a value addition product and it can be used as a rich source of protein and carbohydrate.

Fat content can be changed due to the extraction process which depends on the temperature, time and the physical operation in the cold pressing. But reasons for the differences in two types may be due to the geographical variations and climatic conditions in which they are cultivated in, as one type is grown in India and other is in Ethiopia where a dry climatic condition is prevailed. Thus, moisture content may change. According to Atta [6], environmental factors such as soil condition, storage condition and even maturity stage contribute in variation of physico-chemical properties of black cumin seeds and as well as characterized of the seed cake too.

Conclusion

Nigella seed cake is a useful by product of the black cumin seed obtained after cold pressing which can be utilized in many fields. Its high content of protein and carbohydrates enhances the importance of the residue of black cumin. Further investigation is needed to make use of this underutilized residue in Black cumin seeds.

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