Solubility of Lard in Aqueous Ethanol

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SOLUBILITY DATA of vegetable oils in aqueous ethanol indicate a relation between the fatty-acid composition and the solubility pattern of any given oil (1, 2, 3). As a further investigation of this relationship the solubilities of four lards in four concentrations of ethanol were determined. Two of these were the natural back fat lard and the leaf lard from the same animal. The other two samples were hydrogenated lard produced as follows.

Caustic refined lard was heated to 250° F. and hydrogenated at 40 p.s.i.g. to lower the iodine value from 66.0 to 62.9. Part of the partially hydrogenated lard was cooled to 100° F. and 0.15% sodium methylate was added. The mixture was agitated at 100° F. for two hours, after which 10% cold water was added to decompose the sodium methylate to sodium hydroxide. After settling, the water and foots were drawn off, and the lard was waterwashed to remove any remaining caustic. This rearranged lard, which was dried in a vacuum, was the second of the two hydrogenated samples. The iodine values and capillary melting points of the four lards are given in Table I. The methods and apparatus for determination of solubilities are those previously described (1, 3).

TABLE I

Characteristics of Lards Used

Lard Sample	Iodine Value (Wij's)	Capillary Melting Point °C.
Back fat lard[a]	73.6	40.9
Leaf lard[a]	61.7	45.7
Hydrogenated lard before rearrangement	62.89	45.2
Hydrogenated lard after rearrangement[b]	62.61	40.6

[a] From the same animal.
[b] "Directed" rearrangement after slight hydrogenation.

Results

The solubility data for the untreated back fat and leaf lard were identical and are shown in Figure 1. Data for the hydrogenated lards are shown in Figure 2.

The solubilities of all lard samples, like those previously determined for vegetable oils, increased until the critical solution temperature was reached, at and above which the lard and the ethanol were miscible in all proportions. The temperature-solubility curves are similar to those obtained with vegetable oils (1, 2).

TABLE II

Critical Solution-Temperatures for Lard in Ethanol

Lard Sample	Critical solution-temperature °C. concentration of aqueous ethanol		
	99.9%	98.0%	95.4%
Back fat lard	70	80	95
Leaf lard	70	80	95
Hydrogenated lard before rearrangement	70	80	95
Hydrogenated lard after rearrangement	60	70	90

[1] Present address: National Carbon Company (India) Ltd., Calcutta, India.

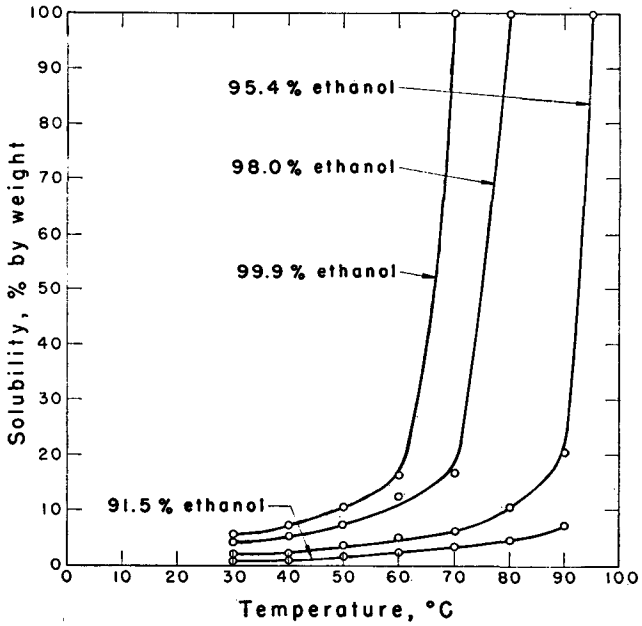

FIG. 1. Solubility of natural lard in aqueous ethanol.

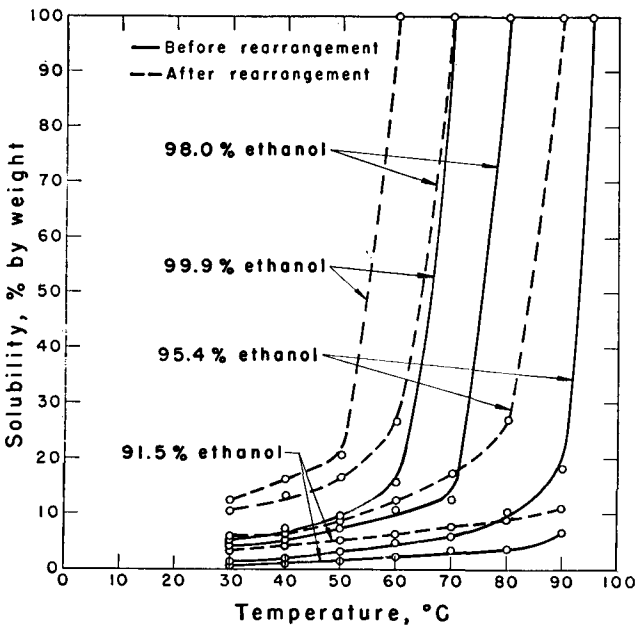

FIG. 2. Solubility of rearranged and unrearranged lard in aqueous ethanol.

The critical solution temperature (Table II) increased linearly with the increase in water content of the ethanol.

Discussion

Apparently the difference in composition of the back fat and leaf lard indicated by the iodine values and

melting points was not sufficient to result in a difference in solubility in ethanol. However the differences between the critical solution-temperatures of the hydrogenated lard before and after rearrangement were quite definite. Since the rearrangement presumably did not change the relative amounts of the different fatty acids in the fat, the difference in solubility may be caused by their relative positions in the glyceride molecule. It is hoped that further work on this problem can be carried out later.

Acknowledgment

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Composition of the Seed and Oil of Cnidoscolus Texanus

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Cnidoscolus texanus (Muell. Arg.) Small *(Jatropha texana)*, family *Euphorbiaceae*, is a wild perennial plant which grows in abundance throughout Oklahoma, Arkansas, and Texas (4). It is commonly known as "bull nettle" but is not related to the plant *Solanum rostratum* sometimes referred to as "bull nettle" and "buffalo burr." *C. texanus* is a low-growing shrubby plant from 18 to 24 in. high, usually occurring in abandoned fields and generally considered an obnoxious weed because of the small spines borne on its stems and leaves. When allowed to mature, *C. texanus* has a large taproot 3 to 4 in. in circumference, with many small secondary roots. The taproot penetrates the soil to a depth of from 4 to 5 feet., and the plant each year grows from the crown of the taproot. The plant bears numerous white waxy flowers with an odor of orange blossoms. The seeds are borne in three-lobed capsules at the tips of the more or less umbelliferous flowering stems, about 27 capsules per plant.

C. texanus matures its seedpods from about the middle of July to the end of August, when, by dehiscence, the seed are scattered within a radius of 4 or 5 ft. about the plant. The seeds are enclosed in a tough, two-layered, seed coat and are slow to germinate.

The composition of the root of *C. texanus* has been determined (6), but no reports of analysis of the seed or oil are available. Two samples of the seed were collected during the 1956 season, one representative of those maturing early and the other late, after the middle of August. A sample of the capsules or hulls of the late maturing seed was also obtained.

The physical dimensions of the whole seed (average of 100) were as follows:

length— 1.38 cm.
width— 0.82 cm.
thickness— 0.52 cm.
weight per 100 seed—25.67 g.

The whole seed and the hulls were ground through a Wiley mill,[2] using a 2-mm. screen, and analyzed by the usual methods (1, 2). The results given in Table I indicate that the seed are rich in both oil and protein. Carotene and ascorbic acid were found to be absent in the seed.

[1] One of the Laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

[2] Mention of the names of firms or trade products does not imply that they are endorsed or recommended by the U. S. Department of Agriculture over other firms or similar products not mentioned.

TABLE I
Composition of Seed and Hulls of *Cnidoscolus texanus* (Moisture-free basis)

Constituent	Whole seed		Hulls
	Early	Late	
	%	%	%
Ash	3.85	3.84	8.18
Protein (N x 6.25)	25.30	28.09	8.39
Oil (petroleum-ether extract)	23.90	27.60	1.90
Crude fiber	30.96	28.95	38.08
Nitrogen-free extract	15.99	11.52	43.45

Analytical data for the oil obtained from the ground seed by extraction with commercial pentane or ethyl ether are tabulated in Table II. These data indicate that the oil is a nondrying oil somewhat higher in linoleic and lower in saturated acids than cottonseed oil. It apparently does not contain glycerides having acids more unsaturated than linoleic acid. The tocopherol present, as determined by the Emmerie-Engle method (3), is in the same range found for many vegetable oils and probably contributes antioxidant properties. The composition of the seed and oil is similar to that reported for the closely related Coastal Plains species, *Jatropha stimulosa* (5).

TABLE II
Characteristics of Oil from *Cnidoscolus texanus* Seed

Characteristic	Early seed		Late seed
	Diethyl ether-extracted	Commercial pentane-extracted	Commercial pentane-extracted
Iodine value (Wijs)	127.8	129.6	131.9
Thiocyanogen value	78.6	79.2	81.5
Saponification value	190.6	192.4	190.1
Tocopherol (%)	—	—	0.032
Acids (calculated from iodine and thiocyanogen values)			
Oleic (%)	25.0	24.2	26.8
Linoleic (%)	58.1	59.5	59.5
Saturated (%)	12.5	11.9	9.3
Acids (spectrophotometric)			
Oleic (%)	25.0	24.2	21.2
Linoleic (%)	57.6	58.8	61.6
Saturated (%)	12.7	12.2	12.4

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