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Physicochemical properties of black cumin seed oil

الخصائص الفيزيوكيميائية لزيت الحبة السوداء (الكمون)

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الحديث

عن رسول الله صلى الله عليه وسلم قال:

(عليكم بهذه الحبة السوداء فإن فيها شفاء من كل داء إلا السأم)

صدق رسول الله صلى الله عليه وسلم

Dedication

TO our fathers

To our mothers

To our teachers

To our friends

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Abstract

The main goal of this research was to study the physical and chemical properties of black cumin seed oil .one kg of black cumin seeds were milled, were collect the powder was kept for further analysis .The oil extracted by petroleum ether and the result revealed that the physical properties of black cumin seed oil contain viscosity 40.12cp , density 0.906 , refractive index 1.463 ,colour 1.0333 , 10.343(R.Y.B)while the chemical properties peroxide value 1.7033 (mgo₂/g) ,saponification value 186.55(mg/g) ,iodine value 97.733(mgI₂/g),acid value 0.396 (mgKOH/g), saponification 1.51(mg/g)from the previous physicochemical tests of black cumin seed oil could be used for edible purpose because it proved to be of high nutritional value.

ملخص البحث

الهدف الأساسي لهذا البحث هو دراسة الخواص الفيزيائية والكيميائية لزيت الحبه السوداء (الكمون).

تم أخذ واحد كجم من بذور الحبه السوداء وتم طحنها لتصبح جاهزه لعمليات التحليل المختلفه . تم إستلاص الزيت بواسطة البتروليم إيثر وأظهرت نتائج الخواص الفيزيائية لزيت أنه يحتوي على لزوجة بنسبة 40.12 وكتافه 0.906 ومعامل إنكسار 1.463 ولون 1.033 و 10.343 وأظهرت نتائج الخواص الكيميائية للزيت انه يحتوي على رقم بيروكسيد 1.7033 ملجم الأوكسجين لكل جرام زيت ورقم تصبين 186.55 ملجم هيدروكسيد بوتاسيوم لكل جرام ورقم يود 97.733 ملجم يود لكل جرام ورقم حموضه 0.396 ملجم هيدروكسيد بوتاسيوم لكل جرام والمواد غير المتصبنة 1.51 ملجم لكل جرام .

ونستنتج من هذه النتائج السابقه أن زيت الحبه السوداء يمكن إستخدامه في عديد من الأغراض المختلفه .

CHAPTER ONE

INTRODUCTION

Cumin is a herbaceous and medicinal crop and one of the oldest and popular seed spice worldwide after black pepper (Agarwal1996).

Cumin is the dried white fruit with greyish brown color of a small slender annual herb.

Types of cumin:

There are two main types of cumin:

- White cumin seeds which are the most common type.
- Black cumin seeds that are popular in Iran. The seeds of black cumin are smaller and

have a sweeter aroma than the white seeds. They are sometimes confused with nigella,

another seed that is used in Indian cookery.

They both come from the Umbelliferae

family of plants.(Agarwal1996).

and other vitamins and minerals. Some research shows that it may stimulate the production of pancreatic enzymes and help digestion. One study found that cumin was protective against memory loss and the damaging effects of stress on the body. (Divakara*et.al* 2013)

Cumin production

Cumin is an annual herb that grows best in sunny climates with some rainfall (over 2000mm a

year). It can grow at elevations up to 1000m above sea level. The plants grow to about 25cm in

height. They should be planted at intervals of about 0.75m. The small white or pink flowers

grow in clusters on short stems, looking like small umbrellas.(Divakara*et.al* , 2013)

Harvesting

The seeds are harvested about 4 months after planting when the plant begins to wither and the

seeds change from dark green to a brown-yellow colour. The seed is small and boat shaped with

nine ridges along the length. The seeds are harvested by removing the whole plant from the cumin(Divakara*et.al* , 2013)

Storage

Dried cumin seeds must be stored in moisture-proof containers away from direct sunlight. The stored seeds should be inspected regularly for signs of spoilage or moisture. If they have absorbed moisture, they should be re-dried to a moisture content of 10%.

The storage room should be clean, dry, cool and free from pests. Mosquito netting should be fitted on the windows to prevent pests and insects from entering the room. Strong smelling foods, detergents and

paints should not be stored in the same room as they will spoil the delicate aroma and flavour of the cumin (Divakara *et al.* 2013).

Objectives:

- To study physical properties of black cumin seeds oil .
- To study chemical properties of black cumin seeds oil.

CHAPTER TWO

LEITTERATEUR REVIEW

2-1 Plant description

Cumin (*Cuminum cyminum*L.) is a thin herbaceous annual plant growing to a height of 30-45 cm. The plant is slender, with a main stem that branches up to five secondary branches from the base; each branch may have 2-3 sub-branches. All the branches attain the same height, giving the plant a uniform canopy. The plant has a branched glabrous the inflorescence is a compound umbel with white or pinkish flowers. The leaves are pinnate or bi-pinnate with thread-like leaflets (Figure 1). The flowers are small and either pink or white colored (Divakara*et.al* 2013

2-2 Taxonomy

S.N: Nigella sativa

E.N: cumin

A.N: kammun

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Apiales

Family: Apiaceae (Umbelliferae)

Genus: *Cuminum*

Species: *C. cyminum* (Linn)

2-3 Historical background

Cumin seeds excavated at the Syrian site Tell ed-Der, have been dated to the second millennium BC. Originally, Cumin was cultivated in Iran and Mediterranean region, today it is mostly grown in Iran, Uzbekistan, Tazikistan, Turkey, Morocco, Egypt, India, Syria, Mexico, Bulgaria, Cyprus and Chile.

Cumin is the seed of a small plant in the parsley family. Its use goes back 5000 years to the Egyptians, who used it not only as a spice but as an ingredient in the mummification process. The Greeks and Romans also used cumin and highly regarded it as one of the essential spices. In the Middle Ages cumin seed was thought to promote love and fidelity, so it was carried by attendees of weddings, and soldiers were always sent off to battle with a fresh loaf of cumin seed bread. Pungent, sharp, and slightly sweet, the greenish brown powder of this herb is an essential ingredient in Mexican and Indian cuisine.

Traditionally, it has also been used in natural remedies and herbal medicine. Traditional texts describe its use as a diuretic and to settle the stomach and stop flatulence. Some cultures have used it for female health and to stimulate menstruation. Like many herbs, it can be made into a poultice, especially for swelling or sore throat. I even found a reference to a remedy of mixing cumin and ghee to relieve hiccups. Cumin's long history even shows in its mentions in the Bible and other historic texts.(Divakara*et.al* , 2013)

2-4 Distribution In the Sudan

Cumin spread up the Nile valley where it continues to be sown by stallholders in the winter season to provide flavoring and other parts of the country. The production is between 0.9 – 1.4 tons in 2013 – 2014(Ministry of agricultural statistic, 2014).

2-5 Nutritional value of cumin seed

Nutritional value-per 100g

Energy	1.567kj	Niacin	4.597mg
Carbohydrates	44.24g	Vitamin C	7.7mg
Sugar	2.25g	Vitamin E	3.33mg
Dietary fiber	10.5g	Vitamin K	5.4µg
Fat	22.27g	Iron	66.36mg
Saturated	1.5g	Magnesium	366mg
Protein	17.81g	phosphorus	499mg
Water	8.06g	potassium	1.788mg
Vitamin a	64µg	sodium	168mg
Riboflavin	0.327mg	Zink	4.8mg

Source: USDA Nutrient database

- Units
- µg = micrograms • mg = milligrams
- IU = International units

2-6 Uses of cumin seed

2-6-1 As food

Cumin seeds are used as spice for their distinct aroma. The seed is a major ingredient of curry and chili powders, special bakery products, processed meats sausages, prepared condiments, pickles, soups and sauerkraut, and is an ingredients in certain teas (Weiss, 1996).

Cumin can be found in some cheese and cumin can be used ground or as hole seeds.

2-6-2 As medicine

seeds are mixed with other ingredients to treat diarrhea and colic, and ground seed or extracts are considered to be a stimulant, antispasmodic, carminative, diuretic and emmenagogue and incorrectly an aphrodisiac (Khan *et.al* 2011).

The health benefits of cumin include its ability to aid in digestion, improve immunity and treat piles, insomnia, respiratory disorders, asthma, bronchitis, common cold, lactation, anemia, skin disorders, boils and cancer. Many of you might remember having hated those curries and soups which had roasted or fried cumin seeds in them when you were kids, because they looked like small black insects. However, you probably liked the taste. So your mother might have removed these flavorful parts before she served you the food.(Khan *et.al* 2011)

2-6-2-1 Health Benefits Of cumin

The health benefits of cumin include the following:

Digestion: Cumin is extremely good for digestion and related problems. The very aroma of cumin, which comes from an aromatic organic compound called Cuminaldehyde, the main component of its essential oil, activates our salivary glands in our mouth, which facilitates the primary digestion of food.. (Khan *et.al* 2011).

Diabetes: Although research is still ongoing, early studies report that cumin, among a number of other spices, can have a powerful effect in preventing diabetes by reducing the chances of hypoglycemia.. (Khan *et.al*2011).

Cancer: Cumin itself has detoxifying and chemopreventive properties, and accelerates the secretion of detoxifying and anticarcinogenic enzymes from the glands, as it also does to other secretions. (Khan *et.al*2011).

2.7 Composition of cumin seed

2.7.1 Proximate analysis of cumin seed

of black cumin seeds showed a composition of 20.85% protein, 38.20% fat, 4.64% moisture, 4.37% ash, 7.94% crude fibre and 31.94% total carbohydrates. Potassium, phosphorus, sodium and iron were the predominant elements present. Zinc, calcium, magnesium, manganese and copper were found at lower levels. However, lead, cadmium and arsenic were not detected in the seeds. Linoleic and oleic acids were the major unsaturated fatty acids while palmitic acid was the main saturated one. Glutamic acid, arginine and aspartic acid were the main amino acids present while cystine and methionine were the minor amino acids. These results indicate the high nutritional potential of Saudi black cumin seeds especially as a source of protein and fat. The total aerobic bacterial count was 7×10^7 cfu/g and the yeast and mould counts were 4×10^2 cfu/g. The low numbers observed for *Staphylococcus aureus* and *Bacillus cereus* make black cumin seeds acceptable, without any associated health hazard

2-7-2 Chemical properties Of black cumin seed oil

Chemical characteristics of any oil are important for determining its nutritional quality **and commercial** value (omujal,2008)

2-7-2-1 Peroxide value

Is a measure of the concentration of peroxide and hydro peroxide formed in the initial stage of lipid oxidation . in general ,the lower the peroxide value, the better the quality of the oil, the more stable the oil (Ramadan 2004). Zeliha (2016)and Mervat *et.al*(2014) found peroxide value of black cumin seed oil were 4.00, 4.35(mgE/kg)respectively.

2-7-2-2 Iodine value

The iodine value is number of milligrams of iodine absorbed by one – gram of fat. its a measure of the degree of un saturation in oil and could be used to quantify the amount of double bond present in the oil which reflects the susceptibility of oil to oxidation.(Nergiz *et.al* 1993).Zeliha(2016) and Mervat *et.al*(2014) reported that iodine value of black cumin seed were 98 , 112.20(mgI₂/g) respectively.

2-7-2-3 Saponification value

The saponification value (SV) is defined as the number of milligrams of potassium hydroxide (KOH)required saponifying one gram of oil or fat(Ramadan 2004).Zeliha(2016) and Mervat *et.al*(2014)found saponification value of black cumin seeds oil were 190 ,172.56(mgKOH/g)respectively

2-7-2-4 Acid value

The acid value (AV).of an oil and fat is defined as number of milligrams of potassium hydroxide required to neutralize the free fatty acid in one gram in the sample .(Nergiz *et.al* 1993). Mervat *et.al*(2014) was found that the acid value was 2.80(mgKOH/g)

2-7-2-5 fatty acid composition

Define as method determines the fatty acids existing in the sample.

is rich in fatty acids, particularly the unsaturated and essential fatty acid (linoleic and linolenic acids) the EFAs, consisting of alpha -linoleic acid(omega-3)and linolenic acid (omega-6)are substances that can not be manufactured in the body and thus must be taken in as supplements or through high -EFA foods in order to sustain health

2-7-3 Physical properties of cumin seed oil

2-7-3-1 Viscosity

Define as the measure of resistance to flow .

Viscosity is the measure of the internal friction in the oil and is the important index of the study of oil and their inter molecular forces and its useful criterion for degradation or depolymerization such as that occur in initial stage of hydrolysis of fat and oil during storage (Goslyn,1971).Ahmed *et.al*(2011) ,Mervat*et.al* (2014) reported viscosity of black cumin seed oil were 41.16 , 40.18cp at 40 centigrade respectively.

2-7-3-2 Refractive index

Defined (RI) as the ratio of the velocity of light in vacuum to the velocity of light in the medium being measured (Omujal ,2008). the RI of oil and fat were closely related to oxidation products and development of rancidity its useful for identification purpose and for establish purity and also for observing the progress of reaction such as catalytic, hydrogenation and isomerization (Nergiz*et.al* 1993).Ahmed *et.al*(2011) Zeliha (2016) and Mervat *et.al* (2014) found refractive index of black cumin seed oil were 1.473 at 40⁰c.

2-7-3-3 Colour

colour in black cumin seed Oil to presence of carotene .According to FAW(1994)and WHO(2004). generally colour as the contain in true or colloidal solution varying quantities of different lipodouble pigments originated from oleiferous tissues ,or artificats caused by degradetion most usually thermal, during prossing treatment . standard show that the colour of oil will be yellow. colour is important quality factor and in order to maintain a bright colour in the final product(Gunstoue 2000).Mervat*et.al* (2014) and Ahmed*et.al*(2011) were found oil coulor was light yellow and red (10.34.R.Y.B)

2-7-3-4 Density

Is the mass per unit volume. Ahmed *et.al* (2011) and Zaliha (2016) was reported density of cumin oil were 0.90 and 1.030 respectively.

CHAPTER THREE

MATERIAALS ANND METHODS

3.1 Materials

3.1.1 Source of seed

Black cumin seed ,fresh fruit were obtained from local market in Khartoum, Sudan .

3. 1.2 Chemicals and reagents

Chemical and reagents used in this study were of analytical grade

3.2 Methods

Extraction of oil:

The seed were dried and the impurities were removed by handpicking. The seed were crushed by using laboratory mixer grinder. The oil was extracted by using soxhlet apparatus with solvent petroleum ether for 5 hours.

3.2.1 Physical characteristics of seed oil

3.2.1.1 Refractive index

The refractive index (RI) was determined by **AOAC (2008)** method .A double prism was opened by means of screw head. Few drops of oil were placed on the prism. The prism was closed firmly by tightening the screw

head and the instrument was then left to stand for few minutes before reading to equilibrate the sample temperature with that of the instrument (32 +2°C). The prisms were cleaned between reading by wiping of the oil with soft cloth, then with petroleum ether and then with left to dry.

3.2.1.2 Colour of oil

The color intensity of oils was measured using a Lovibond tintometer, units of red, yellow and blue were recorded to the **AOAS (2008)** methods. sample of oils were filtered through a filter paper immediately before testing . Appropriate cell (inches 2 cell) was filled with the oil and placed in the tintometer placed near by the window for light . The instrument was switched on and looked upon through the eyepiece . Slides were adjusted until a match color was obtained from a combination of red and blue. The values obtained by matching were recorded as red yellow and blue.

3.2.1.3 Density of oil

The oil density was determined according to **AOAC (2008)** methods, using psycho-meter. An empty stoppered psycho-meter was weighed ,filled with water and kept at constant temperature of 25°C in a water bath for 30 min .the weight of water at 25°C was determined by subtracting weight of empty psycho-meter from its weight when filled with water. The end of time coppered psycho-meter was adjust to proper level , dried with a cloth and weighted. In the same manner, the weight of the oil at 25°C was determined.

The density was calculated as follows:

The density at 25°C=W1/W2

Where:

W1 = Weight of oil at 25°C

W2 = Weight of water at 25°C

3.2.1.4 Viscosity of oil

The viscosity of oil sample under investigation was determined by **AOAC (2008)**.

The viscometer was suspended in the constant temperature water bath so that the capillary was vertical.

The instrumental was exactly filled to the mark at the top of the lower reservoir with the oil by means of pipette inserted in the side arm, so that the tube wall above the mark is 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(35°C).

By means of pressure on the respective aim of the tube, the oil moved into the other the arm so that the meniscus is (1 cm) above the mark at the top of upper reservoir. The liquid was then allowed to flow freely through the tube and the time required for the meniscus to pass from the mark above the upper reservoir to that at the bottom of the upper reserve was recorded.

W1 = weight of water at 40°C.

3-2-2 Chemical characteristics of seed oil

3-2-2-1 Acid value of oil

The acid value was determined According to the **AOAC (2008)** method.

The oil or melted fat was mixed thoroughly before weighing. About 5 to 10 gm of cooled oil sample was weighted accurately in a 250 ml conical flask and 50 to 100 ml of freshly neutralized hot ethyl alcohol and one ml of phenolphthalein indicator solution were added. The mixture was boiled for about five minutes and titrated while hot against standard alkali solution, shaken vigorously during the titration. The weight of the oil/fat taken for the estimation and the strength of the alkali used for titration shall be such that the volume of alkali required for the titration does not exceed 10 ml.

Calculation:

$$\text{Acid value} = (56.1 \times V \times N) / W$$

Where:

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

N = Normality of the potassium hydroxide solution or sodium hydroxide solution.

W = weight in of the sample.

3-2-2-2 Peroxide value of oil

The peroxide value (PV) of oil was determined according to **Wali et al. (1995)**.

About one gm of the sample was weighed in to 250 ml conical flask, 30 ml of glacial acetic acid/chloroform solution (3:2) were added, and the flask was swirled until the sample was dissolved. A 0.5 ml of potassium iodine was added. The solution was again swirled for one minute, 30 ml of distilled water were added and 0.5 ml of 1% starch solution were also

added gradually of the flask were the titrated with 0.1 N sodium thiosulphate added gradually with constant and vigorous shaking and the titration was continued until the blue colour just disappeared. A blank test was carried out. The number of 0.1 N sodium thiosulphate required was recorded.

Calculation:

$$PV = \{(V_a - V_b)N \times 1000\} / W$$

Where:

V_a = Volume of sodium thiosulphite solution used in titration.

V_b = Volume of sodium thiosulphite solution used in blank test.

W = Weight of sample in grams

N = Normality of sodium thiosulphite solution

3-2-2-3 Saponification number of oil

The determined of saponification number was carried out according to the **AOAC (2008)** method.

One gram of oil sample was weighed accurately in to 200 ml conical flask. 25 ml of 0.1N alcoholic KOH solution was added, and the contents of the flask were boiled under reflux for one hour with frequent rotation. One ml of phenolphthalein indicator was added, while the solution was still hot, and the excess alkali was titrated with 0.5 HCL. Te numbers of ml of HCL required (a) were noted. The same process was repeated without oil and the numbers of ml of HCL (b) were also recorded.

Calculation:

$$\text{Saponification Number} = \{(b-a) \times 0.02805 \times 1000\} / S$$

Where:

a= ml of HCL from sample

b = ml of HCL from blank

S = weight of oil in gram

3-2-2-4 Iodine value of oil

The iodine value (IV) was determined according to **Wail *et al.*(1995)**.

Approximately, 0.2 gram of oil was accurately weighed and placed in a dry and clean flask specially offered for the test. A 10 ml of chloroform was used for dissolving the oil. A 25 ml of pyridine sulphate dibromide solution was added and finally 20 ml of KI (0.1 N) were added to the contents of the flask was then and the mixture was allowed to stand for 10 minutes in a dark place. The stopper and the side of the flask were rinsed with enough amount of distilled water, the contents of the flask was then stoppered and the mixture was allowed to stand for 10 minutes in a dark place. The stopper and the side of the flask were then shaken and titrated against 0.1N sodium thiosulphate solution using starch liquid as indicator. A blank determination was carried out simultaneously.

Calculation:

$$\text{Iodine value (IV)} = \{ (B-a) \times 0.0126 \times 100 \} / S$$

Where:

b; Volume (ml) of sodium thiosulphate in blank solution

a; Volume (ml) of sodium thiosulphate in test active solution

S; Weight (gm) of the oil sample

3-3 Statistical analysis

The results were subjected to Statistical Analysis System (SAS) by one factor Analysis of variance (ANOVA) .

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4-1 Physical Properties of black cumin seed oil:

Table (4-1) shows that the physical properties of black cumin seed oil. The viscosity , density , refractive index , and colour were found to be 40.12 ,0.906 , 1.463 , and (1.0333 ,10.343 R. B.Y).respectively .

Viscosity was recorded to be 40.12cp which was similar to 40.18 reported by **Mervat *et .al* (2014)** but was lower than the 41.16 which was reported by **Ahmad *et .al* (2011)**.Density was found to be 0.906 which its similar to 0.90 reported by **Ahmed *et.al*(2011)**but it was lower than the 1.030 reported by **Zeliha (2016)**.Refractive index was found to be 1.463 which was similar to 1.473 reported by **Ahmad *et .al* (2011)** , **Zeliha (2016)** and **Mervat *et .al*(2014)**. Colour (Y, R) which was similar to **Ahmad (2011)** and **Mervat*et.al* (2014)** .

4-2 Chemical properties of black cumin seed oil:

Table (4-2) shows that the chemical properties of black cumin seed oil .the peroxide value, saponification, iodine value , acid value and un saponification matter. were 1.703, 186.55 , 97.73 , 0.396 , 1.57 respectively .

Peroxide value was found to be 1.703(mEq/Kg) which was lower than 4.00, 4.35(mEq/kg) reported by **Zeliha (2016)** and **Mervat *et.al* (2014)** respectively. Saponification was noticed to be 186.55 (mg KOH/kg) which was lower than the 190(mgKOH/g) reported by **Zeliha (2016)** but it was higher than the 172.56(mgKOH/g) reported by **Mervat *et .al* (2014)**. Iodine value was obtained to be 97.73(mgI₂/g) which was lower than the 98 , 112.20 (mg I₂/g) reported by **Zeliha (2016)** and **Mervat *et. al*(2014)** respectively. Acid value was found to be 0.396(mg KOH/g) which was lower than 2,80(mgKOH/g)reported by **Mervat *et .al* (2014)**. un saponification matter was reported to be 1.51 (g/Kg) which was similar to 1.4 (g/kg) reported by **Zeliha (2016)**.

Table 4.1: Physical properties of black cumin seed oil:

	Mean	Std. Deviation
Viscosity{40°C} (cp)	40.12	0.6729
Density	0.906	0.0058
Refractive index{ 40°C}	1.463	0.00041
Colour(degree of colour mixture)* R	1.0333	0.23094
B	0	0
Y	10.343	0.0577

Table 4.2: Chemical properties of black cumin seed oil:

	Mean	Std. Deviation
Peroxide value (mEq/Kg)	1.7033	0.2977
Saponification (mgKOH/g)	186.55	1.0443
Iodinevalue(mg I ₂ /g)	97.733	0.5907
Acid value(mgKOH/g)	0.396	0.0115
Un saponification matter(mg/g)	1.51	0.1473

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

- 1- The results indicate that black cumin oil yield is high (34.2%) with good physicochemical properties , and this means the plant of black cumin is a good source of edible oil .
- 2- The physicochemical characteristics of black cumin seed oil make it a potential raw material for cosmetic , soap and food processing.

5-2 Recommendation

Further studies were needed to cover more information about the importance of this oil e.g ; fatty acid composition, antioxidants ,vitamins and minerals etc...

REFERENCES

- Agrawal,Z.(1996) Uses of *Cuminum cyminum* and *Carum carvi*. Faculty of Agricultural Science and foods .King Faisal University, Saudi Arabia Research Journal of U A E.
- Ahmad, R. G. Soodabeh , S.(2011) Areview on phytochemistry of *cuminum cyminum* seed and its standards from field to market. Faculty of Pharmacy .Tahran University of Medical Sciences.
- Ajayi , I. A. Oderinde , R. A. , Kajogbola , D. D. and UPoni , J .I. (2006) oil content and fatty acid composition of some underutilized legumes from Nigeria Food Chemistry .
- Amany . M. M .Basuny, shaker .and M. Arafat , Azza (2012), Vacuum frying : An alternative to obtain high quality potato chips and fried oil " Food science and Nutrition Department, Faculty of Agricultural Science and foods , King Faisal University, Saudi Arabia , Global Advanced Research Journal of Microbiology .
- AOAC. (2008). Official Methods of Analysis, Association of Official Analytical chemists, Washington D.C .
- Divakara,S.A nandaraj(2013) Medical plant and spices of india ministry of agriculture. India .

Eugene, B. Schultz, T. R, and Repert , P. Morgan AAS Selected Sumposium and Chemists from oil seed (1991) . , Faculty of Agricultural Science and foods , Almalek University, Muroko Global Advanced Research Journal of Chemists .

FAW/WHO, (1994). Fats and oil in human nutrition: FAW Food and WHO Vitamin and minerals requirements in human nutrition.

Gunstone , F.D.(2000) Composition and properties of edible oil . England Sheffieled Academic Press.

Joslyn , M . A . (1971) . Method and analysis, Viscosity , Consistence . Texture , Conductivity , Academic press , New York and London.

Khan, M.A. Chen , H.C. (2011) Anticancer activites of *Nigella sativa* (black cumin) . Journal American Chemists oil.

Matthaus , B. Ozcan , M.M.(2011) Fatty acid , Tocopherol and sterol contents of some *Nigella* species . Journal American Chemists oil.

Mohammed, A.H and Hassan M.A (2013). Physiochemical changes of fried edible oil in to restaurants in college of Agricultural Stuides. African .

Nergiz ,C.Otles , S. (1993) Chemical composition of *Nigella sativa* oil . Journal American Chemists oil.

Omujal, F. (2008).Post harvest handling practices and physico-chemical characteristics of shea butter in Uganda M.sc. Thesis, Department of chemistry, Makeree University, Kampala, Uganda .

- Ramadan , M.F. (2004) Physicochemical properties and Stability of black cumin seed as effected by different extraction methods. Academic Press.London and New York.
- USDA.(2010) .National Genetic Resources Program Germplasm Resources Information Network (GRIN), Beltsville, U S A.
- Wail, S; Sue, T.T. and Yew Ai, T. (1995). Palm oil Research Institute of Malaysia.Ministry of primary Industries. Malaysia. Published by Palm Oil Research Institute of Malaysia.
- Zeliha, U. A .(2016) Determination of Physicochemical properties of *Nigella sativa* seed oil from Balikesir Region, turke Research Journal of Chemical and Process and Engineering.

APPENDICES





