Omega-Three Fatty Acids in Purslane (*Portulaca oleracea*) Tissues

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Total lipids and omega-3 fatty acids in purslane *(Portulaca oleracea)* were determined in leaves, stems and whole plants at three ages. Significant differences ($P<0.05$) existed in levels of total lipids among ages and between leaves and stems, but no relationship of age to plant part (>0.05) was found. Contents of 18:3ω3, 20:5ω3, 22:5ω3, 22:6ω3, 18:2ω6 and 18:1ω9 showed that leaves were the richer source of omega-3 acids at each age.

KEY WORDS: Lipids, omega-three fatty acids, purslane.

Although purslane *(Portulaca oleracea)* is considered to be a weed in the U.S., it is eaten extensively as a vegetable in soups and salads in the eastern Mediterranean countries, where the incidence of both heart disease and cancer is low (1). Purslane is a prized garden vegetable over much of Europe and Asia; and several different varieties have been developed. The entire plant is edible and can be used raw, cooked, or pickled. The tender tips make a very pleasant salad, either alone or in combination with other vegetables. Purslane has a mild acid taste and a fatty or mucilaginous quality which most people like, but a few find objectionable (2). Purslane is widely distributed in the tropics and subtropics including many parts of the U.S. Purslane is the richest source of omega-3 (ω-3) fatty acids of any vegetable yet examined (1). Omega-3 fatty acids have beneficial effects on coronary heart diseases in humans (3,4). This property has led to the proposition by Simopoulos and Salem (1) that purslane could be cultivated as a rich but inexpensive source of ω-3 fatty acids for human consumption, for fish feed in aquaculture, and for animal feed.

Very little information is available on the lipid composition of purslane. There are no data on total lipids and levels of fatty acids at different ages, or in the various parts of the plant. The object of this study was to compare levels of total lipids and ω-3 fatty acids at three ages and in two parts of purslane grown under greenhouse conditions. Only major fatty acids characteristic of marine animal origin (5) were considered in this study to justify an evaluation of purslane as a source of ω-3 acids of marine fish oils.

MATERIALS AND METHODS

Purslane seeds were purchased from Nichols Garden, Nursery, Inc., Albany, OR, and grown for 30, 49 and 50 days at day and night temperatures of 27°C and 19°C, respectively, under typical greenhouse conditions.

Total lipids of tissue samples were extracted by the dry column method of Maxwell *et al.* (6). One to 3 g of frozen tissue was homogenized with 25 mL of dichloromethane: methanol (9:1, v/v). The homogenate was passed through a column packed with 2 g of $Ca(HPO_4)_2$/Celite 545 (1:9, w/w) and topped with 4 g of anhydrous sodium sulfate. The column was eluted with 250 mL of dichloromethane: methanol and the total lipids determined gravimetrically.

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Fatty acid compositions were analyzed by a modification of the direct transmethylation method of Dahmer *et al.* (7). Each sample was dissolved in 1 mL of n-heptane, and 6 mL 10% (w/v) anhydrous methanolic HCL was added. After 15 min water was added and the sample was centrifuged. Fatty acid methyl esters (FAME) were analyzed with a gas chromatogram (GC) equipped with a SP-2330 chromosorb W-AW column (Supelco, Bellefonte, PA).

RESULTS AND DISCUSSION

The levels of total lipids found in the whole plants, stems, and leaves are shown in Table 1. Significant differences ($P<0.05$) existed in total lipids among ages and between plant parts, but no relationship of age to plant part ($P>0.05$) was observed. The 0.45% lipid level in the whole plant was significantly lower ($P<0.05$) than the 0.59% in the leaves. The mean level of the percent lipid content in 30-day-old plants was significantly lower ($P<0.05$) than that in older plants. However, no significant differences ($P>0.05$) were observed in percent lipid content between 49-day-old and older plants. These data show that lipids accumulated in growing plants.

Fatty acids in the whole plants, stems, and leaves of different ages are presented in Table 2. The most abundant of the ω-3 polyunsaturated fatty acids (PUFA) was 18:3ω3. This acid is a precursor of ω-3, longer chain PUFA. The presence of 18:3ω3, 20:5ω3, 22:5ω3, and 22:6ω3 reaffirmed that purslane was an alternative to marine sources of ω-3 PUFA. In addition, the occurrence of 18:2ω6, and 18:1ω9 in high levels compared with other vegetable crops further stresses the potential benefits of purslane in human, animal, and fish nutrition. Based on these results, it appears feasible to determine whether supplementing the diets of fish or animals with purslane would make a significant difference in the levels of these acids in the animals.

The ratios of ω-3 fatty acids to other major fatty acid families are critical indicators of essential fatty acid status (8,9). The ratios of saturated fatty acids to ω-3 acids were low in stems, lower in whole plants, and lowest in leaves, at each age (Table 3). The low ratios of saturated fatty acids and of 18:2ω6 acid to ω-3 acids are an indication of good nutritional quality.

TABLE 1

Total Lipid Composition of Purslane Harvested at Different Growth Periods[a] (wet wt%)

	Plant part			
Plant age	Whole plant	Stem	Leaf	Mean
30th Day	0.31	0.21	0.46	0.33
49th Day	0.42	0.46	0.59	0.49
59th Day	0.62	0.37	0.73	0.57
Mean	0.45	0.30	40.59	

[a]$LSD_{(0.05)} = 0.131$ for plant ages and plant parts.

TABLE 2

Composition of Selected Fatty Acids in the Various Parts of Purslane Harvested at Various Ages After Planting

Fatty acid	mg/kg (wet wt)								
	30th day[a]			49th day[a]			59th day[a]		
	Leaf	Stem	Whole plant	Leaf	Stem	Whole plant	Leaf	Stem	Whole plant
16:0	66.89	27.50	38.36	24.46	12.38	12.14	52.08	43.12	73.48
18:0	4.64	0.03	3.65	2.75	0.02	1.94	10.42	0.05	8.26
18:1ω9	5.96	0.03	3.65	3.98	0.02	4.13	10.42	0.04	13.91
18:2ω6	54.97	4.42	17.35	14.68	5.24	8.98	32.64	4.13	18.45
18:3ω3	290.73	2.50	60.73	97.25	3.02	18.45	120.83	1.83	72.83
20.5ω3	7.28	7.88	16.89	1.22	6.51	13.83	36.80	27.06	13.04
22:5ω3	5.96	Tr[b]	1.37	4.89	Tr[b]	1.94	9.72	Tr[b]	2.61
22:6ω3	1.32	Tr[b]	0.91	7.95	Tr[b]	3.61	18.75	Tr[b]	2.61

[a]Number of days after planting.

[b]Tr = amount of <0.02 mg/kg wet weight of purslane.

TABLE 3

Ratios of Selected Major Fatty Acid Families in the Various Parts of Purslane Harvested at Different Ages After Planting

Plant ages	[a]Saturates/ω-3	[b]ω-3/18:2ω6
Whole plant		
30th day	0.53	4.61
49th day	0.38	4.16
59th day	0.90	1.56
Stem		
30th day	2.65	2.35
49th day	1.30	1.82
59th day	1.49	7.00
Leaf		
30th day	0.23	5.56
49th day	0.24	7.58
59th day	0.38	7.70

[a]Sum of 16:0 and 18:0 fatty acids.

[b]Sum of 18:3ω3, 20:5ω3, 22:5ω3, and 22:6ω3 fatty acids.

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