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

M. K. Sabahelkhier,
Department of Biochemistry, Faculty of Science and Technology, Al Neelain University, Khartoum, Sudan

K E. A. Ishag
Department of Food Science and Technology, Faculty of Agriculture, University of Khartoum, Khartoum, Sudan

A. K. Sabir Ali
Department of Biology and Environmental Sciences, Faculty of Science and Technology, Al Neelain University, Khartoum, Sudan

Abstract

Watermelon (*Citrullus 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 (*Citrullus 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: N_2, at flow rate 50ml./ minute, H_2 at flow rate 55ml / minute, Air at flow rate 500ml / minute, Column temperature is 190 ^oC, injection temperature is 225 ^oC, and detector temperature is 250 ^oC , 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 know 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 ($p \leq 0.05$). The specific gravity of oil-extracted from white and black seeds of watermelon was 0.898 and 0.894 g / cm^3, respectively. These results are within the range that obtained by Abdalbasit, *et al*. (2003) but lower than those values given 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 ($p \leq 0.05$). 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

Oil extracted	White seeds	Black seeds
Refractive index	1.468±0.002	1.467±0.001
Relative viscosity	4.8±0.03	4.5±0.02
Specific gravity (g/cm^3)	0.898±0.001	0.894±0.002
pH value	3±0.1	5±0.2

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. The 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 ($p \leq 0.05$). 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), in addition there is no significance difference in iodine value in both oil at level ($p \leq 0.05$). The peroxide value of oil extracted from white and black seeds of watermelon was 12 and 9 mequiv.O_2 / Kg, respectively. These results indicated no significant difference in peroxide value in both oil at level ($p \leq 0.05$). These findings are higher than those results obtained by Basil *et al*., (2003), Mirjana and Ksenija (2005) and Baboli and Kordi (2010).

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

	White seeds	Black seeds
Oil content (%)	40 ± 0.03	35 ±0.01
Acid value (%)	16 ±0.1	32 ±0.3
Iodine value (mg/g)	85 ± 0.02	80 ± 0.03
Saponification value (mg/g)	609 ±1.0	625 ± 2.0
Peroxide value meqquiv O_2/ Kg	12 ±.02	9 ±0.03

Each value is averaged of three replicates on dry weight bas

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

Oil extracted	White seeds	Black seeds
Ca (mg/g)	0.7±0.3	1.1±0.2
Mg (mg/g)	11±0.1	11±0.2
Fe (µg/ml) ♀	3.3±0.2	7.5±0.3
Mn (µg/ml)	1.0±0.1	0.2±0.1
Zn (µg/ml)	0.8±0.1	2.5±0.1

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

AOAC (1984). Official Methods of Analysis.14th edition. Published by AOAC Inc. IIII North 19th Street No. 210 Arlington, Virginia 22209 USA.

Baboli, Z. M., Kordi, A. A. S. (2010). Characterization and composition of watermelons seed oils and solvent extraction parameters effect. J. Am. Chem. Soc. 87, 667-671.

Basil S. K., Dawson H. and Kakuda Y. (2003). Characteristic and composition of melon and grape seed oils and cakes. J. Am. Oil Chem. Soci. 62(5), 881 - 883.

Christie W. M. (1982). Lipid analysis, isolation, separation, identification and structural. Analysis of lipid 2nd Edition, Pergrman Press Oxford, New York, Toronto, Sydney, Paris and Frankfurt.

Cock S.I. and V. Van Rede (1966)**.** Laboratory Handbook for oil and fat analysis. Academic Press, Inc Ltd.London and New York.

Dane and Liu, (2007). Diversity and origin of cultivated and citron type watermelon (*Citrullus lanatus*). *Genetic Resources and Crop Evolution* 54. 6.

British Standard Institution (1958). Methods of analysis of oil and fat. British Standard House, 2 Park St. London, W.L.Y.4AA.

Kamel B.S., Dawson H. and Kakuda Y. (1982). Characterization and Composition of melon and grape oils and Cake. JAOCS, 62 (5), 881 -883.

Mandel, H., N. Levy, S. Izkovitch, S. H. Korman (2005). "Elevated plasma citrulline and arginine due to consumption of *Citrullus vulgaris* (watermelon)". *Berichte der deutschen chemischen Gesellschaft* **28** (4): 467–472.

Mariod, A.M., Yousif M.A., Bertrand M., Galaleldin K. Andeen S., Aied M. G. and Ibrahim A. (2003). A comparative study of the Properties of Six Sudanese Cucurbit Seeds and Seed Oils. J. Am. Oil Chem. Soc., 86(12), 1181 – 1188.

Mirjana M. and Ksenija P. J. (2005). Characterization and Composition of Melon Seeds Oils. J. of Agric. Sc, 50(1), 41 - 47.

Mossler, M. A. (2007).Watermelon Pest Management Strategic Plan (PMSP). University of Florida IFAS Extension Solutions for Your Life. EDIS.

Motes, J. E., Damicone, J., Warren, R., Duthie, J. and Edelson, J. (2005). Watermelon Production. *Oklahoma Cooperative Extension Service*.

Parsons, Jerry, Ph.D. (2002). "Gardening Column: Watermelons." *Texas Cooperative Extension of the Texas A&M University System*. 2005.

Pearson, D. (1970). The Chemical Analysis of Food. Ed., Egon H.., Kirk R. S., Sawyer, London and New York. 18th Ed.

Sauer J. D. (1993). Historical geography of crop plants a select roster.CRC Press, Boca Raton and Florida.

Sharma P.B. and Gurveen K.G. (1995). Chemical composition of some cucurbits seed. Research and development exporter 12(1-2), 48 -50.

Vanwyk B. and Gericke N. (2000). People's Plants, A guide to useful plants of Southern Africa, Briza Publication, Pretoria.

Zhang M. K. X. P and Wang M. (1990). Nutrients in seeds of edible watermelon. Report Cucurbits Genetics Co-operative 13, 43 – 44.

Zohary, D. and Hopf, M. (2000). Domestication of Plants in the Old World, third edition Oxford: University Press, p. 193.