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Physico-Chemical Characteristics of Released and Improved Black Cumin (*Nigella Sativa L.)* Varieties

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Abstract

Black cumin (Nigella sativa L.) is an annual herb of the Ranunculaceae family, which is growing in Mediterranean region and Ethiopia. In Ethiopia the most people are used as household spice preparation and medicinal purpose. In Ethiopia, black cumin varieties are now days released, but there is no as such work on their physiochemical properties avail. This work presents the investigation of the physicochemical properties of the three-black cumin (Nigella sativa L.) verities (Derbera, Dershaye, and Edan). The results of physicochemical properties Derbera is highest in essential oil content (0.7%) and Edane is lowest (0.3%) than other verities and Dershaye is highest in refractive index of essential oil(1.49), refractive index of oleoresin(1.52%), moisture(8.0%),fat(24.0%),ash(10.45%), protein(20.61%) and lowest in fiber(16.7%) content than other varieties. From this result, Dershaye black cumin Variety, verities show the superior quality in physicochemical properties than the two black cumin verities (Derbera and Edane).

Keywords: Black cumin, Chemical, Derbera, Dershane, Edane, Essential oil, Oleoresin.

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Contents

Contribution of this paper to the literature
This work presents the investigation of the physicochemical properties of the three-black cumin (Nigella sativa L.) verities (Derbera, Dershaye, and Edan).

1. Introduction

Black cumin (Nigella sativa L.) is an annual herb of the Ranunculaceae family and crop is native to the Mediterranean region and it has been used for thousands of years by various cultures and civilizations [1]. Black cumin seeds have been used for centuries in culinary and medicinal benefits due to the strong, hot peppery taste and healing properties to treat all kinds of illnesses except death itself [2, 3]. Both seeds and oils are often used as a nutritional supplement due to its various health properties as they have been reported to possess antitumor activity, antioxidant activity, anti-inflammatory activity, antibacterial activity and a stimulatory effect on the immune system [4-8].

Ethiopia is located around the tropical region; thus, the weather makes a suitable environment for the growth of black cumin seed and it is produced in Amara, Oromiya, South Nation Nationality People and Gambella regions [9] and most Ethiopian peoples are using as household spice preparation. Unlike its medicinal purpose black cumin (Nigella sativa) seed is also used for the production of soap, perfumes, and lotions, food flavorings, food preservation, nutraceuticals and cosmeceuticals from the black cumin oil [10, 11]. Analyzing and compiling the physicochemical properties of black cumin verities is very limited in Ethiopia. Analyzing and compiling the physicochemical properties of black cumin is results in the best verity on quality product and will be a source of income by exporting it to other countries. This study aimed to avail the information on the physicochemical and compiling properties of the released and improved black cum verities.

2. Material and Method

2.1. Sample Preparation

The released and improved three black cumin varieties (Dereshaye, Derbera, and Edan) were collected from Kulumsa Agriculture Research center and Sinana Agriculture Research Center using clean polyethylene plastic bags and transported to Wondo Genet Natural Product laboratory to analyze the following parameter. The samples of Black cumin verities seeds were cleaned and crushed using an electric grinder (Model BLG401, Zhejiang YiLi Tool Co., Ltd., China). The crushed samples were subjected to physicochemical analysis.

2.2. Physicochemical Analysis

2.2.1. Oleoresin Extraction

Oleoresin (none volatile) were extracted according to Houghton, et al. [6] using Soxhlet extractor with N-Hexane. The extracted oleoresin was separated from the solvent by using a Rotary evaporator and oven drying. Finally, the oil content of the plant was measured gravimetrically after oven-drying.

$$Oleoresin\ (\%) = \frac{W2 - W1}{Weight\ of\ sample}\ x\ 100\%$$

Where: W_1= Weight empty flask, W_2 = Weight of flask + extracted samples(oil).

2.3. Essential Oil Extraction

Essential oil content was extracted according to described in European Pharmacopoeia [12] by hydro-distillation for 3 hours using a Clevenger apparatus. The powdered black cumin (100 g) samples were added into 0.5 L water and extracted to obtain the essential oil. Finally, the oil content of the plant was calculated by the following formula:

$$\text{Essential oil content in\% v/w dry} = \frac{volume\ of\ oil\ (ml)}{weight\ of\ dry\ distill\ sample\ (g)}\ \text{x } 100$$

2.4. Refractive Index

The refractive index of essential oils and oleoresin was determined using a Digital refractometer according to the method described by Kirk and Sawyer [13]. The refractometer was calibrating with water and the sample was applied using a micropipette. Then the red button was pressed. Finally, the result of the refractive index was read and recorded.

2.5. Moisture Content

The moisture content was determined according to methods [14]. A sample of 2 g was weighed in triplicates and placed in a forced-air oven at 105°C for 3hrs. The samples were removed and cooled in desiccators. The loss in weight was determined and recorded as the moisture content. The percentage of moisture was calculated using equation:

$$\text{Moisture (\%)} = \frac{W2 - W3}{W1} \times 100$$

Where W1= weight of fresh samples, W2=weight of fresh samples and crucibles and W3= weight of dried samples and crucible.

2.6. Ash Content

The ash content was determined according to the method [14]. A sample 2 g was measured into crucibles of a known weight and incinerated in a muffle furnace at 550°C for 3 hrs. The samples were then cooled in desiccators and weighed. The percentage of total ash was calculated using equation:

$$\text{Ash (\%)} = \frac{W3 - W1}{W2} \times 100$$

Where; W1 = weight of empty crucible, W2 = Weight of fresh samples and W3=weight of ashed samples and crucibles.

2.7. Protein Content

The Kjeldahl method as described by Abdualrahman, et al. [14].was used to determine the crude protein content. 0.5 g of sample to an accuracy of ± 0.1 mg into a 250 ml digestion tube. 2 Kjeltabs CT 3.5 (or 7 g K_2SO_4+0.210 g $CuSO_4x5H_2O$+0.210 g TiO_2) and 25 ml concentrated H_2SO_4 were added and Shake gently to "wet" the sample. The Sample was Digested for 60 minutes and left to cool for at least 15 minutes, then Diluted with 80 ml H_2O and 25-30 ml of receiver solution were added to the receiver flask. 50 ml of 40 % NaOH was added to the diluted digest. the Reaction was allowed to settle (delay) or use the SAfE feature (Steam Addition for Equilibration), to avoid a violent reaction. It was Distilled for the prescribed time and titrated distillate with standardized titrant (0.2 N). A reagent blank was performed before each batch of samples. Finally, the Result was Calculated using the following formula:

$$\%Nitrogen = \frac{(T-B)\times N \times 14{,}007 \times 100}{weight_{sample}(mg)}$$

T = Sample titration, B = Blank titration, N = Normality of titrant.

$$\%protein = N \times F$$

F = protein factor =6.25 in oilseeds.

2.8. Crude Fiber

The crude fiber was determined according to Abdualrahman, et al. [14]. The samples 2 g were introduced into the extraction unit, 150 mL of hot 0.2N H_2SO_4 was added and digested for 30 min. Then, the acid was drained and the sample was washed with hot deionized water. Finally, the fiber was extracted and dried by moistening with a small portion of acetone which was then allowed to drain. The sample was incinerated at 550°C for 3 hrs. until all carbonaceous matter was burnt. The crucible containing the ash was cooled in the desiccators and weighed. The percentage of crude fiber was calculated using equation.

$$\%\ \text{Crude fiber} = \frac{W2-W3}{W1} \times 100$$

Where: W1 = weight of sample used W2 = Weight of sample and crucible before ashing W3= Weight of crucible and ash.

2.9. Statistical Analysis

The all physicochemical properties of black cumin were analyses on both replicates were repeated. The Values are expressed in the means.

3. Result and Discussion

3.1. Physicochemical Properties

The results of the physicochemical properties of the released and improved three-black cumin (N. *Sativa)* verities are shown in Table 1.

Table-1. The physicochemical properties of the released and improved black cumin.

Black cumin varieties	EC (%)	OC (%)	Refractive index of EC	Refractive index of OC	MC (%/)	Ash (%)	Protein (%)	Fiber (%)
Derbera	0.70	18.00	1.47	1.51	6.00	9.33	20.38	17.03
Dershaye	0.65	24.00	1.49	1.52	8.00	10.45	20.61	16.70
Edan	0.30	19.00	1.48	1.48	7.00	9.55	20.45	23.26

Where EC (essential oil content), OC (oleoresin content).

3.2. Essential Oil Content

The essential oil content of black cumin varieties is presented in the above Table 1. The result shows that the highest essential oil content was obtained from Darbera Variety (0.70%) and the lowest one was Eden Variety (0.30%). The results higher than the findings of the researchers who reported that essential oil varied between 0.36% -0.49% [15], 0.27% - 0.35% [16], 0.48.0% - 0.51% [17], 0.01% - 0.50% [18] and 0.28% -0.36% [19]. Most researchers stated that the essential oil composition of black cumin varied depending on the genotype of the plant, growing, climatic and environmental conditions, as well as the distillation method [17-20].

3.3. Oleoresin /Fixed Oil Content

The result of oleoresin Table 1 shows, the highest oleoresin content was obtained from Dershaye variety (24.0%) and the lowest is Derbera(18.0%). The obtained results are lower than the result (30.4% - 36.4%) reported by Matthaus and ÖzCaN [19]; Sener, et al. [20] and the same with the result (24.4% -29.7%) reported by Ustun, et al. [21]. The differences can be due to genotype, growing, localities, climatic and environmental conditions [19-22].

3.4. Refractive Index of Essential oil and Oleoresin

The refractive index of the black cumin varieties showed in Table 1. The results of essential oil refractive index Deshayes is the highest (1.49) and Derbera is the lowest (1.47) and in the refractive index of Oleoresin Dershaye highest (1.52) and Edane the lowest (1.48), The values of the refractive index are normally associated with the purity of oils and thus, seed oil samples from Kelantan showed the highest purity of oil extracted from *N. Sativa* seeds this finding was agreed with Haron, et al. [2].

3.5. Proximate

The composition of black cumin (*Nigella Sativa)* verities samples is shown in Table 1. The results of the proximate analysis Dersahye highest in 8.0% moisture,20.61% crude protein, 10.45% total ash, and lowest in crude

fiber (16.70%) contents. This result is the same as the finding of Haron, et al. [2]; Takruri and Dameh [10]; Sowbhagya, et al. [23].

4. Conclusion and Recommendation

The black cumin Variety had significant effects on all Parameter Table 1 obtained. In the cause of physicochemical determination; the Dershaye is the highest except in Essential oil content and fiber content. Further investigations were done on the chemical compositions of essential oil and oleoresin for specific functions to standardize and determine the best varieties.

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