

Omega fatty acids in Turkish *Neotchihatchewia isatidea* (Boiss.) Rauschert seed oil

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Neotchihatchewia isatidea (Boiss.) Rauschert (family Brassicaceae) is an endemic plant in Turkey. The aim of this study was to evaluate the seeds of 33 different *N. isatidea* populations for their oil content and fatty acids composition. The oil contents of seed lines ranged from 12.3% to 29.1%. Fatty acids were analysed using gas chromatography (GC-FID), wherein the major fatty acid was linolenic acid (45.0% - 59.8%). Linoleic acid and oleic acid levels in the seed oils ranged from 14.06% - 27.48%, and from 16.45% - 0.68%, respectively. The results of this work would provide new knowledge of the nutritional composition, especially omega fatty acids, of *N. isatidea* seeds and could be an important topic for further studies.

Keywords: Alligelin, oil, fatty acids, gas chromatography.

1. INTRODUCTION

Turkey has variable ecological characteristics wherein the extremely diverse ecosystems, have enabled the country to be a home for extensive variety of plant species and subspecies that are peculiar to the region. Turkey's flora comprises of up to 11000 species whereas 34.5% which of are endemic [1]. Turkey is one of the richest countries for the Brassicaceae family with 61 genera and 653 native species [2]. One of the member belonging to this family, *Neotchihatchewia isatidea* (Boiss.) Rauschert is known as Alligelin in Turkish, which refers to an endemic plant [3]. The plant distributed in Giresun, Gümüşhane, Sivas, Tunceli, Elazığ, Erzurum, and Erzincan provinces [4]. This ornamental plant is among endangered species and could be threatened with extinction. The flowers of this endemic plant have an attractive fragrance and have been used in painting [5]. In addition, the plant is used for medicinal properties such as wound in folk medicine [6].

Linolenic and linoleic acids cannot be synthesised by humans; therefore, these compounds are essential for humans. These fatty acids are also known as omega fatty acids which reducing the risk of some chronic diseases. The amount of omega fatty acids and ratio of these fatty acids (omega-6/omega-3) were important for human nutrition and preventing of various diseases [7]. There is a few research about morphological properties and germination of *N. isatidea* [8]. Glutathione, and vitamins of *N. isatidea* were determined in only one work [9]. According to our present knowledge, no studies has been published on the oil content and fatty acids composition of *N. isatidea* seeds. In this work, *N. isatidea* seeds of 33 different lines from different locations in Turkey were investigated for oil content, and fatty acid composition.

2. MATERIALS AND METHODS

2.1. MATERIALS

The trial was carried out at the experimental fields of the Department of Field Crops, Faculty of Agriculture, Ankara University (32:52 E; 39:56 N), during 2009-2011. The long term, 2009-2010, and 2010-2011 outdoor meteorological data, and soil analysis results of the experimental area are shown in Tables I and II, respectively. The plant seeds of the populations were collected from different locations of Turkey (Table III).

Table I - Outdoors climatic data of the experimental city*

Month	Rainfall (mm)			Temperature (°C)			Humidity (%)		
	Long term	2009-2010	2010-2011	Long term	2009-2010	2010-2011	Long term	2009-2010	2010-2011
September	17.5	10.3	1.5	18.7	18.5	22.5	48.7	48.6	42.3
October	33.2	13.7	167.6	13.0	16.6	12.2	62.1	49.2	72.3
November	35.4	43.1	32.0	6.7	7.4	11.2	72.7	74.6	63.6
December	42.5	68.0	67.3	2.3	5.4	6.1	78.8	78.5	78.8
January	39.2	63.0	42.0	0.3	3.1	2.4	77.9	77.8	78.5
February	33.4	65.1	24.3	2.1	6.5	3.2	72.1	70.4	69.8
March	36.7	44.6	57.5	6.2	8.5	6.0	63.2	59.9	67.1
April	50.0	37.5	50.1	11.3	12.2	10.0	60.2	54.4	65.6
May	50.3	31.0	73.1	16.1	18.4	15.2	57.6	44.4	62.3
June	35.3	57.8	44.4	20.2	21.5	19.7	52.7	54.2	55.4
July	15.5	25.7	10.7	23.6	26.2	25.6	45.2	44.2	42.7
August	12.0	0.4	21.1	23.3	28.4	23.8	44.2	30.5	44.9

* The government meteorological association of Turkey

Table II - Soil analyses of the experimental field before sowing

Depth	0-20 (cm)	20-40 (cm)
pH	7.33	7.26
CaCO ₃ (%)	9.00	10.0
Organic Material (%)	1.14	1.02
Salt (%)	0.063	0.076
Sand (%)	39.99	35.31
Clay (%)	22.18	24.35
Loam (%)	37.83	40.24
P ₂ O ₅ (kg/da*)	5.3	4.5
K ₂ O (kg/da)	140	122

*da (decare): one tenth of hectare

Seed sowing was done on 22nd October 2009, using a randomised complete block design with three replications as 40 × 20 cm of plant spacing. Each plot consisted of 5 rows with 75 plants. Each plot was 3 m × 2 m = 6 m². No fertilisation and irrigation were done. The seed harvesting was done on 23 July 2011. Because of the population from different locations of Turkey, flowering dates were different. Therefore, cross pollination among genotypes was not important, however two rows of corn had been planted among them. Flowering was observed in the second year; in other words, flower induction was done in second year. The seeds of different popula-

tions were collected in the second year. Because the seeds were not sufficient, the seeds of three replications were mixed together.

2.2. METHODS

2.2.1. Oil content and fatty acid composition

Approximately 1 g from the seeds were ground and extracted with *n*-hexane by Foss Soxtec 2055 apparatus. The oil content for each sample was calculated and expressed as % (w/w) of the seeds.

Fatty acid methyl esters (FAME) of oil samples were prepared according the AOAC method [10] and analysed by gas chromatography using Shimadzu (Kyoto, Japan) equipped with a capillary column (DB 23, 30 m × 0.25 mm ID × 0.25 μm), and flame ionisation detector (FID). Column temperature was maintained at 190°C for 30 min. The injector and detector temperatures were 230°C and 240°C, respectively. Helium was used as a carrier gas at a flow rate of 1.0 mL/min. A sample of 1 μL was injected by the auto-sampler with a split mode (split ratio of 1:80). FAME peaks were identified by comparing the retention times of individual reference FAME standards including myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), oleic acid (C18:1), linoleic acid (C18:2), arachidic acid (C20:0), gadoleic acid (C20:1), behenic acid (C22:0), and lignoceric acid (C24:0) as well as FAME mix (37 components, Sigma-Aldrich, Sternheim, Germany).

3. RESULTS AND DISCUSSION

The results of oil content for Alligelin seeds are summarised in Table IV. Oil content of *N. isatidea* seeds varied from 12.30% (sample n° 30) to 29.13% (sample n° 1). There was no comparable data about oil content, but the oil yield of seeds were similar to grape

Table III - Places of different *Neotchihatchewia isatidea* populations collected in Turkey

Sample n°	Place		Latitude	Longitude
	Province	District		
1	Sivas	Suşehri	40.162777	38.088626
2	Giresun	Şebinkarahisar	40.288496	38.422166
3	Malatya	Hekimhan	38.816525	37.930779
4	Erzincan	Kemah	39.746797	39.491124
5	Erzincan	Kemah	39.746797	39.491124
6	Giresun	Şebinkarahisar	40.288496	38.422166
7	Malatya	Darende	38.556664	37.490605
8	Erzurum	Köprüköy	39.973599	41.873118
9	Tunceli	Ovacık	40.883471	40.417910
10	Giresun	Şebinkarahisar	40.288496	38.422166
11	Malatya	Hekimhan	38.816525	37.930779
12	Tunceli	Pülümür	39.486504	39.895394
13	Erzincan	Central	39.746797	39.491124
14	Malatya	Darende	38.556664	37.490605
15	Sivas	Zara	39.750545	37.015022
16	Gümüşhane	Central	39.746797	39.491124
17	Erzincan	Kemah	39.746797	39.491124
18	Erzurum	Tortum	40.294651	41.549952
19	Sivas	Central	39.746797	39.491124
20	Erzurum	Aziziye	39.945790	41.105188
21	Erzincan	Çayırlı	39.826369	39.951262
22	Erzurum	Aziziye	39.945790	41.105188
23	Malatya	Hekimhan	38.816525	37.930779
24	Erzurum	Aşkale	39.920188	40.694704
25	Tunceli	Ovacık	40.883471	40.417910
26	Tunceli	Ovacık	40.883471	40.417910
27	Tunceli	Central	39.746797	39.491124
28	Tunceli	Pülümür	39.486504	39.895394
29	Erzurum	Çat	39.920188	40.694704
30	Erzurum	Aşkale	39.920188	40.694704
31	Tunceli	Central	39.746797	39.491124
32	Bayburt	Central	39.746797	39.491124
33	Tunceli	Pülümür	39.486504	39.895394

Table IV - Oil content of *Neotchihatchewia isatidea* seeds

Sample n°	Oil (%)	Sample n°	Oil (%)	Sample n°	Oil (%)
1	29.13	14	20.20	27	21.20
2	25.83	15	14.70	28	25.40
3	20.56	16	19.60	29	20.20
4	17.50	17	21.32	30	12.30
5	16.60	18	22.75	31	22.70
6	16.80	19	24.76	32	23.40
7	20.10	20	22.15	33	24.00
8	18.30	21	23.92		
9	15.50	22	18.99		
10	21.30	23	20.00		
11	22.00	24	13.50		
12	24.21	25	27.10		
13	25.10	26	13.30		
			Samples n. 1 - 33		
Grand mean			20.74		
CV			0.198		

Table V - Fatty acid composition of *N. isatidea* seed oils

Sample n°	C14:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	ΣSFA	ΣUFA
1	0.06	5.41	0.71	0.14	0.09	2.22	18.60	27.48	45.09	0.08	0.11	7.91	92.09
2	0.08	4.67	0.59	0.13	0.09	2.03	18.46	19.77	53.99	0.06	0.13	6.96	93.04
3	0.08	5.63	0.87	0.16	0.08	2.11	16.45	19.03	55.42	0.08	0.09	8.06	91.94
4	0.08	5.22	0.61	0.13	0.09	2.32	17.83	23.33	50.22	0.08	0.09	7.82	92.18
5	0.08	5.32	0.78	0.17	0.09	2.60	18.05	21.34	51.39	0.10	0.08	8.27	91.73
6	0.09	5.20	0.86	0.19	0.09	2.75	18.68	19.94	52.00	0.10	0.09	8.34	91.66
7	0.11	5.86	0.84	0.14	0.13	3.48	20.27	18.33	50.64	0.14	0.07	9.72	90.28
8	0.08	5.11	0.96	0.21	0.10	2.85	19.17	19.63	51.67	0.11	0.11	8.36	91.64
9	0.11	4.74	0.87	0.21	0.10	2.20	18.46	20.93	52.19	0.08	0.12	7.34	92.66
10	0.08	4.81	0.68	0.14	0.09	2.26	17.50	19.82	54.45	0.08	0.09	7.37	92.63
11	0.08	5.16	0.88	0.19	0.08	2.52	19.83	19.25	51.79	0.09	0.11	8.05	91.95
12	0.07	5.41	0.78	0.18	0.07	2.38	17.45	20.62	52.83	0.09	0.12	8.12	91.88
13	0.08	5.21	0.78	0.17	0.08	2.53	18.62	19.74	52.63	0.09	0.09	8.07	91.93
14	0.08	5.06	0.92	0.21	0.08	2.88	19.57	21.02	49.98	0.10	0.10	8.33	91.67
15	0.08	4.90	0.78	0.15	0.08	2.53	17.83	18.05	55.39	0.10	0.11	7.77	92.23
16	0.12	4.97	0.80	0.19	0.10	2.23	17.46	19.72	54.19	0.09	0.13	7.60	92.40
17	0.07	5.00	0.75	0.15	0.07	2.40	17.20	19.35	54.77	0.09	0.14	7.71	92.29
18	0.11	4.89	0.66	0.15	0.08	2.42	16.86	22.27	52.33	0.11	0.13	7.67	92.33
19	0.08	5.18	0.86	0.16	0.08	2.74	20.07	20.03	50.60	0.11	0.10	8.27	91.73
20	0.07	4.88	0.76	0.16	0.07	2.41	20.13	21.64	49.67	0.09	0.10	7.61	92.39
21	0.10	4.38	0.64	0.12	0.08	2.19	20.20	20.72	51.32	0.08	0.16	6.87	93.13
22	0.08	4.67	0.63	0.16	0.08	2.24	16.49	20.82	54.64	0.07	0.11	7.22	92.78
23	0.08	5.20	0.96	0.17	0.09	2.10	19.27	20.92	51.08	0.08	0.07	7.62	92.38
24	0.09	4.34	0.63	0.13	0.08	2.08	17.38	18.46	56.56	0.08	0.17	6.72	93.28
25	0.07	4.49	0.73	0.15	0.06	2.60	18.44	24.16	49.06	0.09	0.16	7.39	92.61
26	0.08	4.55	0.72	0.13	0.07	1.99	16.61	21.09	54.56	0.06	0.13	6.81	93.19
27	0.10	4.77	0.75	0.14	0.09	2.22	16.48	19.62	55.67	0.07	0.09	7.29	92.71
28	0.10	4.71	0.74	0.13	0.09	1.97	17.53	19.90	54.65	0.05	0.13	6.95	93.05
29	0.09	4.65	0.75	0.14	0.10	1.94	16.87	19.56	55.74	0.05	0.11	6.87	93.13
30	0.13	5.13	0.87	0.15	0.11	2.35	19.21	19.95	51.94	0.07	0.09	7.83	92.17
31	0.08	3.75	0.53	0.11	0.06	1.65	17.95	19.14	56.50	0.08	0.15	5.67	94.33
32	0.08	4.17	0.71	0.10	0.08	1.93	20.68	20.31	51.69	0.12	0.14	6.40	93.60
33	0.10	5.16	1.04	0.16	0.10	2.35	16.98	14.06	59.86	0.10	0.10	7.87	92.13
Grand mean	0.087	4.92	0.77	0.15	0.08	2.34	18.2	20.3	52.8	0.08	0.11	7.60	92.3
CV	0.18	0.86	0.15	0.17	0.16	0.14	0.06	0.10	0.05	0.22	0.22	0.09	0.007

seed and other seeds from Rosaceae family that are 11.6% - 19.6% [11] and 3.49% - 46.15%, respectively [12].

The results of the fatty acid composition of *N. isatidea* seed oil are summarised in Table V. The percentages of total saturated fatty acid (ΣSFA) varied between 5.67% and 9.72%. Despite that, the dominating fatty acids in *N. isatidea* seed oils were unsaturated fatty acid (ΣUFA) that accounted for from 90.28% to 94.33%. According to GC-FID analysis, the dominant saturated fatty acid was stearic acid C_{18:0} which with percentage levels from 1.65% to 3.48%.

The main constituent in the oil samples was polyunsaturated ω-3 linolenic acid (C_{18:3}) that ranged from 45.09% to 59.86%. The linolenic acid levels in *N. isatidea* seed oils were like that of *Chondrilla juncea* (56.27% of total fatty acids), *Montia fontana* (47.65% of total fatty acids) [13], perilla seed oil (55-60% of total fatty acids) [14], and linseed oil (53.21% of total

fatty acids) [15]. A relationship between dietary linolenic acid intake and cardiovascular disease (CVD) is found in many reports. One of them explained that higher linolenic acid exposure is associated with a moderately lower risk of CVD [16]. The other study emphasised that linolenic acid reduced serum cholesterol in humans [17].

The second major polyunsaturated acid in *N. isatidea* seed oils was ω-6 fatty acid with linoleic acid C_{18:2} which was detected between 14.06% and 27.48%. These results for linoleic acid showed similarity with those reported in previous studies [14, 18] on perilla seed oil (18% - 22%) and almond oils (19.49% - 33.29%). Oleic acid C_{18:1}, an ω-9 fatty acid, was the third common unsaturated fatty acid in all *N. isatidea* seed oil samples, ranging from 16.45% to 20.68%.

To our knowledge, this work is the first on the fatty acid composition of *N. isatidea* seed oils. The

remarkable high content on omega fatty acids, linolenic, linoleic, and oleic acids must be emphasised.

4. CONCLUSIONS

Our results demonstrated that *N. isatidea* seeds obtained from different Turkish locations contain high levels of omega fatty acids especially omega 3 fatty acids (i.e., linolenic acid), which is essential for human nutrition and have health-promoting properties. To the best of our knowledge, this work is the first investigation on the fatty acid composition of *N. isatidea* seed oils. The nutritional value of *N. isatidea* seed could be investigated to obtain valuable information on possibilities for a usage in food, pharmaceuticals, cosmetics, and other non-food applications.

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