Investigation of the composition of Sunflower Seeds oil and their physicochemical properties in different zones in Iraqi Kurdistan Region

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A R T I C L E  I N F O

A B S T R A C T

The study aimed to determine the quality of different sunflower seeds cultivated in different places in Kurdistan region - North of Iraq. The sunflower seeds were collected at four main zones, each zone were sub-divided into three places according to the topography and environmental factors were affected on physicochemical properties in sunflower seeds which cultivated in these locations. The lowest oil content (mechanical extraction) and the highest cake rate were found in sunflower seeds in Halabja (15.0 and 82.8%) respectively. Whereas, the highest oil content (29.3 %) and lowest cake content (68.0%) were found in sunflower seeds in Kifri. There was a significant difference among zones for smoking point except for zones A (261.2 ºC) vs B (264.9 ºC) and zones C (271.2 ºC) vs D (27.9 ºC). However, the sunflower seeds oil showed the highest values of peroxide value, conjugate diene and conjugate trine, (0.432 mEq/kg), [(0.344) 232nm] and [(0.553) 270 nm] respectively, at zone A. In the present study, the spectra of IR analysis were slightly similar with minor differences in locations of spectrum which indicate the change in the functional groups. The NMR analysis showed that patter of signals of Qaladza, Koysinjaq, and Dohuk sunflower oil seems to be similar due to existing unsaturated fatty acid. In contrast, the patter of signals of Kalar indicate that the unsaturated fatty acid was lower compared to other places.

Keywords: Sunflower seeds; oil content; physicochemical properties; Environmental.

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ARTICLE INFO

Received: 01/06/2017
Accepted: 05/08/2017
Published: 20/12/2017

1. INTRODUCTION

Sunflower (Helianthus annuus L.) is an important crop for oil seeds production and it’s ranked the third largest source in the production following Groundnut and Soyabeans. Sunflower plant is originated in western of North America, and it thought domesticated around 3,000 BC (Myers, 2002). Environmental factors are significantly affect the composition of the oil as sunflower seed oil (Sonntag, 1979). The quality of sunflower is strongly affected by environmental conditions such as temperature, precipitation, relative humidity, cloudiness (Turhan et al., 2010). Sunflower can be cultivated and grown in different soil and environmental conditions (Kaya, and Kolsarici, 2011; Lopez-Valdez, et al., 2011). Iraqi Kurdistan is suitable environment and climate for growing sunflower seeds and it’s one of the major...
producer of sunflower seed and sunflower seed oil (USAID/IRAQ, 2008). The sunflower can be cultivated in two seasons (spring and summer) and commonly practiced (Dag et al., 2002 and Al-Amery et al., 2011).

Sunflowers are of two types: oilseed and confectionery (Merrien, 1998). Sunflowers oil is valuable nutrients that play an important role in human health and nutrition (Bachmann, 2001). Oil from oilseeds can be extracted either by solvent extraction or mechanical pressing or by collecting of two depending on the seed type (Bachmann, 2001). The chemical composition of sunflower shows that the seed is an important source of oil, protein, calcium, carbohydrate and ash. Fat is a major nutrient in sunflower, it’s made up of fatty acids which include saturated fatty acids and polyunsaturated fatty acids (Nagraj, 1995). Oil cakes/oil meals are by-products obtained after oil extraction from the seeds (Ramachandran et al., 2007). Physicochemical properties of oil show a significant role to differentiate between dissimilar types of oils (Javed, 1994). According characteristics of sunflower oils are acid value 4.0 mg KOH/g oil, Peroxide value up to 15 milliequivalents of active oxygen/kg oil, Iodine value 118-141. Relative density 0.918-0.923 at 20°C and Refractive index 1.461-1468 at 40°C. However, Iraqi specifications for sunflower oil are Relativity density for oil is 0.918-0.923 at (20 °C), Refractive index is 1.467-1.469 (ND 40°C), Iodine value is 110 – 143, Acidity of crude oil and non-crude oil are 4 and 0.6mg (KOH)/g oil (maximum). Al-Dalain et al., (2011) report that initial characteristics of sunflower oil, acid value is 0.275mg KOH/g oil (% Oleic acid), Iodine value is 122.85 gm/100gm, Peroxide value is 0.5 meq/kg, Thiobarbituric acid (TBA) is 0.073 mg/kg, Conjugated diene is 1.3 and Conjugated triene is 0.59 revealed that the sunflower oil was of good quality.

The aim of this study was to investigate the effect of environmental and topographical conditions on quality of sunflower seed, oil content and fatty acid composition in a locally sunflower, the results of this study may help the strengthen determination of agricultural, manufacturing and marketing policy based on oil yield and quality of sunflower.

2. MATERIALS AND METHODS

Sunflowers seeds (*Helianthus annuus* L.) were collected from different locations in Kurdistan Region-Iraq.

This Experimental site located in (Kurdistan Region/ Iraq). The region lies between latitudes 34° 42’ N and 37° 22’ N and between longitudes 42° 25’ and 46° 15’ east. It provides the largest ratio of sunflower production and grows hybrid sunflower cultivars. This area was divided into different zones according to topographical map (Figure 2) (FAO, 2001), which were assigned a number and shown in Figure (1) and their parameters Table (2).

![Figure 1: Map shows different zones according to the topography areas for Kurdistan Region-Iraq (FAO, 2001).](image-url)
Table 1. Parameters describes four different zones according to the topography areas for Kurdistan Region-Iraq (FAO, 2001).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Zone A</th>
<th>Zone B</th>
<th>Zone C</th>
<th>Zone D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude (m)</td>
<td>Above 2000</td>
<td>1000 - 2000</td>
<td>500 - 1000</td>
<td>200 - 450</td>
</tr>
<tr>
<td>Annual temperature (°C)</td>
<td>Less than 15</td>
<td>15 - 17.5</td>
<td>17.5 - 20</td>
<td>20 - 22</td>
</tr>
<tr>
<td>Rainfall (mm)</td>
<td>Over 900</td>
<td>700 - 850</td>
<td>400 - 500</td>
<td>200 - 500</td>
</tr>
<tr>
<td>Evaporation (mm)</td>
<td>900 - 1500</td>
<td>1000 - 1500</td>
<td>1500 - 2000</td>
<td>Above 2000</td>
</tr>
</tbody>
</table>

Three replicate samples were taken at the places of each zones through the growing season of 2014 (Table 2), the samples were mixed up and 1 kg sample was taken from this bulk as a subsample and then used for oil production and cake extraction.

Table 2. Shows the distribution of different locations based on the main zones.

<table>
<thead>
<tr>
<th>Zone A</th>
<th>Zone B</th>
<th>Zone C</th>
<th>Zone D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penjween</td>
<td>Koya</td>
<td>Hawler</td>
<td>Kfri</td>
</tr>
<tr>
<td>Qaladze</td>
<td>Slemani</td>
<td>Duhok</td>
<td>Karkuk</td>
</tr>
<tr>
<td>Merga sur</td>
<td>Halabja</td>
<td>Bazyan</td>
<td>Kalar</td>
</tr>
</tbody>
</table>

The sunflower seed samples were brought to the laboratory and kept at room temperature for the present study as shown in (Figure 2).

2.1 Oil extraction:
Continuous screw presses are used for the mechanical extraction of sunflower seed by small scale machine oil extraction. The user machine oil extraction-DL-ZYJ02 was used to oil extraction and the cake production. 1000 grams of the sunflower seeds were weighed and transferred into Machine oil extraction. After extractaction the extract was centrifuged (MIKRO 22OR- Hettich) at 3500 rpm for 30 min. Subsequently the oil and cake were collected in separate tubes (Figure 3). The amounts of oil and cake were calculated, [Weight of sunflower seed (g) = weight of crude oil (g) + weight of cake (g)].

2.2 Cake composition
Determination of percentage oil of the Cake composition: The macronutrients of sunflowers such as: oil, protein, fiber, moisture and ash content were determined according to the official method (AOCS, 1989). However, carbohydrate ratio is calculated by difference according to A.O.A.C official method NO.50 - 1-16 (AOAC, 2000).

2.3 Physical analysis of oil:
The unrefined sunflower oil was prepared and weighed as required for the chemical analysis of oil, centrifuged at spped (3500
rpm), and then determined to separate impurities in crude oil.

Density was determined by using a pycnometer at 25 °C which performed according to AOAC official method No.962.37 (AOAC, 2005). Smoke point was identified according to AOCS official method No. Ca ga-48 (AOCS, 1989). Refractive index was determined by using a digital refractometer (RFM330) at 25°C according to AOAC Official Method No.921.58 (AOAC, 2005). Brookfield viscometer (Brook Field, DV-E Viscometer) was used to measure the viscosity of oil samples at 25 °C according to the method described by (Saguy et al., 1996).

2.4 Chemical analysis of oil:

The Wijs method was used for the determination of the iodine value No. 920.158 (AOAC, 1995). Peroxide value (PV) was also measured according to AOAC method No. 965.33(AOAC. 1995). Free fatty acids (FFA) were measured according to AOAC method 940.28. The acid value and the percentage fatty acid were calculated from the expression Acid value (mg KOH/g oil) = FFA*1.99 (AOAC, 1995). Conjugated Dien and trien fatty acids were measured by using UV/VIS scanning spectrophotometer (AOCS, 1995). Infrared spectroscopic analysis was performed to characterize the near infrared spectrometer (NIR) using (6500 Scanning Spectrophotometer) The spectral data of the oil samples were collected as absorbance spectra according to (Leon-Carrion and Leon-Dominguez, 2012).

The oil samples were dissolved in dimethyl sulphoxide (DMSO) solvent for 1H NMR determination. 1H NMR spectra were recorded on Bruker NMR Spectrometer with Oxford 400 MHz NMR Magnet, Gemini 2000 Console and 5 mm probe,” located at Main Chemical Laboratory - China”. Observing 1H at 400 MHz at temperature of 25 °C, chemical shifts are expressed in δ units (ppm). (Andrade et al., 2012).

Statistical analysis of variance was performed using SAS computer package -SAS Institute, 2001. The experimental design was a randomized block design with three replicates.

3. RESULTS

3.1 Oil content:

Data in table (3) shows the chemical properties of sunflower seeds. There were significant differences (P≤0.05) among the zones in term of the oil content of the sunflower seeds extracted by mechanical methods.

The results of this study were observed that sunflower seeds from the hot places can provide a higher amount of oil content compared to the cold places. For example, in zone D, Kfri had a highest amount of sunflower oil (29.3%), in the zone A, Penguin had less oil content mechanical method, (18.8%).

There was a significant difference (P≤0.05) in kernel oil content between kernel sunflower with and without the hull Kernel oil from Kfri and Kalar provided a highest amount of oil because of higher temperature during growth and development, which was 33.078% and 31.307% respectively (Table 3).

3.2 Cake composition:

The results in (Table 4) shows the cake chemical composition of sunflower seed oils that were obtained in this study, the moisture content of the cake was (0.94%) for the zone D and (2.07%) for the zone A. There was a significant difference (P≤0.05) in the protein content of the sunflower cake among the zones. It has also been observed the zone C had the highest protein content (32.2%) whereas zone D had the lowest (28.3%). For instance, zone D had the highest oil and carbohydrate content of the cake (5.15 and 42.1%) respectively.
There was a significant difference (P≤0.05) in the fiber content of the cake within the places in each zone and between the zones as well with exception for zone A, which zone C had the lowest fiber content (18.3%) and zone D had the highest fiber content (19.1%).

According to ash content there was a significant difference (P≤0.05) among the zones A, B and C with D, (4.98%, 4.08% and 4.57% with 4.40%) respectively. In addition, there was a significant difference (P<0.05) in the oil content of the cake among the zones, but there was no significant difference between zone A and zone D (Table 4).

### Table 3. Mean values of some chemical properties of sunflower seeds

<table>
<thead>
<tr>
<th>Zone</th>
<th>Place</th>
<th>Oil Content (Mechanical) %</th>
<th>Cake %</th>
<th>Kernel oil content (Soxhlet) %</th>
<th>Moisture %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Penguin</td>
<td>18.8 h</td>
<td>71.4 e</td>
<td>21.3 h</td>
<td>6.10 a</td>
</tr>
<tr>
<td></td>
<td>Qaladze</td>
<td>21.7 c</td>
<td>23.9 e</td>
<td>17.4 b</td>
<td>4.72 ab</td>
</tr>
<tr>
<td></td>
<td>Mergasur</td>
<td>22.5 f</td>
<td>23.9 b</td>
<td>17.3 c</td>
<td>5.11 a</td>
</tr>
<tr>
<td></td>
<td>Koya</td>
<td>25.5 d</td>
<td>70.3 f</td>
<td>25.7 b</td>
<td>8.30 a</td>
</tr>
<tr>
<td>B</td>
<td>Slemani</td>
<td>22.2 b</td>
<td>74.5 a</td>
<td>26.5 b</td>
<td>7.40 a</td>
</tr>
<tr>
<td></td>
<td>Halabga</td>
<td>15.0 i</td>
<td>82.8 a</td>
<td>5.10 a</td>
<td>4.28 a</td>
</tr>
<tr>
<td>C</td>
<td>Hawler</td>
<td>26.8 c</td>
<td>70.3 f</td>
<td>30.3 c</td>
<td>4.61 c</td>
</tr>
<tr>
<td></td>
<td>Duhok</td>
<td>21.8 d</td>
<td>78.3 c</td>
<td>24.4 c</td>
<td>4.86 c</td>
</tr>
<tr>
<td></td>
<td>Bazyan</td>
<td>21.9 g</td>
<td>73.8 d</td>
<td>25.5 f</td>
<td>4.93 c</td>
</tr>
<tr>
<td>D</td>
<td>Kfri</td>
<td>29.7 a</td>
<td>68.0 h</td>
<td>33.1 a</td>
<td>3.18 e</td>
</tr>
<tr>
<td></td>
<td>Karkuk</td>
<td>25.1 a</td>
<td>72.8 b</td>
<td>29.8 a</td>
<td>3.87 d</td>
</tr>
<tr>
<td></td>
<td>Kalar</td>
<td>27.5 b</td>
<td>69.0 g</td>
<td>31.3 b</td>
<td>3.46 e</td>
</tr>
</tbody>
</table>

* Means with the same letter for each line are not significantly different at P=0.05

### Table 4. Mean Values of Cake Composition (on dry weight basis)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Place</th>
<th>Moisture %</th>
<th>Protein %</th>
<th>Fiber %</th>
<th>Ash %</th>
<th>Oil Content %</th>
<th>Carbohydrate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Penguin</td>
<td>2.11a</td>
<td>32.4b</td>
<td>18.4d</td>
<td>4.72ab</td>
<td>4.28e</td>
<td>38.1d</td>
</tr>
<tr>
<td></td>
<td>Qaladze</td>
<td>2.06a</td>
<td>31.2b</td>
<td>18.4c</td>
<td>4.93a</td>
<td>5.11a</td>
<td>38.3c</td>
</tr>
<tr>
<td></td>
<td>Mergasur</td>
<td>2.04a</td>
<td>31.3d</td>
<td>18.3d</td>
<td>5.10a</td>
<td>4.96d</td>
<td>39.0cd</td>
</tr>
<tr>
<td></td>
<td>Koya</td>
<td>1.40cd</td>
<td>29.2g</td>
<td>18.7d</td>
<td>4.06bc</td>
<td>4.89d</td>
<td>42.7b</td>
</tr>
<tr>
<td>B</td>
<td>Slemani</td>
<td>1.49c</td>
<td>31.3b</td>
<td>18.9d</td>
<td>4.04c</td>
<td>3.98dc</td>
<td>39.7b</td>
</tr>
<tr>
<td></td>
<td>Halabga</td>
<td>1.73b</td>
<td>35.6a</td>
<td>20.8a</td>
<td>4.18bc</td>
<td>5.37c</td>
<td>42.5b</td>
</tr>
<tr>
<td></td>
<td>Hawler</td>
<td>1.13eh</td>
<td>29.7fg</td>
<td>16.7f</td>
<td>5.08a</td>
<td>5.20cd</td>
<td>42.7b</td>
</tr>
<tr>
<td>C</td>
<td>Duhok</td>
<td>1.11e</td>
<td>32.7a</td>
<td>18.3c</td>
<td>4.22bc</td>
<td>4.23c</td>
<td>39.5b</td>
</tr>
<tr>
<td></td>
<td>Bazyan</td>
<td>1.11ef</td>
<td>31.9bc</td>
<td>18.1d</td>
<td>4.36bc</td>
<td>4.23c</td>
<td>40.2c</td>
</tr>
<tr>
<td>D</td>
<td>Kfri</td>
<td>0.94d</td>
<td>28.3c</td>
<td>19.1a</td>
<td>4.40bc</td>
<td>4.56ac</td>
<td>39.0cd</td>
</tr>
<tr>
<td></td>
<td>Karkuk</td>
<td>0.93g</td>
<td>26.5h</td>
<td>18.9c</td>
<td>3.44d</td>
<td>5.96a</td>
<td>44.7a</td>
</tr>
<tr>
<td></td>
<td>Kalar</td>
<td>0.94g</td>
<td>26.5h</td>
<td>18.9c</td>
<td>3.44d</td>
<td>5.96a</td>
<td>44.7a</td>
</tr>
</tbody>
</table>

*Means with the same letter for each line are not significantly different at P=0.05
Carbohydrate significantly different (P<0.05) between most studied zones and places which ranged from 38.3% zone A and 42.1% zone D, and the lowest carbohydrate content was 34.4% obtained in Halabja and the highest was 44.3% in Kalar.

3.3 Physical properties of sunflower oil:
Results in Table (5) shows the physical properties of sunflower seeds.

There was a significant difference (P<0.05) in the density between all oils that come from different zones.

There was significant difference(P<0.05) in the smoking point among the zones. For example, Kalar had the highest smoking point (279.7°C) among all other places. The statistical analysis of the refractive index showed that there were significant difference (P<0.05) among the zones. For instance, zone B had the highest refractive index (1.4812) among all other zones (Table 5).

There was also a significant difference (P<0.05) in the viscosity of the sunflower oils among all places (Table 5), for example, zone D had the highest viscosity value (74.3
KG/(S-M)) while the iodine value of the same zone was 126.4 g/100g (Table 6).

3.4 Chemical properties of sunflower oil: Data in Table (6) showed that there were significant difference (P<0.05) in iodine value among the zones except zone A and B which was not significant, zone C had the highest iodine value (135.9 g/100g) and zone D had the lowest iodine value (126.4 g/100g) (Table 6). All the acid value of the sunflower oil from the zones and the places were less than the normal range except Halabja and Kirkuk, (0.266 mg KOH/g) and (0.213 mg KOH/g) (Table 6). In addition, there was a significant difference (P<0.05) in the conjugated diene among all zones (Table 6).

Infrared Spectroscopic Analysis: From the spectra of IR which showed in the Figure (4), it can be seen that the spectra of each zone look similar in general, with minor differences in locations from Spectrum that indicate Functional grope. When The extremely broad O-H absorption occurring in the region 3200 cm which will often absorption band at frequency ranged between 1455 and 1374 cm referred to C-H bond of methyl group –CH3, weak bands occur at 1654 cm of C=C and =C-H bonds at 613 cm.1.
Figure 5. $^1$H-NMR Spectrum of Sunflower oil

$^1$H-NMR Spectrum: Data of $^1$H-NMR for shows that the all the spectra are representatively placed on the same scale. It can be seen that most of the signals are located on downfield position (towards positive also known as high frequency or deshielded) (Figures 5). This is due to the presence of saturated fatty acids in the Kalar sunflower seed oil higher than Qaladza, Koysinjaq and Dohuk sunflower seed oils.

4 DISCUSSION

4.1 Oil content

It has been observed that sunflower seeds from the warmer places can provide a higher amount of oil content. Since, it is usually growing in warm to moderate climate to provide optimum temperature which is 20-25°C. Cold temperature and snowing have a negative influence on planting through reducing the amount of oil content in the seeds (FAO, 2010). On the other hand, the cool places provided sunflower seeds with less oil content. Although Halabja and Kirkuk are considered as warm places but, the sunflower seeds from these places had the lowest oil content extracted, this could be due to high chemical and environmental pollution in these places.

4.2 Cake compositions:

Cake is by-products gained after oil extraction from the seeds mostly used for feed applications (Ramachandran et al., 2007). That is widely used in animal feed application (Chris, 2011). The moisture content of the cake can be affected by the environment. The results of moisture content from the warm places higher than cool places. It has been reported that the moisture content is an important factor to determine the quality of the cake for animal feed uses (Chris, 2011). Protein is another vital nutrient of the cake and gives a good quality and nutrition value to the cake. (Kreps et al., 2014). In this study, the protein content of the
sunflower cake among the zones indicate that may be due to the Sunflowers grown for confectionery uses (Ramachandran et al., 2007). These finding are quiety agreed with the other studies. For example, Dorrell and Vick, (1997) reported that the protein content of the sunflower cake ranges from 30-50%. This wide range in protein content of the cake could be due to wide ranges in oil content and carbohydrate content of the cake. In addition, Park and Marx, (1984) stated that there is an inverse relationship between protein content and oil content of the cake. The fiber content might be due to the effect of the environmental factors on the fiber content. Also, Rosa et al., (2009) found that there was a significant difference in the fiber content of the different samples, for example, E122 was 18.40% and sample F2BR 15.28%. Also, oil cake content it might be due to the nature and efficiency of the mechanical extraction method.

4.3 Physical properties of sunflower oil:

Physical properties of sunflower oil play an important role in the conformation of the quality of oil and its products, which these properties related to the environment of different places especially the temperature and there different in fatty acid composition. It is well known that temperature has a direct effect on the density of oil and the relationship is inverse (Esteban et al., 2012). While, sunflower oil density is between 0.9200-0.9270 g/mL at 15°C (Shahidi, 2005). Oils with high content of unsaturated fatty acid have low smoking point. Therefore, it has noted that the oil samples containing low free fatty acid give high smoking point (Sarwar et al., 2016) Rustle of refractive index change with content of unsaturated fatty acid. It has also been reported that the refractive index depends on degree of saturation and degree of the conjugation (O’Brien, 2008). In addition, zone B had the highest conjugated Diane test which indicates to the high content of the unsaturated fatty acids. Kim et al., (2010) reported that viscosity increases with decrease the level of unsaturated fatty acid.

4.4 Chemical properties of sunflower oil:

The chemical characteristics of sunflower oil established its capability of application in either nutrition or industry (Sati, et al., 2011). Iodine value is one of the test which helps to determine the amount of unsaturated fatty acids the increased number of Iodine value can be used as an indicator increasing C=C double bonds (Al-Senaidy, et al,2013). These finding are agreed with O’Brien (2008) and Al-Dalain et al., (2011) who stated that the iodine value of the sunflower oil range from 126 to 136 g/100g. Peroxide value is the parameter which used as an indicator for primary oxidation and rancidity of the oils (Poiana, 2012). All peroxide values of the sunflower oils from the zones and places were within the normal range (Table 6). According to the Codex Alimentary (1999), peroxide value of oils should be less than10 mEq/kg. Therefore, it can be said that peroxide value in this study was agreed with the Codex standards. Acid value is an indicator used to determine the degree of breakdown of triglycerides into free fatty acids which has an adverse effect on the quality of many oils (Sadoudi et al., 2014). The acid value of all the type of sunflower oils from the zones and the places were less than the normal range except Halabja and Kirkuk, this exception of these two places might be due to the chemical pollution effect on these places. According to Codex Alimentary (1999), the initial acid value of sunflower oils should be equal or less than 0.13 mgKOH/g. Conjugated dine is a parameter which can be used as an indicator for primary oxidation of oils while Conjugated trine can be used for secondary oxidation assessment (Shahidi, 2005). Souza, et al., (2004) report that the auto-oxidation of unsaturated fatty acids produces a decrease in
the thermal stability of the vegetable oils, causing a decrease in the oxidative induction time. Factors such as change in color, increase in viscosity and unpleasant odor are observed in the process of degradation of these oils.

Infrared Spectroscopic Analysis: From the spectra of IR which is placed, the spectra of each zone look similar in general. This could indicate that composition of typical oil spectrum (Devoort et al. 2001), with minor differences in locations from Spectrum that indicate Functional grope. These minor differences might be affected by environmental and topographical conditions. This was affected confirmed by some other researcher who stated that fatty acid composition was substantially influenced by ecological and topographical factors (Turhan et al., 2010).

1H-NMR spectrum are seen that most of the signals are located on downfield position (Figures 5). This could refer to the presence unsaturated fatty acids in sunflower oil samples. Similar results were found when solid fat and oil where compared which found that the signal most intensive signals were observed to be in the upfield position. The authors attributed this to the presence of saturated fatty acid (Martinez-Yusta and Guillen, 2014). Even in the chemical analysis of sunflower oil showed that the iodine value of Qaladza, Koysinjaq, Dohuk and Kalar were (134.51, 136.2, 134.52 and 126.95 g/100g) respectively, which indicate that the iodine values for the first three places are higher than Kalar. This is due to the presence of saturated fatty acids in the Kalar oil. This is in agreement with 1H-NMR spectrum which showed the intensive signal in the upfield (towards negative side which also known low frequency or shielded) which proves to presence saturated fatty acids. Environmental conditions strongly influence the degree of unsaturation of sunflower oil, when this value provided a useful guide to the degree of unsaturation of the oil and was often accompanied by the chemically determined iodine value (Simpson and Hamilton, 1981). In addition, Turhan et al. (2010) reported that the environment or growing conditions have a significant effect on sunflower oil content and fatty acid composition. Therefore, growing zone is an important factor for meeting market requirements of sunflower oil in terms of the quality.

4. CONCLUSIONS

In conclusions, the ecological and topography of Kurdistan region have significantly affected on chemical and physical properties of sunflower seed oil. Most of the sunflower seed seemed to be suitable for confectionary industries. Cakes of the sunflower seeds were found to be rich in sources of nutrients particularly proteins. In addition, the quality of the oils can be considered as well-accepted because of very low content of peroxide and acid value. The IR spectra and 1H-NMR spectra showed that there were minor differences in the fatty acid composition of the three places in zones (A, B, C and D).

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