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**SHORT COMMUNICATION**

# CHARACTERISTICS AND CHEMICAL COMPOSITION OF THE OIL OF *CUCURBITA PEPO* SEEDS

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**ABSTRACT.** The seeds of *Cucurbita pepo* are used locally to treat tapeworm, where the dried seeds are eaten on an empty stomach. The seeds were found to be rich in oil 35%. The oil was examined for its iodine value, saponification value, acid value and other characteristics. The moisture content and protein content of the seeds have also been determined. The fatty acid composition of the oil was analysed by gas chromatography. The value (area percent) for fatty acids as methyl esters were: 16.0 (14%), 18.0 (8%), 18.1 (34%) and 18.2 (43%). The iodine value (Hanus) was 123.00. The oil contains an appreciable amount of unsaturated fatty acids (77.00%), and especially linoleic acid 18.2 (43.00%). The total percentage composition of the two saturated fatty acids present was found to be 22% palmitic acid 16.0, being the predominant one (14%).

## INTRODUCTION

Pumpkin, *Cucurbita pepo*, belongs to the family cucurbitaceae. Members of this family are herbs climbing by tendrils with abundant sap and very rapid growth, the fruit is very fleshy [1, 2]. Seeds have long been used as a remedy for various ailments particularly as a treatment against worms [3]. The seed oil is a common salad oil which is produced in Hungary and Austria [4]. The characteristics of the seed oil or its fatty acid composition of the African variety of *Cucurbita pepo* have not been reported so far. Earlier analyses of European and American varieties and allied species have been made [5-7]. The purpose of this work was to determine the physico-chemical properties of the oil from the seeds of this plant grown in Eritrea.

## EXPERIMENTAL

Seeds of *Cucurbita pepo* were collected from fruit samples obtained from Agricultural Research Centre in Asmara. They were shade dried and finely ground with a micromill. The powdered seeds were treated with hexane and refluxed for 16 hours in a Soxhlet extractor [8]. The solvent was removed by rotary evaporator yielding about 35% of oil. The water content was determined by drying flaked seeds in a vacuum oven for 16 hours and was found to be 4%. The protein content of the defatted meal was determined by two methods, namely, the nitrate free sample procedure and the nitrate containing sample procedure [9] and was found to be about 58% (see Table 1).

Table 1. Composition of *Cucurbita pepo* seed.

| Property | Value |
|---|---|
| Moisture content (%) | 4 |
| Oil content (%) | 35 |
| Protein content of defatted meal (%) | 58 |

Chemical analysis to determine approximate chemical composition and physical properties, e.g. iodine value, specific gravity, acid value, saponification value, refractive index, free fatty acid and optical rotation, were done as described by AOAC [9] (see Table 2). The Libermann-Burchard test for cholesterol gave a transient faint red colouration.

Table 2. Physico-chemical properties of *Cucurbita pepo* seed oil.

| Properties | Mean value ± S.D. |
|---|---|
| Specific gravity* | 0.9150 ± 0.00 |
| Refractive index* | 1.4695 ± 0.0007 |
| Optical rotation* | (+)0.35 ± 0.07 |
| Acid value (%) | 0.66 ± 0.20 |
| Free fatty acid (%) | 0.33 ± 0.66 |
| Saponification value | 132.33 ± 0.02 |
| Iodine value | 123.00 ± 0.10 |

* Determined at 23 °C.

Fatty acid methyl esters were formed from the extracted triglycerides in methanol with *p*-toluenesulphonic acid as a catalyst [10]. Gas chromatographic analysis was performed using Varian 2800 series gas chromatograph equipped with a flame ionization detector (FID). The column used was a 6 feet (length) x 0.25 inch (diameter) glass column packed with Silar 10 (10% on chromosorb WHP 80/100). The oven temperature was kept at 150-250 °C, at a rate of 8 °C/min. Nitrogen (oxygen free) carrier gas was used at a flow rate of 8 mL/min. Gas chromatograph peaks were identified by comparison with pure standard fatty acid methyl esters with respect to retention times. The percentage of each ester was calculated as the area ratio of each peak to the total area of all peaks.

## RESULTS AND DISCUSSION

The *Cucurbita pepo* seeds upon Soxhlet extraction with hexane for 16 hours yielded *ca* 35% oil. The protein content of the defatted meal was *ca* 58%. The recovered oil has a nut-like taste and brownish yellow colour. In a similar study on a number of European varieties of *Cucurbita pepo* seeds the oil content was found to be in the range of 34-43%. The variability of the oil content was attributed to the broad genetic diversity [11]. The protein content of the European varieties, 37-44%, is lower than that found in the present investigation. Moreover, it was reported that the oil has a dark green colour [11, 12]. The free fatty acid content, acid value and saponification value are about 0.33, 0.66 and 132.0, respectively. These values are comparable to those of known edible oils such as cotton seed and soybean oils (Table 2 and Table 4). The Gas chromatography analysis (Table 3) for fatty acid composition gave *ca.* 14% palmitic, 8% stearic, 34% oleic and 43% linoleic. No detectable unsaponifiable matter has been identified. It can also be seen that (Table 3) the total unsaturated fatty acids amounts up to 77%, while the saturated ones are only 22% of

Table 3. Fatty acid composition of *Cucurbita pepo* seed oil derived from GC analysis.

| Fatty acid | Retention time (min) | Composition (%) |
|---|---|---|
| Palmitic 16.0 | 5.02 | 14 |
| Stearic 18.0 | 6.13 | 8 |
| Oleic 18.1 | 6.49 | 34 |
| Linoleic 18.2 | 7.00 | 43 |

the total fatty acid composition of the oil. This property qualifies this oil to be a promising edible oil. This is also expressed by the iodine value 123.00. It is noteworthy to mention that epidemiological studies [12] showed that the probability of coronary artery disease decreases linearly with the increase of quantities of the unsaturated fatty acids in the food stuff. Moreover, linoleic acid averaged *ca.* 43% of the total fatty acids present which indicates that *Cucurbita pepo* seed oil is a rich source of linoleic acid. Studies on human subjects [12] using diets rich in linoleic acid showed that in groups provided with higher amounts of soybean oil (50% linoleic acid) the mortality rate due to coronary artery disease decreased significantly.

The gas chromatography analyses has not shown the presence of conjugated fatty acids, long chain fatty acids ($C_{20}$ and above), cholesterol or poisonous fatty acids such as ricinoleic, or linolenic acids. presence or absence of conjugated fatty acids in the oil is not an important factor on the possible use of the *Cucurbita pepo* seed oil as an edible oil. The Libermann-Burchard test for cholesterol gave a transient faint red colouration which was not supported by gas chromatography analyses. This indicates that the presence of cholesterol is negligible.

Table 4. Comparison of the characteristics of *Cucurbita pepo* seed oil with some common edible oils and allied species.

| Characteristics | Soybean [8] | Cotton seed [8] | Corn [8] | Sunflower [8] | *Cucurbita foetidisima* [4] | *Cucurbita pepo** |
|---|---|---|---|---|---|---|
| Oil (%) | 21.50 | 22.90 | 4.50 | 30.00 | 36.00 | 35.07 |
| Free fatty acid (%) | 0.50 | 0.70 | 1.50 | 0.40 | 0.50 | 0.33 |
| Acid value (%) | 1.00 | 1.40 | 3.00 | 0.80 | 1.10 | 0.66 |
| Iodine value | 126.00 | 105.00 | 125.00 | 145.00 | 129.00 | 123.00 |
| Saponification value | 193.00 | 195.00 | 190.60 | 191.00 | 191.50 | 132.30 |
| Specific gravity | 0.9190 | 0.9170 | 0.9175 | 0.9210 | 0.9172 | 0.9150 |
| Refractive index | 1.4730 | 1.4700 | 1.4720 | 1.4750 | 1.4720 | 1.4695 |

* This work.

Table 5. Comparison of fatty acid composition of *Cucurbita pepo* seed oil with some common edible oils and allied species.

| Fatty acid (%) | Soybean [14] | Peanut [15] | *Cucurbita foetidisima* [8] | *Cucurbita pepo** |
|---|---|---|---|---|
| Myristic 14.0 | 0.1 | - | - | - |
| Palmitic 16.0 | 11.0 | 17.6 | 12.0 | 14.0 |
| Palmitoleic 16.1 | 0.1 | - | - | - |
| Stearic 18.0 | 4.0 | 2.0 | 3.5 | 8.0 |
| Oleic 18.1 | 25.0 | 59.3 | 22.0 | 34.0 |
| Linoleic 18.2 | 50.0 | 18.9 | 61.0 | 43.0 |
| Linolenic 18.3 | 8.0 | - | - | - |
| Arachidic 20.0 | 0.4 | 0.3 | - | - |
| Eicosenic 20.1 | - | 0.7 | - | - |
| Behenic 22.0 | 0.3 | 0.6 | - | - |
| Lignoceric 24.0 | - | 0.5 | - | - |
| Total Saturated Acids | 16 | 21 | 16 | 22 |
| Total Unsaturated Acids | 75 | 78 | 83 | 77 |

* This work.

Comparison of the *Cucurbita pepo* seed oil with an allied species such as *Cucurbita foetidisima* [5] shows that the characteristic of the two oils (Table 4) as well as their fatty acid composition (Table V) are of similar nature. It can be seen from Table 5, that the total unsaturated fatty acid composition of *Cucurbita pepo* oil (77%) is typically similar to those of soybean (75%) [14] and peanut (78%) [15]. These results have also shown that *Cucurbita pepo* oil is physico-chemically similar to common edible oils and that it is of highly unsaturated nature which makes it attractive for food purposes.

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