Fatty acid Profile, Ash Composition and Oil Characteristics of Seeds of Watermelon Grown in Sudan

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Abstract

Watermelon (Citrus lanatus Thunb, Malsum and Nakai), seeds oil characters were evaluated to know whether this oil could be exploited as edible oil. White and black seeds of watermelon contain 40 and 35 % crude oil, respectively. The fatty acids profile of white and black seed unsaturated fatty acid content 79 %. The predominant fatty acid was linoleic (18:2) in 68 %, oleic (18:1) in 11 %, stearic (18:0) in 16-18 % and palmitic (16:0) in 13–15 %. Furthermore, physiochemical characterization and ash composition of seed oil were determined namely: refractive index, relative viscosity, specific gravity, pH, acid value, iodine number, saponification number, peroxide value, Ca, Mg, Fe, Mn and Zn.

Keywords: Watermelon, Fatty acid, Oil, White and Black Seeds.

1. Introduction

Watermelon (Citrus lanatus Thunb, Malsum and Nakai), belongs to the family cucurbitaceae. Watermelon is one of the major underutilized fruits grown in the warmer part of the world. The juice or pulp from watermelon is used for human consumption while rind and seeds are major solid wastes (Dane and Liu, 2007). The rind is utilized for products such as pickles and preserves as well as for extraction of pectin whereas seeds are a potential source of protein (Zohary and Hopf, 2000 and Mandel, 2005) and lipids (Motes, et al 2005). The young fruit and leaves can be cooked and eaten as vegetable. Flour of watermelon contains several anti-oxidants e.g. stachyose, raffinose and verbascose. The dry seed of watermelon has been reported to contain proteins and fats. However, seedless watermelons are produced in many areas of the world e.g. in Florida, USA (Parsons, 2002 and Mossler, 2007). There is a bitter form of wild watermelon which is poisonous, but it has been used medicinally (Sauer, 1993 and Vanwyk and Gericke, 2000). Watermelon plays a very important role in Africa as it is used to quench thirst when there is shortage of water. Watermelon seeds are used for oil production at the subsistence level in several African countries, and in the Middle East. They can be bruised and rubbed up with water to form an emulsion, which can be used to cure catarrhal infections, disorders of the bowels, urinary passage and fever. It is also being used as worm expeller; in recent years it has been used to expel tape worms and a natural Viagra (Mossler, 2007). Watermelon seed oil is light, penetrating and rich in essential fatty acids. The Objectives of this study are to evaluate the fatty acid profile, ash composition and physicochemical characterizations of oil extracted from white and black seeds of watermelon.

2. Material and methods
2.1 Sample preparation
White and black seeds of watermelon are collected from Horticulture Department, Faculty of Agriculture, University of Khartoum, Sudan. These seeds are prepared according to method described by AOAC (1984).

2.2 Methods
2.2.1 Oil extraction
Oil of white and black seeds of melon is determined according to method described by AOAC (1984) by using soxhlet apparatus.

2.2.2 Fatty acid analysis
The methyl ester of fatty acid was prepared according to the method described by Christie (1982). Then methyl ester was injected into Gas Chromatography (type AGILENT 6890 Series GC System) under following condition, Column: Capillary, Carrier gases: N₂, at flow rate 50ml/ minute, H₂ at flow rate 55ml / minute, Air at flow rate 500ml / minute, Column temperature is 190 °C, injection temperature is 225 °C, and detector temperature is 250 °C. The size of sample is 4 ul., speed of chart is 0.5 cm / minute and attention is 32. Peaks of fatty acid are identified by comparing their retention time with known standard methyl ester.

2.2.3 Physical analysis
Refractive index, relative viscosity, pH value and specific gravity were determined according to the method described by Cocks and Van Rede (1966).

2.2.4 Chemical analysis
Oil content, acid value, iodine value, saponification value and peroxide value were determined according to method described by British Standard Institution (1958). Mineral extraction was done according to method described by Pearson (1981) and measurement the element by using atomic absorption.

2.3 Statistical analysis
Three samples were taken, analyzed and averaged. Data were assessed by using Analysis of Variance (ANOVA) as described by Gomez and Gomez (1984).

3.0 Results and Discussion

3.1 Fatty acid composition
Table 1 showed palmitic, stearic, oleic, linoleic and Linolenic acid of oil extracted from white seeds of watermelon were 13, 18, 11, and 68 %, respectively. While palmitic, stearic, oleic, linoleic and Linolenic acid of oil extracted from black seeds of watermelon were 15, 16, 11, 68 %, respectively. Ratio of unsaturated / saturated fatty acid is same (2:1) in both oil. These findings are indicated the amount of unsaturated fatty acid is higher than saturated in both seed oil. The results are similar to those values given by Mirjana and Kseenija (2005) and (Baboli, et al., 2010).

| Table 1; Fatty acids profile of oil extracted from white and black seeds of watermelon. |
| Oil extracted | White seeds | Black seeds |
| Palmitic acid % (16:0) | 13 ± 0.1 | 15 ± 0.03 |
| Stearic acid % (18:0) | 18 ± 0.02 | 16 ± 0.02 |
| Oleic acid % (18:1) | 11 ± 0.1 | 11 ± 0.1 |
| Linoleic acid % (18:2) | 68 ± 0.03 | 68 ± 0.2 |
| Ratio unsaturated / saturated fatty acid | 2:1 | 2:1 |

Each value is averaged of three replicates on dry weight basis.

3.2 Physical characters
Table 2 found that the refractive index of oil extracted from white and black melon seed were 1.468 and 1.467, respectively. These findings are agreement with those values given by (Baboli, et al., 2010) but higher than those values reported by (Mariod, et al. 2003). The relative viscosity of oil-extracted from white and black melon seed was 4.7 and 4.5. These results are indicated that there is no significance...
difference in relative viscosity for both oil-extracted from white and black melon seeds at (p≤0.05). The specific gravity of oil-extracted from white and black seeds of watermelon was 0.898 and 0.894 g / cm³, respectively. These results are within the range that obtained by Abdalbasit, et al. (2003) but lower than those values reported by Mirjana and Kseenija (2005). In addition, there is no significance difference in specific gravity for both oil-extracted from white and black seeds at (p≤0.05). The pH value of oil-extracted from white and black seeds of watermelon was 3 and 5, respectively. The results are found that oil extracted from white seeds is more acidic than oils extracted from black melon seeds.

Table 2; Physical Characters of oil extracted from white and black seeds of watermelon

<table>
<thead>
<tr>
<th>Oil extracted</th>
<th>White seeds</th>
<th>Black seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractive index</td>
<td>1.468±0.002</td>
<td>1.467±0.001</td>
</tr>
<tr>
<td>Relative viscosity</td>
<td>4.8±0.03</td>
<td>4.5±0.02</td>
</tr>
<tr>
<td>Specific gravity (g/cm³)</td>
<td>0.898±0.001</td>
<td>0.894±0.002</td>
</tr>
<tr>
<td>pH value</td>
<td>3±0.1</td>
<td>5±0.2</td>
</tr>
</tbody>
</table>

Each value is averaged of three replicates on dry weight basis

3.4 Chemical characters
Table 3 indicated oil contents of white and black melon seeds were 40 and 35%, respectively. The results are demonstrated that white seeds contain high amount of oil content compared with black melon seeds. These findings are lower than those values reported by Sharma (1995), Mirjana and Kseenija (2005) but higher than those values reported by Mariod, et al. (2003) and Basil et al., (2003). The acid value of oil extracted from white and black melon seeds was 16 and 32%, respectively. These findings are indicated the acid value of oil extracted from black seeds is greater than the white seeds. These results are similar to those results obtained by Baboli, and Kordi, (2010) but higher than those values reported by Abdalbasit, et al. (2003) and (Basil et al., 2003). The iodine values of oil extracted from white and black seeds of watermelon were 85 and 80 mg/g, respectively. These values are lower than those given by Basil et al., (2003), Mirjana and Ksenija (2005) and Baboli, and Kordi, 2010, in addition there is no significance difference in iodine value in both oil at (p≤0.05). The saponification value of oil extracted from white and black melon seeds was 609 and 625 mg /g, respectively. These findings are higher than those results obtained by Basil et al., (2003), Mirjana and Ksenija (2005) and Baboli and Kordi (2010). These findings are indicated no significant difference in peroxide value in both oil at (p≤0.05). The peroxide value of oil extracted from white and black melon seeds of watermelon was 12 and 9 mequiv.O₂ / Kg, respectively.

Table 3; Chemical Characters of oil extracted from white and black seeds of watermelon,

<table>
<thead>
<tr>
<th></th>
<th>White seeds</th>
<th>Black seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil content (%)</td>
<td>40 ± 0.03</td>
<td>35 ± 0.01</td>
</tr>
<tr>
<td>Acid value (%)</td>
<td>16 ±0.1</td>
<td>32 ± 0.3</td>
</tr>
<tr>
<td>Iodine value (mg/g)</td>
<td>85 ± 0.02</td>
<td>80 ± 0.03</td>
</tr>
<tr>
<td>Saponification value (mg/g)</td>
<td>609 ±1.0</td>
<td>625 ± 2.0</td>
</tr>
<tr>
<td>Peroxide value mequiv O₂ Kg</td>
<td>12 ± 0.02</td>
<td>9 ± 0.03</td>
</tr>
</tbody>
</table>

Each value is averaged of three replicates on dry weight basis.

3.5 Ash composition
Table 4 showed Ca, Mg, Fe, Mn and Zn contents of oil extracted from white melon seeds were 0.7 mg / g, 11 mg /g, 3.3 ug/ml, 1.0 ug/ml and 0.8ug/ml, respectively. While Ca, Mg, Fe, Mn and Zn contents of oil extracted from black melon seeds were 1.0 mg / g, 11 mg /g, 7.5 ug/ml, 0.2 ug/ml and 2.5 ug/ml,
respectively. These results indicated Ca and Zn of oil extracted from white melon seeds is lower than those oil of black melon seeds, Fe content of oil extracted from black seed is higher than those oil of white melon seeds, Mg content for both oil (white and black seeds) are nearly the same (11 mg/g), but Mn of oil of white seeds is higher than those oil of black seeds. These findings are agreed with those results given by Basil et al., (2003) and (Mariod, et al., 2003).

Table 4: Ash composition of oil extracted from white and black seeds of watermelon

<table>
<thead>
<tr>
<th>Oil extracted</th>
<th>White seeds</th>
<th>Black seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca (mg/g)</td>
<td>0.7±0.3</td>
<td>1.1±0.2</td>
</tr>
<tr>
<td>Mg (mg/g)</td>
<td>11±0.1</td>
<td>11±0.2</td>
</tr>
<tr>
<td>Fe (µg/ml)</td>
<td>3.3±0.2</td>
<td>7.5±0.3</td>
</tr>
<tr>
<td>Mn (µg/ml)</td>
<td>1.0±0.1</td>
<td>0.2±0.1</td>
</tr>
<tr>
<td>Zn (µg/ml)</td>
<td>0.8±0.1</td>
<td>2.5±0.1</td>
</tr>
</tbody>
</table>

Each value is averaged of three replicates on dry weight basis

Conclusion
The presented data suggests that the oil extracted from white and black melon seeds contains linoleic acid as a major fatty acid (68%), the white and black seeds of watermelon contains high amount of crude oil (40 and 35%), respectively. Finally, Watermelon seeds could be used successfully as a source of edible oils for human consumption because it might be an acceptable substitute for highly unsaturated oils.

References


