VARIABILITY IN THE FATTY ACID COMPOSITION OF SUNFLOWER SEED OIL

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Studies of the fatty acid composition of the seed oil of safflower (Carthamus tinctorius) has resulted in the introduction of a high oleic type, essentially a new oil crop, into California agriculture (1). Additional types with intermediate levels of both oleic and linoleic acids and higher levels of stearic acid are also under study (2). In cultivated sunflower Putt et al. (3) reported considerable variability in stearic, oleic and linoleic acids, but not in palmitic acid. Encouraged by this information, it was decided to examine the variability in both cultivated and wild versions of sunflower (Helianthus annuus L.). This is a report of examinations in progress on wild sunflower.

Fatty acid determinations have been described (1,2), and are summarized below:

1. Five to six seeds were crushed, and oil washed from the seed through a sintered glass filter with petroleum ether.
2. The oil was converted to methyl esters with methanol and dry HCl, and redistilled chloroform added.
3. One microliter of the chloroform-esther solution was injected into a Varian Aerograph gas chromatograph, Model 1800, using a flame ionization detector. The stainless-steel column was 183 x 0.3 cm, packed with 20% diethylene glycol succinate on 80/100-mesh Chromosorb W. Column temperature was 210 C, and injector and detector temperature 250 C. Flow rate of the nitrogen carrier gas was 32 ml/min. Retention time of the last peak was 10 minutes.
4. The recorder was a Minneapolis-Honeywell, Model 14. Percent concentrations of the fatty acid methyl esters were measured with a Varian Aerograph digital integrator, Model 477.

Results have been obtained thus far from wild materials collected in California and Mexico. Samples of wild sunflower from Dr. Murray Kinman which were collected in Texas have not been analyzed as yet.

Collections from California vary mostly in proportions of oleic and linoleic acid (Table 1). Undoubtedly some of this variation is caused by differences in the environment of different locations. However, the fact that different collections (usually single plants) from the same location had distinctly different levels of oleic and linoleic acid would suggest that the variation had a strong genetic component. Stearic acid varied between 1.0 and 9.0%. Palmitic acid was mostly in the range of 5 to 7%, though a few collections did go above 10%. Linoleic and oleic acids covered almost the same range as cultivated safflower (2), though none was as high in oleic acid as oleic safflower oil (1). These results are

very similar to those obtained by Putt et al. (3).

Collections that departed most from the expected pattern for sunflower oil were found on the Central Plateau of Mexico (Table 2). The distinctive features of these were: the high levels of palmitic acid (10.5 to 16.7%); the high levels of stearic acid (7.2 to 19.6%); and the low levels of oleic acid (3.5 to 17.3%). The wild species of the Plateau is a distinct type with light green strongly pubescent leaves and stems. Heads are strongly convex.

A perennial species found in one location near Guadalajara also had high levels of palmitic acid and stearic acid and low levels of oleic acid. Two collections of domestic sunflower from north of San Luis Potosi were similar to other cultivated varieties in their fatty acid composition.

Table 1. Range in proportions of fatty acids in the seed oil of collections of wild sunflower (Helianthus annuus) in California.

Fatty acid	Range in %
Palmitic (16:0)	4.4 - 12.9
Stearic (18:0)	1.0 - 9.0
Oleic (18:1)	10.8 - 51.6
Linoleic (18:2)	39.2 - 77.6

Table 2. Range in the fatty acid composition of the seed oil of wild sunflower in different locations in Mexico, 1968.

Location	No. of samples	Range in fatty acid content, in %			
		Palmitic 16:0	Stearic 18:0	Oleic 18:1	Linoleic 18:2
Santa Ana*	3	6.7-7.4	3.3-4.8	20.7-22.4	66.9-68.0
Ciudad Obregon*	3	5.6-7.9	4.2-5.2	19.3-30.3	57.6-68.9
51 mi. SE Tepic	3	13.9-16.6	9.8-13.2	4.9-9.8	63.1-68.7
108 " " "	3	12.5-13.6	12.0-19.6	7.9-11.3	58.0-64.2
10 " " Guadalajara	4	13.0-16.7	11.0-14.4	3.5-11.3	61.8-70.3
10 " W Irapuato	4	10.8-12.3	8.4-10.5	12.6-17.3	63.5-66.2
1 " W D. Hidalgo	3	10.5-11.7	7.2-11.3	9.5-13.5	64.1-71.6
3 " N S.L. Potosi	1	11.3	13.5	13.7	61.5
104 " N " "	1	11.9	8.8	9.3	70.0
31 " S Saltillo	1	12.2	8.4	9.7	69.7
26 " N Monterrey*	1	7.0	4.3	14.7	74.0

* Not on the Central Plateau.

It is obvious (Table 3) that sunflower can be a source of oil resembling chemically the oil of several crops.

The following conclusions can be drawn from these limited studies:

1. Only four fatty acids, palmitic, stearic, oleic and linoleic, are present in appreciable amounts.

2. Palmitic acid varies over the range of 5 to 16%.

3. Stearic acid varies over the range of 1 to 18%.

4. Oleic acid varies from about 3.5 to 50%.

5. Linoleic acid varies from about 40 to 75%.

6. There is ample encouragement for a further search of wild types.

7. There is a need to explore the possibilities of adding some of this variability to the domestic type and exploring all possible combinations of the variability in separate fatty acids.

Table 3. Comparisons of oil of wild sunflower collections with oils from commercial crops.

Sunflower collection or crop	Fatty acid in %			
	Palmitic 16:0	Stearic 18:0	Oleic 18:1	Linoleic 18:2
Most collections	6.3	4.6	24.5	64.6
Commercial sunflower*	6	5	20	63
Corn oil*	8	2	28	53
High oleic collection	6.3	2.9	51.0	39.8
Peanut oil*	8	6	47	29
Sesame oil*	8	4	38	42
Int. safflower oil†	5.2	1.3	46.2	47.3
Low oleic collection	13.2	12.9	8.6	65.3
Cottonseed oil*	22	2	21	50

*USDA, 1959. Fatty acids and food fats. Home Ec. Report No. 7
(Other fatty acids not reported.)
†Knowles, P. F., and A. B. Hill, 1964. Crop Sci. 4:406-409.

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