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Physiochemical Characteristics of Cumin Oil

الخصائص الفيزوكيميائية لزيت (الحبة السوداء)

A Dissertation Submitted to Sudan University of Science And Technology in partial fulfillment for the degree of B.Sc. in food Science and Technology.

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Dedication

To My

Family ***for their kind support and encouragements****,*

Teachers

And all my Friends

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I would like to express my thanks to my supervisor **Prof. Dr . Mahdi Abass Saad Shakak** For helpful assistance, guidance, patience and keen supervision during this work.

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ABSTRACT

The aim of this study was to evaluate physical analysis of black cumin seeds and determined chemical composition of black cumin seeds extraction oil from black cumin seeds

Black cumin seeds collected from the local market, were

analyzed for :protein – moisture –oil content– fibers _carbohydrates and ash contents then the results were recorded 18.64 ,3.88,27.095,29.74,17 ,3.615 respectively.

physical properties colour (red 10.55 , yellow 44.5, blue 0.015), refractive index (RI) 1.4675, viscosity(16.48), density(0.9065) and chemical properties (free fatty acid (FFA) 2.009, peroxide value (PV) 4.8.

ملخص البحث

الهدف من هذه الدراسة هو تقدير الخصائص الفيزوكيميائية لزيت الكمون الأسود و أيضا الخواص الكيميائية لحبة الكمون الأسود وأيضا تقدير استخلاص الزيت لحبة الكمون الأسود تم جمع حبة الكمون الأسود من الأسواق المحلية تم قياس التحليل التقريبي لحبة الكمون الاسود لتقدير محتوى كل من (بروتين 18.64%, رطوبة 3.88%, دهون27.095% , الياف29.74%, كربوهيدرات17%, الرماد3.615%). أيضا تم قياس الخصائص الفيزيائية (درجة اللون ,الاحمر10.55, الاصفر44.5,الازرق0.015) معامل الانكسار1.4675 , اللزوجة16.48 , الكثافة0.9065) وأيضا الخصائص الكيميائية (الأحماض الدهنية الحرة 2.009, قيمة البيروكسيد 4.8)

CHAPTER ONE

INTRODUCTION

Nigella sativa L. is a vegetal spice belongs to the ranunclaceae family commonly known as black cumin seed .the seeds *nigella sativa L* have several therapeutic effects such as prevention of cancer ,antihypertensive effect anti-inflammatory ,analgesic and antihistaminic action .*N. sativa* seed are used for edible and medicinal purposes .they are used in the preparation of traditional sweet Dish, composed of black cumin paste, which is sweetened with honey or syrup, and in spices of foods, especially bakery products and cheese **(Salma *et al.*2007)**.

Black cumin seeds contain appreciable quantities of poly unsaturated fatty acids (48 to 70%), while mono unsaturated (18 to 29%) and saturated fatty acids (12 to 25 %), in lesser proportion . Besides a better fatty acid profile, it contains considerable quantities of tocopherols and allied bioactive compounds. Moreover, the presence of phytosterols in amount of 0.33 to 0.36% **(Sultan *et al.*, 2009)**

Objectives

Main objective

To evaluation of nutritional value of cumin seeds.

Specific objectives

- To carry out physicochemical properties of black cumin seeds oil
- To determined chemical composition of black cumin seed.
- To extraction oil from the black cumin seed
- To evaluate physical analysis of black cumin seeds.

CHABTER TWO

LITRETURE REVIEW

2.1. Cumin

Cumin (kjuːmɪn/or UK: /ˈkʌmɪn/,US: /ˈkuːmɪn/) (Cuminum cyminum) is a flowering plant in the family Apiaceae, native to a territory including Middle East and stretching east to India. Its seeds – each one contained within a fruit, which is dried– are used in the cuisines of many cultures in both whole and ground form. Although cumin is thought to have uses in traditional medicine, there is no high-quality evidence that it is safe or effective as a therapeutic agent.

2.1.1.Description:

Cumin is the dried seed of the herb *(CumInum cyminum*), a member of the Parsley family. The cumin plant grows to 30–50 cm (12–20 in) tall and is harvested by hand. It is an Annual herbaceous plant, with a slender, glabrous, branched Stem that is 20–30 cm (8–12 in) tall and has a diameter of 3–5 cm (4–2 in). Each branch has two to three sub branches. All the branches attain the same height, so the plant has a uniform canopy.[7]The stem is colored grey or dark green. The leaves are 5–10 cm (2–4 in) long, pinnate or bipinnate, with thread-like leaflets. The flowers are small, white or pink, and borne in umbels. Cumin seeds have eight ridges with oil canals. They resemble caraway seeds, being oblong in shape, longitudinally ridged, and yellow-brown in color, like other members of the Apiaceae (Umbelliferae) family such as caraway, parsley, and dill. Cumin is a small, slender, glabrous herbaceous annual of the parsley family, usually reaching 25 cm (some varieties being double this height) and tends to droop under its own weight. The blue-green linear leaves are 5-10 cm long, pinnate or bipinnate, thread-like leaflets. The

white or pink flowers bloom in small compound umbels. The fruit is a lateral fusiform or ovoid achene 4-5 mm long, containing a single seed. The plants bloom in June and July and are harvested when 85% of fruits are ripe.

2.1.2. Uses of black cumin *(Nigella sativa)*

2.1.2.1. as medicine:

In the traditional system of medicine practiced in the Arabian Gulf region, black seed is recommended for a wide range of ailments, including fever , cough, bronchitis, asthma,chronic headache, migraine ,dizziness, chest congestion, dysmenorrheal, obesity, diabetes, paralysis, hemiplegic, back pain, infection ,inflammation rheumatism, hypertension, and gastrointestinal problems such as dyspepsia , flatulence, dysentery, and diarrhea.

It has been used as a stimulant, diuretic, emmenagogue, lactagogue, anthelmintic and carminative .

Black seed has also been used externally where it is applied directly to abscesses, nasal ulcers, orchitis, eczema, and swollen joints. The results of extensive pharmacological studies justify the broad, traditional therapeutic value of black seeds. these studies found black seed to have analgesic, anti-lipemic, post coital contraceptive, diuretic and antihypertensive, bronchodilator and calcium antagonist ,histamine release inhibitor, hepatoprotective , anthelmintic , antimicrobial (against a wide range of organisms), anti-cancer, and antiflammatory activities **(Ansari and Satish, 2013).**

2.1.2.2 Foods

Nigella sativa L. used as a condiment in bread and other dishes and in the preparation of a traditional sweet dish, composed of black cumin paste,

which is sweetened with honey or syrup and in flavoring of foods, especially bakery products and cheese.

Nigella sativa seed oil or extract has protective and curative actions and is considered as one among newer sources of edible oils **(Hamadi, 2007)**.

2.1.2.3 Cosmatics

Nigella sativa L. can affect skin by causing an allergic reaction. Simply touching black seed may cause a red rash along the skin .this rash is often accompanied by an itching sensation **(Alherz, 2012).**

2.10 Vegetable oils and fats:

Oils and fats are water insoluble organic compounds , chemically they are esters of the tri, di, and glycerides in which only two or one hydroxyl group of the glycerol is ester fied with fatty acids are one only formed in small amounts (0.1-0.4%) reported by Elkhattab ,(2011).

2.1 Chemical composition

Black cumin seed (*Nigella sativa)*seed are rich nutrients organic compounds and minerals .the seed content of these compounds was investigated by **Baboyan *et al.,*** (1978); **Osman** (1996) and **Elshiekh** (1999) they reported the protein content is 18-21% also ***Baboyan et al***. (1978) showed that the seed component of amino acids were arginine ,glutamic acid, leucine, lycine ,methionine, tyrosine , prolineand threonine, etc. the unsaturated fatty acid represents linoliec ,linolenic ,arachidonic, eicosaeienoic ,oleic and almitolic acid (**Gad *et al.***,1963; **Babayan *et al.*,1978**). While saturated fatty acid represent plamitic, stearic and myristic (**Gad *et al.*,1963**; **Menounos *et al.*, 1986**). Minerals (1.79-3.74%) calcium, phosphorus, potassium ,sodium and iron **(El-Zawahry,** 1997; **Babayan**,**1978**) moisture 7.43,ash 4.14%, fixed oil 37%, volatile oil 1.64, albumin 8.2% organic acid precipitated by copper

0.38%, melanthin 1.4%, cellulose 8.32%, sugar 2.75% and other substance dissolved by soda 9.38% (**Saeed**,**1972**).

Chemical analysis of black seed (*Nigella sativa*) showed that potassium ,phosphorus ,sodium and iron are the predominant elements present , zinc , calcium ,magnesium , manganese and copper are found at lower level, cadmium and arsenic are not detected in the seeds ,(**Al-jasser**,**1992**) the seed also contains triterpenes components of alpha-hedrin **(Kumarass and Haut, 2001).**

2.2 The oil extract:

Gad *et al.*, (1963) investigated chemical and physical properties of the oil extract from black seed (*Nigella sativa*) cultivated in Egypt. They found that specific gravity was about 0.92, acid value 30.30, and oleic acid represent about 43.76 .seeds of *Nigella sativa* are frequently used in flock medicine in the middle east and some asian countries for the promotion of good health and treatment of many ailments including fever, common cold, headache, asthma rheumatic disease, various microbial infections and to expel warns froms the intestines.

2.3 Botanical description of black seed nigella sativa

Nigella sativa is spice plant belonging to the family ranuncukaceae (**Agel and Shaheen,1996).** It seed oil contains thymoquionone and many monterpenes such as e-cymene, and apinene, and it has bronchodilator **(Al-thair *et al.* w ,1999),** antibacterial **(Hanfy and Hatem,1991).**

Black cumin has been cultivated since ancient times and the nutritional content is as follows: 20.8% raw protein, 3.7% raw cinder, 7.0% moisture, 34.8% lipids and 33.7% carbohydrates (Atta, 2003). Pharmacological properties of black cumin according to the chemical composition are as follows: antibacterial antifungal, antiviral, anti

protozoan, anti oxidant, on inflammatory and immuno stimulant. Black cumin is in the treatment of a range disease, including asthma, hypertension, inflammation coughing, bronchitis, headaches, eczema, influenza, fever and vertigo **(Antınterim, 2010)**.

2.4 Effect of black cumin oil on the oxidative stability:

Lipid oxidation has negative effects on food quality and human health. The oxidative changes of lipids lead to some changes in flavor, color, and odor and decrease the con- centration of bioactive compounds, which reduces the nutritional value of foods. Therefore some precautions must be taken to minimize oxidation and improve the oxidative stability of lipid products (**Raghavan, 2007; Shahidi and Zhong, 2010)** Natural Olbioactive compounds have been frequently applied in the food industry for quality and safety preservation of the food products **(Luther *et al.* 2007).**

Mayonnaise is one of the oldest and most widely used sauces in the world. Traditional mayonnaise is a mixture of oil (70–80%), egg yolk, vinegar and spices. Due to its high content of oil, mayonnaise is susceptible to spoilage and more prone to auto-oxidation **(Depree and Savage, 2001).** Nowadays, consumers are interested in natural foods and natural preservatives for healthier lifestyles. Therefore, the food industry has been searching for new and unique spice flavorings for ethnic and cross-cultural cuisines **(Raghavan, 2007)** Black cumin(*Nigella satival*) seeds and its crude or essential oils are widely used in functional foods, Nutraceuticals and pharmaceutical products because of their antioxidant properties and health benefits **(El-Abhar *et al.*2003).**

2.5 Fatty acid composition:

Fatty acid methyl esters (FAME) of BCO and SFO were prepared according to IUPAC (1987). The compositions of FAMEs were determined using a GC (Shimadzu, Kyoto, Japan) equipped with an FID detector and a DB 23 capil- lary column (30 m, 0.25 mm i.d. 0.25lm film thickness) (Agilent J&W, USA). Injector and detector temperatures were 230 and 240° C, respectively. Initial oven tempera- ture was 40° C for 5 min, then the oven temperature was programmed to rise from 40 to 190° Cat10° C/min and kept at 190° C for 10 min. Helium was the carrier gas at a linear flow of 1.0 mL/min. 1 L sample was injected to the GC by splitting (1:100). Identification of FAMEs was performed by comparison of their retention times with those of the reference standards and the fatty acid com- position (percentage by weight) was calculated from their corresponding integration data.

2.7 Essential oil composistion of cumin seed:

Cumin (*Cuminum cyminumL*.) is a wild grassy plant, growing in many parts of Iran. In Iranian folk medicine, cumin seeds have been used to treat diarrhea, toothache and epilepsy. In recent years, there are some reports regarding the anti-diabetic activities of this herb and its effects on reductions of cholesterol, phospholipids, free fatty acids, and triglycerides in plasma and tissue.

Chemical composition of cumin seed essential oil has been extensively studied and cuminal-dehyde has been introduced as the characteristic constituent of the seed. Among the many different methods utilized for the extraction of essential oil of plant materials, micro extraction techniques have found extensive appli-cations in recent years. Both solid phase micro extraction and solvent micro extraction methods have been utilized for this purpose

2.8 Extraction of essential oil

125g of whole cumin seeds were weighed for extraction of cumin seed essential oil. The weighed cumin seeds were placed in a round bottom flask which was then connected to a distillation condenser. Thus, the cumin seed oil obtained by hydro distillation process in which700 ml distilled water was used. The round bottom flask was kept in a heating mantle and the temperature was gradually increased from 60ºC to80ºC, 80ºCto 90ºC and finally at 100ºC. The extraction process was carried out for 3 hours (no more oil drop was coming out of the condenser).The oil obtained from whole cumin seeds through extraction process is called as extracted cumin oil. The oil was collected in glass bottle. Both extracted as well as market cumin oil were stored in refrigerator.

The main components of extracted cumin oil were cumin aldehyde (74.62%), γ-Terpinen-7-al (7.95%), p-cymene (6.67%), α-Terpinen-al (3.98%), 4-Hydroxy cryptone(1.68), β-pinene (1.58) and p-Menth-3-en-7-al (1.11%). Whereas the main components of market cumin oil were cuminaldehyde (64.31%), p-cymene (17.36%), α-Terpinen-7-al (4.59%), γ-Terpinene (3.51%), α-Neocallitropsene (2.19%), β-pinene (1.63%), Cumic acid (1.43%)and o-Cymen-7-ol (1.11%).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials

3.1.1 Sampling materials

The seeds of cumin seed were collected from the local market in Khartoum bahri.

3.1.2. Chemicals and reagents

All chemicals and reagents used in this study were collected from laboratory of food science and technology department of Sudan University of Science and Technology.

3.2 Methods

3.2.1. Sample preparation

Sample of black cumin seeds were cleaned by removing foreign particles, and then kept in polyethylene bags for further analysis away from light at room temperature.

3.2.2. Proximate analysis of cumin seeds

3.2.2.1. Determination of moisture content

Moisture was determined by the AOAC (2000). Two grams of sample were dried in an oven at 103±℃ for 24 hours; the test repeated three times , then the average was taken.

$$\text{Moisture content\%} = \frac{W1(gm)}{W\ (gm)} \times 100$$

Where:

W1= loss in gm of the material on drying

W=weight in gm of the material taken for test

3.2.2.2. Extraction of cumin oil

The cumin seed oil was extracted using Soxhelt extraction M.H.Eikani *et al*. (2007) .

3.2.2.3. Determination of oil content

Oil content was determined according to the (A.O.A.C, 2000). Two grams of sample were extracted with hexane for 6 hours in soxhlet apparataus;

$$\text{Oil content} = \frac{\text{weight of extracted oil}}{\text{Weight of sample (gm)}}$$

3.2.2.4. Determination of protein content

Nitrogen content determination were made in fat free meals by microKjeldahl technique following the method of the (A.O.A.C, 2000). About 0.2 gm of sample was weighed accurately into kjeldahl flask, 0.4 gm of catalyst mixture and 3.5 ml of concentrated sulphuric acid were added, the flask was placed in the digestion equipment for 2hrs.

The digested sample was then placed in the distillation apparatus, 20 ml of 40%NaoH were added and the ammonia evolved was received in 8ml of 2% boric acid solution.

The trapped ammonia was titrated against 0.02 N/HCL using universal indicator (Methyl red + bromocresol green);

$$\text{N} = \frac{\text{volume of HCL} \times 0.02\ \text{N / HCL} \times 14 \times 100}{\text{Weight of sample} \times 1000}$$

Protein content =% N×6.25

3.2.2.5. Determination of crude fiber

Crude fiber was determined according to the (A.O.A.C, 2000). 2gram of fat free meals was treated successively with a boiling solution of H2SO4 and KOH (0.26hN and 0.23N, respectively). The residue was separated by filtration, washed, dried, weighed and ashed at 500 ℃

The loss of weight resulting from ashing corresponded the crude fiber in the sample.

3.2.2.6. Determination of ash content

Ash content was determined to the (A.O.A.C, 2000).One gm of defatted sample was ignited at 550℃ in a muffle furnace for 3 hrs.

$$\text{Ash content} = \frac{W2-W1}{Ws} \times 100$$

Where

W1=weight of empty crucible

W2= weight of crucible with ash

Ws= weight of sample

3.2.3.Physical analysis of black cumin seeds oil

The physical of black cumin oil was conducted from the National Food Research Centre (NFRC).

3.2.3.1. The color

The color intensity of oils was recorded using a Lovibond Tint meter as units of red, yellow and blue in the manner described by Balla (2001).

Samples of oils were filtered though filter paper immediately before testing. An appropriate 5.25 inches was filled with oil and placed in the tint meter in specific place. The instrument was switched on and looked

through the eyepiece, and then slides were adjusted until a color match was obtained. The values obtained by matching were recorded as red, yellow and blue.

3.2.3.2 The density

The density of oil was determined using density bottle method. A clean and dry bottle of 25 ml capacity at 30℃) was weighted in gram (W0). Then the bottle was filled with water and reweighted at 30℃) (w1). Melted oil was brought to 300℃) and the water was substituted with oil after drying the density bottle and weighted again (w2) and the specific gravity was determined (A.O.A.C, 2000).

$$\text{The density} = (w1-w0)/(w2-w0) = \frac{\text{Mass of substance}}{\text{Mass of an equal volume of water}}$$

Where:

W1 = weight in gm of specific gravity bottle with oil at 30℃

W2= weight in gm of specific gravity bottle at 30℃

W0= weight in gm of specific gravity bottle with water at 30℃

3.2.3.3 Refractive index (RI)

The refractive index (RI) was determined by Abbe 60 refractometer as described by (A.O.A.C, 2000). A double prism was opened by means of screw head, few drops of oil were placed in prism. The prism was closed firmly by tightening the screw head and the instrument was then left to stand for few minutes before reading in order to equilibrate the sample temperature with that of the instrument (32±2℃). The prism were cleaned between readings by wiping of the oil with soft cloth, and then with cotton moister with petroleum ether and left to dry, test was repeated three times.

3.2.3.4 Viscosity (cp)

The viscosity of the oil samples was detected using an Oswald-U-tube, viscometer according to Cocks and Van Rede (1966) the viscometer was suspended in a constant temperature bath (32±2℃).

So that capillary was vertical .The instrument was filled to the top of the lower reservoir with the oil by means of pipette into arm , so that the tube above the mark was not wetted .the instrument was then left to stand for few minutes before reading in order to equilibrate the sample temperature with that of the instrument (32±2) By means of the pressure on the respective arm of the tube , the oil was moved into the other arm so that the meniscus was 1cm above the mark at the top of the upper reservoir .The liquid was then allowed to flow freely through the rube and the time required for the meniscus to pass from the mark above the upper reservoir to that at the bottom of the upper reservoir was recorded.

Calculation:

$$\text{Viscosity of the oil} = \frac{T - To}{T0}$$

T=flow –time of the oil

To= flow – time of the distilled water

3.2.4 Chemical analysis of oil

The chemical analysis of black cumin seeds oil was conducted from Khartoum University Collage of Agricultural Studies.

3.2.4.1 Peroxide value (pv)

The peroxide value of the oil samples was determined according to the(**A.O.A.C, 2000).** about 5 gm of the sample were weighed into a 250 ml stopper conical flask .30 ml of acetic acid chloroform solvent mixtures were added and swirled to dissolve .

.0.5 ml saturated potassium iodide solution was added with a Mohr pipette stood for 1 min in dark with occasional shaking ,and then about 30 ml of water was added .slowly the liberated iodine was titrated with 0.1 N sodium thiosuiphate solutions ,with vigorous shaking until yellow color was almost gone .

About 0.5 ml starch solution as indicator was added and was continued titration shaking vigorously to release all iodine gas from CHCL layer until blue color disappeared. If less than 0.5 ml of 0.1

Was repeated. Blank determination (must be less than 0.1 ml 0.1N) was conducted . peroxide value expressed as mille equivalent of peroxide oxygen per Kg sample (Meq per Kg oil)

Calculation:

$$\text{Peroxide value} = \frac{\text{titer} \times N \times 1000}{\text{Weight of the sample}}$$

Where:

Titer= ml of sodium Thiosulphate used (blank corrected)

N= normality of sodium thiosulphate solution.

3.2.4.2 Free fatty acids (FFA)

Free fatty acid was determined according to **(A.O.A.C, 2000)**.About 5 to 10 g of cooled oil sample was weighed in a 250 ml conical flask and about 50 to 100 ml of freshly neutralized hot ethyl alcohol was added, and about 1ml of phenolphthalein indicator solution ,the mixture was warmed about 5 minutes and was titrated while hot against standard alkali solution shaking vigorously during the titration .the weight of the oil was taken for the estimation and strength of the alkali used for titration shall be such that the volume of alkali required for the titration must not exceed 10 ml.

Calculation

$$\text{Acid value} = \frac{56.1 \times v \times N}{W}$$

Where:

V=volume in ml of standard sodium hydroxide or potassium hydroxide used.

N = normality of the sodium hydroxide solution 0r potassium hydroxide solution.

W = weight in g of the sample.

The acidity is frequently as free fatty acid for which calculation shall be.

$$\text{Free fatty acids as oleic acid percent by weight} = \frac{28.2 \times v \times n}{W}$$

Acid value percent fatty acid (as oleic) ×1.99

CHAPTER FOUR

RESULT AND DISCSSION

4.1 Proximate Composition

Table (1) show the proximate composition of black cumin seeds which includes: Moisture, oil, protein, crude fiber, carbohydrate and ash contents.

The moisture content of black seeds found to be 3.88%

This percentage was lower than the value obtained by **Gharby *et al.*, (2015); Ali *et al.*, (2012); Javed *et al.*, (2012); Sultan *et al.*, (2009) and Cheikh-Rouou *et al. (*2007)**. Their readings were 8.10, 4.20, 5.40, 6.46 and 11.60% respective.

Black cumin seeds had an oil content which was 27.095%. It was lower than all readings of previous work **(Javed *et al.*, 2012; Matthaus and Oscan, 2011;** which was 21.67, 30.40, 31.6, 49.00 and 30.00% respectively.

The protein content of black cumin seed was 18.55% , which was lower than the values reported by **Gharby *et al.*, (2015); Ali *et al.*, (2012); Javed *et al.*, (2012); Sultan *et al.*, (2009); Atta, (2003) and Takruri and Dame, (1998).** Their readings were 26.50, 19.80, 24.05, 22.80, 20.00 and 20 .00% respectively.

The crude fiber of black cumin seeds was 29.74% this value was higher than the values reported by **Gharby *et al.*, (2015); Ali *et al.*, (2012); Javed *et al.*, (2012); Sulltan *et al.*, (2009); Cheikh –Rouhouh *et al.*, (2007) and Ataa, (2003),** which was 6.80, 5.10, 5.50, 6.03, 5.10 and 5.10%, respectively .

The ash content of black cumin seeds was 3.615 % this value was lower than the value reported by **Gharby *et al.*, (2015) which was 9.6%,** but it was higher than the value obtained by **Ali *et al.*, (2012); Javed *et al.*, (2012); Podmas, (2010) and sultan *et al.*, (2009).** Their readings were 4.00, 4.34, 6.00 and 4.20% respectively.

Table 1. Proximate chemical composition of black cumin seed

Parameters	Values	SE
	n=2 ± SD	
Moisture content	03.13 ± 0.000	0.000
Fat content	27.10 ± 0.926	0.655
Protein content	18.64 ± 0.127	0.090
Crude fiber	29.74 ± 0.099	0.070
Carbohydrates	17.02 ± 0.021	0.015
Ash Content	03.50 ± 0.707	0.500

n= number of

SD= standard of deviation

SE= standard of error

4.2 Physical properties of black cumin seeds oil

Table (2) shows that the physical properties of black cumin seeds oil , which covers: Refractive index which was 1.4675 ; it was higher than those brought **by Gharby *et al*., (2015); Ali *et al.*, (2012) ; Salma *et al*., (2007) and Cheickh-Rouhou *et al.*, (2007).** their readings were found to be 1.4680, 1.4683, 1.4680, and 1.4600 – 1.4700, respectively . It was lower than the value obtained by **Sultan *et al.***, (2009) which was 1.4730.

The density of BCSO was 0.9065 at 24℃ this value was lower than those value reported by **Zzaman *et al*., (2014) and Sultan *et al*., (2009)**, which were 0.930 and 0.923 respectively. It was higher than that reported by **Ali *et al*., (2012)** which was 0.907 at 25℃.

The viscosity of BCSO was 16.48 centipoises. it was observed that the BCSO viscosity value was higher than the value reported by **Hamadi *et al*., (2007)** which was 11.23 cp .but it was lower than the value reported by **Zzaman *et al*., (2014)** which was 64.53cp.

The color of BCSO was yellow =44; Red=10.5; Blue=0.015 at24℃. this value of yellow higher than yellow =33.98 and red =0.86 while lower than blue =0.48 which were reported by **Sultan *et al*., (2009)** and 28.59 yellow, 4.5 red and lower than 9.41 blue were reported by **Zzaman *et al*, (2014).**

Table 2. Physiochemical and chemical properties of black cumin seeds oil

Parameters	Values	SE
	n=2 ± SD	
Red colour	10.55±0.071	0.050
Yellow colour	44.5±0.707	0.500
Blue colour	0.015±0.071	0.030 0.100
Refractive index	1.4675±0.000	0.030 0.050
Density	0.9065±0.001	0.001
Viscosity	16.48±0.099	0.000 0.030
Peroxide value	4.7±0.141	0.500
Free fatty acid	2.009±0.23	0.050

n= number of

SD= standard of deviation

SE= standard of error

4.3 Chemical properties of black cumin seeds oil

Table (2) shows the chemical properties of BCSO which cover :peroxide value which was found to be 4.8 (meq O2/kg of oil) this value was lower than that obtained by **Ali *et al* .,(2012); Bourgou *et al*., (2010); Sultan *et al*., (2009); Cheickh-Rouhou *et al*.(2007)**

Their records were 12.70 , 10.00 , 5.703 ,5.65 (meq O2/kg of oil), respectively ,but it was higher than that obtained by **Gharby *et al* .,(2015)** which was 3.4(meq O2/kg of oil).free fatty acid as oleic acids was found to be 23.000029 % which was higher than the values reported by **Gharby *et al*.,(2015); Ali *et al.*, (2012); Sultan *et al*.(2009).**

Their finins were 0.9, 1.2 and 0.67 %respectively. But it was higher than that found by **Zzaman *et al*., (2014)** which was 0.2 %

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5-1 Conclution

1. Oil content of black cumin seeds was found to be lower 27.
2. Its physicochemical properties were found to be of good quality.
3. The study concluded that the cumin seeds oil is acceptable oil according to its physical and chemical properties.

5.2 Recommendation

1. More studies are needed to determine the quantity of BCSO required, which should be less than 5% according to the results obtained.
2. More studies should be paid in cumin seeds crude oil to recognize the shelf life
3. Recommend more attention and care should be taken for growth and maintenance of cumin tree.

Reference:

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