IOSR Journal of Applied Chemistry (IOSR-JAC)
e-ISSN: 2278-5736.Volume 4, Issue 5 (May. – Jun. 2013), PP 06-09
www.iosrjournals.org

Oil and Fatty Acids Composition in Glasswort (*Salicornia Fruticosa*) Seeds

Elsebaie, E. M.;Elsanat, S. Y.; Gouda, M. S. and Elnemr, K. M.
Food technology. Dept., Fac. Agric., Kafr El-Sheikh Univ., Egypt

Abstract: *glasswort (Salicornia fruticosa) is the most widely distributed species of the perennial genus of glasswort in Egypt and it shows great biotechnological potential as a salt-water irrigated crop. Oil analysis of Salicornia fruticosa seeds was carried out in the current study. Chloroform and methanol mixture (2:1 v:v) extraction yielded maximum oil content from seeds (28.59%). The physical and chemical characteristics of Salicornia fruticosa seed oil were also analyzed. The results were as follows: the iodine value 84.5 gI/100 g oil, acid value 1.84 mgKOH/g oil and saponification value 195.6 mgKOH/g oil. The unsaturated fatty acids accounted for 78.05%, in which oleic acid accounted for 56.58 %, linoleic acid accounted for 17.40 %,and linolenic acid accounted for 3.98 %. It showed that Salicornia fruticosa seed oil was a high quality health oil.*
Key Words: *glasswort, fatty acids composition, oleic acid, oilseeds, Salicornia fruticosa.*

I. Introduction

Glassworts or marsh samphires are small succulent shrubs native to coastal marshes, mangroves and salt deserts, as well as a potential new seed oil crop for direct irrigation with salt water [1; 2 and 3]. Glassworts are members of three closely related genera *(Salicornia, Sarcocornia and Arcthronemum)* of the subfamily *Salicornioideae* (family *Chenopodiaceae*) [4; 5 and 6]. The most successfully cultivated glasswort is the annual *Salicornia bigelovii*. Seeds of *S. bigelovii* may contain 26-33% of fatty acids [7; 1 and 8], exceeding levels of traditional oil-seeds such as cotton (15- 24%) and soybean (17-21%) [7 and 8]. The average annual seed production of this species (*Salicornia bigelovii*) varies from 2.0 [1] to 3.7 tonnes/hectare/year [9].

The cultivation of *S. bigelovii* has been successful in the U.S., Mexico, Saudi Arabia, the United Arabic Emirates, Egypt, Eritrea and Pakistan [9; 7, 8 and 3]. Several researchers have emphasized the importance of halophyte oil as a potential source of polyunsaturated fat and biodiesel supply for growing global demands [1 and 10]. The predominant fatty acid in glasswort (*salicornia fruticosa*) seed oil was linoleic acid and no fatty acids exceeding 20 carbons detected. Saturated fatty acids accounted for 19.98 % of the fat. The polyunsaturated fatty acids accounted for 19.98 % of the fat [11]. glasswort (*salicornia fruticosa*) seed oil was found to contain high levels of linoleic acid (74.66-79.49%) and less oleic acid (12.33-16.83%). Saturated fatty acids, palmitic acid ranged from 7 to 8.50% and stearic acids ranged from 1.24 to 1.69%. Linolenic acid (C(18:3) omega-3) was found within the range of 1.50 to 2.31% [8]. The study was undertaken to analyse content, fatty acid composition and physico-chemical parameters of glasswort seeds oil as a new resource for oil.

II. Materials and Methods

Plant material

Glasswort (*salicornia fruticosa*) was collected from international coastal road near El-Boruls city, Kafr El-Sheikh Governorate, Egypt (latitude 32° 35`N and longitude31° 16`E) during January 2012. All chemicals and solvents used in this investigation (HPLCspectral grade) were purchased from El-Gomhorea company, Egypt. Seeds were obtained by milling the dry plants in a hammer mill and the chaff was screened on a series of agricultural screens. Air from a blower was used to separate chaff and seed material[1].

Methods

Gross chemical composition

Moisture, crude protein, ether extract, ash and crude fiber content were determined [12]. Total carbohydrates were calculated by difference.

Oil extraction

The total oil from the seeds was extracted following the solvent method using hexan, petroleum ether and cholorform: methnol mixture (2:1 v/v). about 100g powdered seed immersed in solvent was agitated in a conical flask for 24 h. the residue was allowed to settle and supernatant was decanted and heated to 40°C until solvent was completely evaporated. The final weight of solid material left after evaporation was noted.

Physico-chemical properties

For physico-chemical properties of oil specific density were determined at room temperature (28℃) using a specific density bottle. Iodine, acid, saponification, peroxide and ester values were determined [12].

Fatty acid profiles

Fatty acids compostion of glasswort *(Salicornia fruticosa)* seeds oil was determined using gas chromatography (GC Model, Shimadzu-8A, equipped with a FID detector and glass column 2.5m ×3mm id, under the following: Column 5% Degs on 80/100 Chromo Q, Detector temperature 270℃, H2 Flow rate 75 mL/ min, sensitivity 16 ×10 2, Column temperature 150-180℃ at rate 2℃/ min, N2 flow rate 20 mL/min, air flow rate 0.5 ml/ min and start speed 2.5 mm/ min)[13].

III. Results and Discussion

Table (1) shows gross chemical composition of glasswort (*salicornia fruticosa*) seeds. Data indicate that, moisture, crude protein, ether extract, ash, crude fiber and total carbohydrate contents of glasswort (*salicornia fruticosa*) seeds were 6.89, 28.2, 27.48, 6.96, 6.39 and 30.97, respectively these results are in agreement with those reported in another study [14 and 15].

Table 1: Gross chemical composition of glasswort (*salicornia fruticosa*) seeds (% on dry weight bases)

Components	%
Moisture	6.89
Crude protein	28.20
Ether extract	25.48
Ash	6.96
Crude fiber	8.39
Total carbohydrate	30.97

Seed oil extracted from glasswort (*salicornia fruticosa*) varied in yields using three solvent systems, viz. hexan, petroleum ether and chloroform: methnol mixture (2:1 v/v). maximum oil yield of 28.59 % was obtained when the seeds was extracted with chloroform: methnol mixture (100 ml/ 100g seed) for 24 h (Table 2). Whereas 100ml of hexan was required for 100 g seed to get 24.61% oil yield (Table 2) . Thus, chloroform: methnol mixture (2:1 v/v) extraction gave higher oil yield compared to extraction with hexan or petroleum ether.

Table 2 : Total oil extraction using hexan, petroleum ether and cholorform: methnol mixture (2:1 v/v).

Solvent type	Oil extraction
Hexan	24.61
Petroleum ether	25.98
Cholorform: methnol mixture (2:1 v/v)	28.59

Table (3) presents physico-chemical properties of glasswort (*salicornia fruticosa*) seeds oil. Acomparison of seed oil properties with olive oil also Table (3) revealed that iodine and peroxide values were lower than olive oil on the other hand, acid and saponfication values of *salicornia* seeds oil were higher than olive oil. Its saponification and iodine values are quite close to that of semi dry oils such as corn, cotton seed and sunflower oils. The above result are in accordance with those reported in another study [8; 16 and 17].

Table 3: Physico-chemical properties from *salicornia fruticosa* seeds oil

properties	*salicornia fruticosa* seeds oil	Olive oil [18]
Specific gravity (28°C)	0.918	-
Iodine value (gI/100g)	84.5	89.00
Acid value (mg/g)	1.84	0.20
Saponification value (mg/g)	195.6	186.00
Peroxide value (mEqO_2/kg oil)	1.3	2.50

The GC analysis of glasswort (*salicornia fruticosa*) seeds oil showed nine fatty acids prominent. The oil was composed of 17.40 wt.% linoleic-ω6 acid (18:2), 16.40 wt.% palmitic acid (16:0), 56.58 wt.% oleic acid (18:1), 2.5 wt.% stearic acid (18:0) and 3.98 wt.% linolenic-ω3 acid (18:3) as shown in Table (4).

Table 4: Fatty acids profile of from *salicornia fruticosa* seeds oil.

Acid	Symbol	%
Luric	$C_{12:0}$	0.91
Myristic	$C_{14:0}$	1.78
Palmitic	$C_{16:0}$	16.40
Palmitolic	$C_{16:1}$	0.09
Stearic	$C_{18:0}$	2.50
Oleic	$C_{18:1}$	56.58
Linolic	$C_{18:2}$	17.40
Linolenic	$C_{18:3}$	3.98
Arachidic	$C_{20:0}$	0.36
Total Saturated	%	21.95
Total Unsaturated	%	78.05
U / S ratio*		3.56:1

*Unsaturated / Saturated ratio

The oil was rich in polyunsaturated fatty acids, particularly oleic and linoleic acid, which has medical significance and, more specifically, the oil contained a small amount of C18:3 linolenic-ω3, which may result in better oil stability than commercial oils [7]. For instance, soyabean oil contains up to 6.8% of linolenic-ω3, and it is less stable due to fast oxidation when compared to *Salicornia bigelovii* seed oil, which has only 1.4% of this fatty acid [7]. The sum of saturated acids (21.95%) in glasswort (*salicornia fruticosa*) seed oil represents a major quantitative difference in comparison to commercial oils. Intermediate values of saturated acids were found in seeds from *Salicornia brachiata* (16.5%) [16] and the chenopod *Suaeda fruticosa* (17.0%) [14]. Similar high concentrations of palmitic acid (21.8-29.4%) were found in seeds of salt fat and coastal dune halophytes (*Arthrocnemum macrostachyum, Haloxylon stocksii, Alhagi maurorum, Cressa cretica* and *Halopyrum mucronatum*) from Asia [14].

References

[1]. Glenn, E. P.; O'leary, J. W.; Watson, M. C.; Thomas, T. L and Kuehl, R. O. *Salicornia bigelovii* Torr.: an oilseed halophyte for seawater irrigation. Science, 251, 1991, 1065-1067.

[2]. Costa, C. S. B. Restoration of coastal habitats in Brazil using native salt marsh plants. In: Greipsson S (Ed), Restoration Ecology, Sudbury (MA. U.S.A.): Jones and Bartlett Publishers, 2011, p. 333-338.

[3]. Zerai, D. B.; Glenn, E. P.; Chatervedi, R, L.; Mamood, A. N.; Nelson, S. G and Ray, D. T. Potential for improvement of *Salicornia bigelovii* through selective breeding. Ecol Eng 36, 2010, 730-739.

[4]. Shepherd, K. A.; Macfarlane, T. D and Colmer, T. D. Morphology, anatomy and histochemistry of *Salicornioideae* (*Chenopodiaceae*) fruits and seeds. Ann Bot (Lond) 95, 2005, 917-933.
[5]. Davy, A. J.; Bishop, G. F.; Mossman, H.; Redondo-gómez, S.; Castillo, J. M.; Castellanos, E. M.; Luque, T and Figueroa, M. E. Biological Flora of the British Isles, n. 244. *Sarcocornia perennis* (Miller) A. J. Scott. J Ecol 94, 2006, 1035-1048.
[6]. Alonso, M. A and Crespo, M. B. Taxonomic and nomenclatural notes on South American taxa of *Sarcocornia* A. J. Scott (*Chenopodiaceae*). Ann Bot Fennici 45, 2008, 241-254.
[7]. El-mallah, M. H; Turui, T and El-shami, S. Detailed studies on seed oil of Salicornia SOS-7 cultivated at the egyptian border of Red Sea. Grasas Aceites 45(6), 1994, 385-389.
[8]. Anwar, F.; Bhanger, M. I.; Nasir, M. A and Ismail, S. Analytical characterization of *Salicornia bigelovii* seed oil cultivated in Pakistan. J Agric Food Chem 50, 2002, 4210-4214.
[9]. Clark, A. Samphire: from sea to shining seed. Saudi Aramco World 45(6), 1994, 2-9.
[10]. Ruana, C. J.; Lia, H; Guob, Y. Q.; Inb, P.; Gallagherc, J. L.; Seliskarc, D. M.; Luttsd, S and Mahye, G. Kosteletzkya virginica, an agroecoengineering halophytic species for alternative agricultural production in China's east coast: Ecological adaptation and benefts, seed yield, oil content, fatty acid and biodiesel properties. Ecol Eng 32(4), 2008, 320-328.
[11]. Attia, F. M.; Alsobayel, A. A; Kriadees, M. S.; Al-Saiady, M. Y. and Bayoumi, M. S. Nutrient composition and feeding value of *salicornia bigelovii torr* meal in broiler diets. Animal feed science technology 65, 1997, 257-263.
[12]. Association of Official Analytical Chemists. Official methods of analysis.; 17Th ed. Washington, DC., USA, 2000.
[13]. D'oca, M. G. M.; Viêgas, C. V.; Lemões, J. S.; Miyasaki, E. K.; Morón-villarreyes, J. A.; Primel, E. G and Abreu, P. C. Production of FAMEs from several microalgal lipidic extracts and direct transesterifcation of the Chlorella pyrenoidosa. Biomass Bioenergy 35, 2011, 1533-1538.
[14]. Weber, D. J.; Ansarib, R.; Gulb, B and Ajmal, K. M. Potential of halophytes as source of edible oil. J Arid Environ 68, 2007, 315-321.
[15]. Epagri, K. Panicêutivo-Você sabe o que significa? Agropecuária Catarinense 21(2), 2008, 13.
[16]. Eganathan, P.; Subramanian, H. M. S.; Latha, R and Rao, C. S. Oil analysis in seeds of Salicornia brachiata. Ind Crops Prod 23, 2006, 177-179.
[17]. Hongshan, L. I and Yanxia, F.A.N. Extraction and characteristics analysis of *Suaeda salsa* seed oil. Journal of China Oils and Fats 30, 2010, 1522-1527.
[18]. Arafat, S.M.; Gaafar, A.M.; Basuny, A. M. and Nassef, S. L. (2009). Chufa tubers (*Cyperus esculentus*): As a new source of food. World Applied Sci. J., 7(2), 2009, 151-156.