CHAPTER ONE

INTRODUCTION

Fats and oils are produced throughout the world from both animals and plants.Vegetable oils are essential in meeting global nutritional demands and are utilized for many food and other industrial purposes (Idouraine *et al*., 1996).Despite the broad range of sources for vegetable oils, the world consumption is dominated by soybean, palm, rapeseed, and sunflower oils with 31.6, 30.5, 15.5, and 8.6 million tons consumed per year, respectively (Stevenson *et al*., 2007). These conventional sources of vegetable oil no longer meet the ever increasing demands of domestic and industrial sectors (Idouraine *et al*., 1996).

Odoemelam (2005) reported that, seeds with nutritive and calorific values are also good sources of edible oils and fats.The pumpkin seeds possess valuable dietary and medicinal qualities besides the source good- quality edible oils (Gohari *et al*., 2011).The oil of pumpkin seeds are being used as cooking oil in some countries in Africa and Middle East, and as a salad in South Australia and adjacent regions in Solvenia (Wenzl et al, 2002).

Pumpkin seed oil produced from roasted pumpkin seeds is thick, green-red color (Kerft and Kerft 2007).Pumpkin seed oil contains, vitamins, minerals and dietary fiber and fatty acids, such as oleic acid and alpha- linoleic acid (Baves *et al*., 2007).Pumpkin seed oil has many health benefits derived from its consumption. It contains essential fatty acids that help maintain healthy blood vessels, nerves and tissues (Levin, 2008).

In Sudan, the major sources of edible oils are groundnut oil (*Arachis hypogoea* L.); cotton seeds oil (*Gossypium barbadense* L); sesame seeds oil (*Sesamum indicum* L.). These oils are used mainly as cooking oils, beside the soap production. With increasing demand, which has led to importation of cooking oils, so, there is a need to source for local oil bearing seeds which can be used in oils production, both for consumption and industrial applications (Imad, 2003).

Main objective:-

The main goal of this study is to extract oil from pumpkin seedsusing an organic solvent.

Specific objective:-

1- To determine the chemical composition of pumpkin seeds.

2- To extract oil from pumpkin seeds using petroleum ether.

3-To determine physiochemical characteristics of the pumpkin seeds oil.

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CHAPTER TWO

LITERTURE REVIEW

2.1Back ground of pumpkin:

Pumpkin *Cucurbita pepo*is grown all over the world for a variety of reasons ranging from agriculture purposes to commercial sales (Wolford, and Drusilla 2008) of the seven continents, only Antarctica is unable to produce pumpkin. The biggest international producers of pumpkins include the United State, Canada, Mexico, India and China (WHO, 2008).

Pumpkin in Sudan is grown in Kordofan (Western Sudan) where it contributes up to 39.1% of the total vegetables produced.Also pumpkin brings a good market price and could be shipped for long distances with little damage and most of pumpkin fruit are consumed locally with meat and tomato (Obeid Alla and Riley 1984). In Sudan pulp from pumpkin fruit is used in the production of jam, the pectin substances from the fruit pulp found that it a good source of pectin for jam making industries (El-Shafie, 1981).

2.2Uses of pumpkin seeds:

Pumpkin seeds are small, flat, green, edible seeds. Most pumpkin seeds are covered by white husk, although some pumpkin varieties produce seeds without them. Like other members of cucurbitaceae, pumpkin bears numerous seeds where fifty to seventy percent of full mature consists of rind and seeds (Butt, 1995).

Raw or roasted pumpkin seeds are used as a snack food for human consumption in many cultures all over the world. The kernels of pumpkin seeds have been utilized as flavor enhancers in gravies and soups, and used in cooking, baking and ground meat formulations as a nutrient supplement and a functional agent (Tsaknis *et al*., 1997; El-Adawy and Taha, 2001)

2.3 Nutritional value of pumpkin seeds:

The seed is found to contain majority of the nutrients. They are power food rich in many nutrients including vitamin E, Zinc, vitamin A and precious omega (omega 3 and omega 6) also known as the essential fatty acids (Michael *et al*., 2000).They are also natural source of proteins, triterpenes, lignans, phytosterols , antioxidative phenolic compounds, carotenoids, tocopherol, and minerals (Fu *et al*., 2006).

Pumpkin seed extract has been reported to have antidiabetic, antitumor, antibacterial, anticancer, antimutagenic, and antioxidant activities. It has also been found to have strong hypotriglyceridemic and serum cholesterol-lowering effects. The health benefits of pumpkin seeds are attributed to their macro- and micro- constituent compositions(Fu *et al*., 2006).

2.4Proximate analysis of the pumpkin seed:-

2. 4.1 Oil content of pumpkin seeds:

The oil content of pumpkin seed is 50% reported by (Belyaev, 1992). And olso found in the range of 35-38% (Eckeyand Lawrence, 1954).

2.4.2 Moisture content of pumpkin seeds:

Pumpkin seed contains 8.1% water reported by (Gohari *et al*., 2011). The moisture content of pumpkin seed is 8.01% according to the work of (Kim and Sok, 1978).

2.4.3 Protein content of pumpkin seeds:

The protein content of pumpkin seed is found 35% reported by(Kamel, 1982). Seeds of pumpkin contain about 34% crude proteins reported by (Gohari *et al*., 2011).

2.4.4Crude fiber:

The fiber of pumpkin seed is 2.42% (Gohari *et al*, 2011). Also the crude fiber of pumpkin seed is 3.7d% reported by Kamel (1982.)

2.4.5Ash content of pumpkin seed:

Pumpkin seed contain 4.13% ash on dry basis reported by (Kamel 1982), the ash content of pumpkin is 5.34% reported by (Gohari *et al*., 2011).

2.5 Physical characteristics of pumpkin oil:

2.5.1Density:

The density of pumpkin seeds oil measured at 30 ºC was given 0,78 given by (Gohari *et al.*,2011). The Indian and American varieties to have specific gravities of 0.915 at 25/25 ºC and 0.919 at20/20 ºC, respectively (Butt, 1995).

2.5.2 Viscosity:

Viscosity is an important parameter for the design of industrial processes. It can also be used to evaluate the quality of fats and oils used in frying (Nichols and Sanderson, 2003).The viscosity of pumpkin seeds oil is 48.9 reported byImad(2003) and also value of viscosity 47.3 reported by (Oomah *et al*., 2000).

2.5.3 Refractive Index:

The refractive index of common pumpkin seeds oil is 1,466 reported by (Gohari *et al*., 2011). The European varieties have a refractive index within the range of 1.406-1.469 reported by Imad (2003).

2.5.4Color:

Pumpkin seeds oil was greenish brown in color with nut-like taste (Gohari *et al*,2011). pumpkin seed oil have pale yellow color described by(Butt,1995). The characteristic dark color of the pumpkin seed oil was due to the carotenoids and chlorophyll (Untersuchungen, 1978). Most of the oils of cucurbitaceae family seeds were nearly colorless. (Gohari *et al*,2011).

2.6 Chemical characteristics of pumpkin seed oil:

2.6.1Acid value:

High acid value (4-12) for common pumpkin seeds oil and high acid value for Indian and American varieties where they gave values 10.1 and 12.40 respectively (Gohari *et al.*, 2011).

2.6.2Free fatty acid content:

The fatty acid composition of common pumpkin seed oil was within 24-41% as oleic, and the ranges of 7-12% Palmitic,6-7%stearic, 57%linoleic acids(Eckey and Lawrence, 1954).Yugoslavian pumpkin seeds oil contained:Palmitic 11.2%Stearic 5.0-5.3%, oleic 27, 1-30.4 and linoleic 53.4-56.7%(Markovic and Bastic, 1976).

2.6.3 Peroxide value:

The peroxide value of pumpkin seeds oil in rang 10.85-11.47(Gohari *et al*, 2011). And peroxide value in the range 3.9-9.0 reported by (Imad, 2003).

2.6.4Saponification value:

Saponification value of pumpkin seeds oil is a range of 185-195.3. And reported by (Nichols d Sanderson, 2003) in rang 174-197.

2.6.5 Iodine value :

Theiodine value of pumpkin seeds oil was 105.1 reported byAlfawaz (2004), and Tsaknis et al. (1997) found it 107.0, and the iodine value was 123.0 reported by Younis *et al.* (2000).

2.7 Methods of oil extraction from oil seeds:

Crude vegetable oils and fats are obtained from oil bearing seeds and fruits etc, by either of two methods mechanical pressure or extraction by solvent. The effect of treatment by either method is to separate the oil more or less completely from the solid matter naturally associated with it. The residue latter is generally used for agricultural purposes either for stock feeding or fertilizer. The winning of the oil from the original materials is much more nearly perfect by solvent extraction than by mechanical pressure, though the difference varies greatly in different circumstances and with different material (Eljack,1999).

CHAPTER THREE

MATERIALS AND METHODS

3.1Materials:

Pumpkin seeds were purchased from the central market (Khartoum North).

3.1.1Chemicals and reagents:

All chemicals and reagent used in this study from Sudan University, Khartoum University and the Arab Sudanese Vegetable Oils Company.

3.2 Methodology:

3.2.1 Sample preparation and oil extraction:

Pumpkin seeds were firstly cleaned by removing the sand and foreign materials, washed and then dried in oven at 60 for 24 hours. And were powdered with a mechanical grinder also mortar, packaged and stored in refrigerator at about 4 ºC until usage.

The pumpkin seeds oil was extracted according to the method described byGohari *et al*, (2011)with some modifications.Certain amount of ground pumpkin seed was placed into filter paper and placed in the thimble of the Soxhlet extractor; seeds were extracted for 6 hour with petroleum ether (boiling point60-80°C) in 2L Soxhlet extractors. The solvent was evaporated under reduced pressure, and the oils from different batches were combined and kept in sealed bottles under refrigeration (4ºC) until analysis.

3.2.2 A proximate analysis of pumpkin seeds:

The moisture, oil, protein, fiber and ash were determined according to the following. Total carbohydrates were obtained by subtracting (moisture+ crude fat+ crude protein+ crude fiber + ash) from 100.

All the analysis were performed in triplicate.

3.2.2.1 Determination of moisture content:

The moisture content of sample was determined by drying of sample in a pre -dried and trared dish, then the samples were placed in oven and let to dry about 6 hrs at 105ºC unit a constant weight-was obtained after drying, the covered samples were transferred to desiccators and cooled to room temperature before reweighing triplicate results were obtained for each samples, the loss of weight was calculated as percent of sample weight and expressed as moisture content(AOAC, 2000) percent by weight.

Moisture content = W_1x100 /W

Where:

W_1= loss in gm of the material on drying

W= weight in gm of the material taken for test

3.2.2.2 Determination of oil content of pumpkin seeds:

The oil content of pumpkin seeds was determined by extraction with petroleum ether analytical grade in Soxhlet extractors. A dry empty extraction flask was weighed; about 2g of sample was weighed and placed in filter, then placed in extraction thimble free from fat and covered with cotton wool. The thimble was placed in extractor Extraction was carried out for 6

hrs with petroleum ether (boiling point range was 60-80ºC the beat was regulated to obtain at least 15 siphoning per hour. The residual petroleum ether was dried by evaporation. The extraction flask was placed in an oven till drying was completed then cooled in desiccators and weighed.

The oil content was calculated using following equation:-

Oil content (%) = W_2-W_1× 100 / W_s

Where:

W_1= weight of extraction flask

W_2= weight of extraction flask with oil

W_s= weight of sample

3.2.2.3 Determination of Crude protein of pumpkin seeds:

The crude protein content in the sample was determined by the micro- Kjeldahl method following the method of (AOAC, 2003).

The sample was digested with a strong acid so that it released nitrogen which can be determined by a suitable titration technique. The amount of protein present in the sample is then can be calculates from the nitrogen concentration of sample. A conversion factor of 6.25(equivalent to.16 g nitrogen per 100 grams of protein) was used in this study.

The Kjeldahl method is divided into three steps: digestion, distillation, and titration

A) Digestion

The fruit sample (0.2grams) was transferred into a digestion flask and then digested by heating for 2-3 hours in (3.5N) sulfuric acid. The digestion process was catalyzed by a mixture 0.4 of 10 parts K_2SO_4 to one part of $CuSO_4$. The heating was continued till the black color turned to pale blue and the fumes disappeared which indicated that digestion was completed.

B) Distillation

After the digestion has been completed the digestion flask was cool and transferred to a distillation unit using a minimum volume of water The solution in the distillation unit was then turned alkaline by addition of 20 ml of sodium hydroxide(40%) to release the ammonia. Then, the released ammonia was distilled into 20 ml of 2% boric acid in a conical flask, adding to it 2 to 3 drops of Bromochresol Methyl red indicator.

C) Titration

The nitrogen content in the sample was then estimation by titration of the ammonium borate formed with a standard hydrochloric acid (0.1N). The titrations continued till the color of the solution turned to red (pink), at the end point. Then the following is used to determine the protein concentration as per-cent:

Crude Protein = TVx N x 14.00 x F x 100/ 1000 x sample weight (g)

Where:

TV: actual volume of HCl use for sample titration (ml HCl - ml blank).

N: normality of HCI.

F: protein conversion factor 6.25

3.2.2.4Determination of Crude fiber of pumpkin seeds:

The crude fiber was determined according to (AOAC, 2003). About two grams sample were weighted and two hundred (200) ml of sulphuric acid (0.26N) were added boiled for 30 minutes and then filtered. The residue was washed three times by using hot water and after that 200 ml of NaOH was added, boiled again for 30 minutes and filtered. Then the residue was carefully washed three times with hot water until it was free from alkali. After that, the sample was transferred to an oven at 105ºC (overnight) and reweighted. The residue was ached in a muffle furnace (LEF- 103S, watts: 2K serial no: 07033002, Korea) at 550ºC for three hours till a light gray ash was formed and a constant weight was obtained. Then, the total crude fiber per-cent was calculated using the following equation:

Crude fiber %=W_1- W_2 x 100 \Sample weight (g)

Where:

W_1= weight of the sample before ignition

W_2= weight of sample after ignition

3.2.2.5 Determination of Ash content of pumpkin seeds:

The ash content of the sample was determined according to (AOAC, 2003). The empty crucibles were accurately weighed and then tow grams of crash seeds were transferred to each crucible by using a sensitive balance. Then, the crucibles and their content were placed in a muffle furnace at 550ºC to 700ºC for more than 6 hours until white to grey ash was obtained. After that, the crucibles were transferred from furnace to desiccators to cool to room temperature and re-weighed. Then, the ash content was calculated using the following equation:

Ash content (%)=

(Wt1 –Wt_2) x 100/ Sample weight (g)

Where:

Wt_1=weight of crucible with the asked sample.

Wt_2= weight of the empty crucible

3.2.3 Physical analysis of oils:-

3.2.3.1Density:

The oil density was determined according to (AOAC, 1990) methods, using psycho-meter and empty Stoppard psycho-Meter was w the psycho-meter was filled with water and kept at constant temperature of 25ºC in water bath for 30 min the weight of water at 25ºC was determined by subtracting weight of empty psycho-meter from its weight filled with water the end of time Stoppard psycho-meter was adjust to proper level, dried with a cloth and weighed. In the same manner, the weight of the oil at 25ºC was determined the density was calculated as follows:-

The density at 25 C° /25 C° = W/ W1

Where:

W= weight of oil at 25 ºC

W_1 =weight of water at 25 ºC

3.2.3.2 Viscosity:

The viscosity of the oil sample was detected using an ostwald-U-tube viscometer according to(AOAC, 2003) .The viscometer was suspended in constant temperature bath (32ºC) so that the capillary was vertical The instrument was filled to the mark at the top of lower reservoir with the oil by mean of pipette instrument into the tide 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 (32ºC) by mean of the pressure on respective arm he tube, the oil was moved into the other arm so that the meniscus 1cm above the mark at the top of upper reservoir The liquid was them allowed to now 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 upper reservoir to that the bottom of upper reservoir was recorded.

Calculation:

Viscosity of oil= $T- T_0 /T_0$

Where:

T: flow time of the oil

T_0: flow time of distilled water

3.2.3.3Refractive index:

The refractive index (RI) was determined by Abbe 60 Refract meter as described by (AOAC, 2000). Double prism was opened by means of screw head, few drops of oil were place in prism the prism was closed firmly by tightening the screw head and the instrument was them left to stand for few minutes before reading in order to equilibrate the sample temperature with that of

instrument (32ºC). The prisms were cleaned between reading by wiping of the oil with soft cloth, then with cotton moistened with petroleum ether and left to dry lest was repeated low times.

3.2.3.4Color:

The color intensity of oils was recorded using a Lovibond Tito meter as units of red, yellow and blue according to (AOAC, 2000).

Sample of oils were filtered through filter paper immediately before testing an appropriate cell (2 cells) was filled with oil and placed in the tin meter nearby window for light. The instrument was switched on and looked through the eyepiece the yellow color was adjusted to 25 and slides were adjusted until a color match was obtained from a combination of red and blue. The values obtained by matching were recorded as red, yellow and blue.

3.2.4 Chemical analysis of oils:-

3.2.4.1Free fatty acids

Free fatty acid was determined according to (AOAC, 2000). About 5 to 10 g of cooled oil sample was weight in a 250 ml conical flask and 50 ml to 100 ml of freshly neutralized hot ethyl alcohol was added and about 1 ml of phenolphthalein indicator solution, the mixture was warmed about 5 minutes and was titrated while hot against alkali solution shaking vigorously during the titration. The weight of the oil was 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 must not exceed 10 ml.

Free fatty acids as oleic acid= 28.2xV x N /W

Where:

V=volume in ml standard sodium hydroxide used

N= Normality of the sodium hydroxide solution

W= weight in g the sample

3.2.4.2Peroxide value:

The peroxide value (PV) of the oil samples was determined according to (AOAC, 2000). 5 gm of the sample were weighted into a 250 ml stopper conical flask 30 ml of mixture of glacial acetic acid and chloroform (3:2) were added and the solution was swirled gently to dissolve the oil a 0.5 ml of 0.IN KI was added to the flask, and the content of the flask were left to stand for one minute before adding 30 ml of distilled water after awhile the content were titrated with o.1N sodium thiosulphate unit the yellow color almost disappeared. Ao.1 ml of 1% starch solution was added and the titration continued with vigorous shaking unit the blue color completely disappeared. Blank determination was carried out.

Calculation:

Peroxide value= B-A x N x 1000/ Weight of sample used

Where

B= ml of sodium thiosulphat used (blank corrected) A= Normality of sodium thiosulphate solution

3.2.4.3 Saponification value:

The determination of Saponification value (Sv) was carried out according to (AOAC, 2000), two gm of oil sample were weighed accurately into 200 ml conical flask. 25 ml of 0.2N alcoholic KOH solutions was added and the content of flask was boiled under reflux for 1 hr with frequent rotation. One ml of phenolphthalein indicator was added, which the solution was still hot, and the excess alkali was titrated with 0.5N HCL. Then ml of HCL required (A) were noted the same

process was reported without oil and the numbers of ml of the acid required (B) were also recorded.

Calculation:

SV: (B- A) 28.05x N/ S

A: ml of ICL for sample

B: ml of HCL for blank

S: weight of oil (gm)

N: normality of the standard hydrochloric acid

3.2.4.4 Iodine value

The iodine value (I V) of the oils which quantifies their unsaturation level was determined according to the (British Standard Institute Method 1985). Approximately ,0.2 grammes 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 solutions was added and finally 20 ml of KI (0.1 N) were added to 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 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:

Iodine value (IV) = (b-a) x 0.01269 x 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

Iodine factor: 0.01269

3.3. Statistical analysis

The results were subjected to Statistical Analysis System (SAS) by using One-Factor Analysis of Variance (ANOVA). The Mean values were also tested and separated by using Duncan's Multiple Range Test (DMRT) as described by Steel *et al.* (1997).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1Chemical composition of dried pumpkin seeds:

The result of chemical composition of dried pumpkin seeds were presented in Table (1). The dried seeds contained 6.25 ± 0.28 % of moisture; this value is higher than the value reported by Gohari *et al*. (2011). These values safe the pumpkin seed oil for long storage period without spoilage, because the dried pumpkin seeds have low moisture content, they are generally not highly susceptible to microorganism attack(Gohari *et al.*, 2011).

As shown in Table (1), the oil content was38 ± 0.02%. This value fell in the range reported for African varieties (21.9- 39%) (Younis *et al*., 2000) and lower than the value reported for the European varieties (54.9%) (Murkovic *et al*.,1999). Therefore, the pumpkin seed can be considered as a potential source of vegetable oil for domestics and industrial purpose.

The protein content was shown in Table (1). It was24.69 ± 0,61% this value is lower than that value 25.40% reported by Gohari *et al*. (2011). The protein content in pumpkin seeds are higher than those of other oil seeds, e.g. cotton seed (21.9%) and sesame (18.7%) and that of animal proteins (16- 18%) such as lamb, fish and beef (Gohari *et al*., 2011). Overall the pumpkin seeds are considered to be rich in protein .The protein content of the pumpkin seed suggests that it can contribute to the daily protein need of 23g - 100g for adults as recommended by some authorities (Gohari *et al*., 2011).

Crude fiber content was shown in Table (1).It was 2.76 ± 0.11% this value is close to that value obtained by (Gohari *et al.*, 2011) who reported 2.49%, and lower than the value 7.1% reported by Cirrilli (1971).

Total ash content was shown in Table (1). It was 4.64 ± 0.04% this value is lower than that value obtained by (Gohari *et al.*, 2011) who reported 5.34%. The value is close to that value 5.30 % reported by Imad (2003).

Ash content determination is important because it an index of the quality of feeding material used by animal feed producers for poultry and cattle feeding (Esuoso *et a*l,. 1998). Total carbohydrate content was calculated to be 23.66% of the dry matter (Table 1), this value was much higher than 19 reported by Gohari *et al*. (2011) for pumpkin seeds.

Table (1): Proximate chemical composition of pumpkin seed

Parameter	Content %
Moisture	6.25 ± 0.28
Crude fat	38 ±0.02
Crude protein	24.69 ± 0.61
Crude fiber	2.76 ±0.11
Total ash	4.64 ± 0.04
Carbohydrate	23.66 ±0.3

The values are means± standard deviation of three determinations.

4.2 Physical characteristics of the pumpkin seed oil:

The results of the physical analysis of the pumpkin seed oil are shown in Table (2) the pso was liquid at room temperature. Table (2) shows the results for the pso color. It was found that the readings for pumpkin seeds oil color were (70 ± 0.70and 11 ±0.01) R.y.b for yellow unite and red unite colors; respectively. The value for yellow unit is higher than value reported by Imad (2003), which is 30 R.y.b and the value for the red unit is lower than the value (15) reported by Imad (2003), and is higher than value of 46.0 R.y.b of yellow unit and higher than the value 4 R.y.b of red unit reported by Kochhar *et al*.(1983).

The specific gravity of the oil was shown in Table (2). It was 0.9935 ± 0.02 this value was close to the value reported by (Gohari *et al*., 2011) who reported a value of 0.9151. Also, close to the value 0.916 reported by Tsaknis *et al*.(1997), and the value fell in rang(0.903-0.999) reported by (Nichols and Sanderson, 2003)

The refractive index shown in Table (2). It was 1.4725 ± 0.01 this value was close to the value reported by (Gohari et al., 2011) who reported a value of 1.4662, and it is close to the value 1.465 reported by Tsaknis et al. (1997).

The viscosity value of pumpkin seeds oil was shown in Table (2). It was 48.9 ± 0.02 cps this value was close to the value of 48.09 cps reported by ALfawaz (2004), and higher than the value of 47.3 reported by Oomah *et al*.(2000).And the value is lower than the value (93.659) reported by Tsaknis *et al*. (1997)

The density of pumpkin seeds oil shown in Table (2). It was0.94±0.02 g/c^3 this value was close to the value of 0.92 reported by El Gharbawi (1977).and close to the value 0.92 was given by Eckey (1954), and lower than the value 0.97 reported by Tsaknis *et al*. (1997).

Table (2) Physical properties of pumpkin seeds oil.

Parameter	Value
Physical state	Liquid
Red unit R.y.b	11± 0.01
Yellow unit R.y.b	70 ±0.70
Specific gravity 30 ºC	0.9935 ± 0.02
Refractive index 30 ºC	1.4725 ± 0.01
Viscosity 30ºC cps	48.9 ± 0.02
Density g\cm^3	0.94±0.02

The values are means± standard deviation of three determinations.

4.3 Chemical characteristics of pumpkin seed oil:

Table (3) shows the chemical characteristics of pumpkin seeds oil, considering the content of free fatty acids (0.701 ± 0.01%) as oleic acid. This value was higher than that value (0.39% as oleic acid) reported by Gohari *et al*. (2011), And lower than the value as 0.97% as oleic acid reported by Tsaknis *et al.* (1997).

Acid value of pumpkin seeds oil was shown in Table (3). It was (1.403 ± 0.02 mgKOH/g oil) this value is higher than the value 0.86 reported by Imad (2003) and 0.78 reported by Gohari *et al*. (2011).

Table (3) shows the peroxide value of pumpkin seeds oil (6.88 ± 0.62 m eq o_2/kg oil) this value was lower than the value of 8.5 reported by Mohammed (2004).The extracted pumpkin seed oil had an acceptable initial quality. The Codex Alimentations Commission expressed the permitted maximum acid values of 10 and 4 mg KOH/g oil for virgin palm and coconut oils, respectively (Alfawaz, 2004). It has been shown that oils become rancid when the peroxide value ranges from 20.0 to 40.0 meq o_2/kg oil (Ajayi *et al.*, 2006). On the other hand, according to the Codex Alimentary Commission, the peroxide value for unrefined olive oil may maximum 20 meq o_2/kg oil (Markovic and Bastic, 1975). Therefore, considering that the oil studied was unrefined and its initial quality indicators were within the reported limits, the pumpkin seed oil can be regarded as an edible oil with good quality. The saponification value of the oil was (191.68 ±0.5) as shown on Table (3). This value fell in the range 174-197 reported for the pumpkin seeds oil by(Nichols and Sanderson, 2003).And also fell in rang 185.5-195.3 reported by Markovic and Bastic (1975), however, it was lower than 200-218 range reported by Al-Khalifa (1996), 206 of El-Adawy and Taha (2001) and 201 of Tsaknis *et al*. (1997) and was higher than 132.3 reported by Younis *et al*. (2000) Moreover, it is lower than the value(199.2)

reported by Butt (1995). The pumpkin seed oil had an iodine value was 104.4 ± 0.0 (g of I_2/100 g oil) shown on Table (3), indicating a high degree of unsaturation. This value was close to 103.2and 105.1 reported by, respectively, Lazos (1986) and Alfawaz (2004), but higher than 80.0 that was indicated by Esuoso *et al*. (1998), and lower than 123.0 of Younis *et al*. (2000).

Table (3): Chemical characteristics of pumpkin seeds oil

Parameter	Content
Free fatty acid(% as oleic acid)	0.701 ± 0.01
Acid value (mg KOH/g of oil)	1.403 ± 0.02
Peroxide value (ml eq o_2 / kg oil)	6.88 ± 0.62
Saponification value (mg KOH/g of oil)	191.68 ±0.5
Iodine value (g of I_2/100 g oil)	104.4 ± 0.0

The values are means± standard deviation of three determinations.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion:

The results of this study showed that pumpkin seed was rich in oil and protein, and it is acceptable oil according to its physicochemical properties and similarity to physicochemical characteristics of the other commercial edible oils.

5.2 Recommendations:

1-To use pumpkin seeds as source of edible oil.

2-More studies are recommended in pumpkin seeds oil.

3-More attention and care should be taken for pumpkin cultivation to produce seeds for oil production.

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