Solubility of Jojoba Oil in Organic Solvents

Sirs:

Solubility data on fatty oils in organic solvents are useful for extractions and crystallizations. Such data is also useful and necessary for carrying out various types of organic reactions particularly those in which the solvent participates in part as a reactant or as a promoter. In the course of studies aimed at producing novel organic products from jojoba oil, the solubility at 15 C of this mixture of long chain fatty acid esters (1) was measured in 20 organic solvents. The solvents, listed on Table I, consist of the common laboratory and industrial solvents and range from non-polar hydrocarbons to ethers, ketones, alcohols and acids.

The jojoba oil used in this study was obtained from So-Cal Jojoba, Inc., Riverside, California. Both the natural oil and the refined colorless oil gave similar solubility results. Reduction with lithium aluminum hydride in tetrahydrofuran and analysis of the resulting alcohols by g.c./mass spectrometry gave the following results: palmitoleyl alcohol, 0.65%; oleyl alcohol, 5.5%; eicosenol, 59.7%; docosenol, 29.4%; tetracosenol, 4.4%; saturated alcohols, 0.35%. These results confirm earlier analysis from experiments by McKinney and Jamiesen (2) and Miwa (3,4).

Most solvents were reagent grade and were checked for purity by gas liquid chromatography. The less common solvents—dimethylsulfoxide, dimethylformamide, aniline, phenylacetonitrile and m-cresol—were obtained from established suppliers and the purity confirmed as 98+% by gas-liquid chromatography and infrared spectroscopy. Solubilities were determined by the visual observation of the disappearance of haze when solutions were mixed in a constant temperature bath held at 15 C. Duplicate samples of 0.2 g of jojoba oil were placed in vials and in each case 2 ml of solvent were added with magnetic stirring. When complete solubility disappearance of haze was observed at this concentration, the mixture was considered soluble. With less soluble solvents additions were made using a burette and observing the solutions after 0.2 ml additions of solvent.

Two ternary liquid systems were examined with solvents of lower solubility for jojoba oil. The 2 systems included jojoba-methanol-toluene and jojoba-dimethylformamide-toluene. Both systems are well adapted for the 3 component experiment of Vernon and Brown (5). In these experiments the initial mixture of jojoba oil and methanol or jojoba oil and dimethylformamide are placed in an Erlenmeyer flask and in each case toluene is added from a

TABLE I

Solubility Characteristics of Jojoba Oil in Common Organic Solvents at 15 C[a]

Solvent	ml of solvent	Observation[b]
Water	5.0	I
	10.0	I
Acetic Acid	10.0	I
	40.0	I
	50.0	S
Methanol	1.0	I
	10.0	I
	40.0	S
Ethanol	1.0	I
	5.0	I
	20.0	S
t-Amyl Alcohol	1.0	S
1-Butanol	1.0	S
Acetone	1.0	I
	3.0	I
	8.0	S
Benzene	1.0	S
Toluene	1.0	S
Carbon Tetrachloride	1.0	S
s-Tetrachloethane	1.0	S
Diethylether	1.0	S
Tetrahydrofuran	1.0	S
Hexane	1.0	S
Cyclohexane	1.0	S
Dimethylformamide	1.0	I
	10.0	I
	30.0	S
Dimethylsulfoxide	1.0	I
	5.0	I
	20.0	S
Acetonitrile	1.0	I
	10.0	I
	30.0	S
Aniline	2.0	S
m-Cresol	2.0	S

[a]All measurements used 0.2 g.
[b]I = insoluble; S = soluble.

TABLE II

Solubility Data for the 3-Component System, Jojoba-Methanol-Toluene

Jojoba oil		Methanol		Toluene	
ml	Vol %	ml	Vol %	ml	Vol %
10.0	42.0	2.0	8.3	11.8	49.7
10.0	21.7	10.0	21.7	26.0	56.6
10.0	11.7	30.0	35.1	45.6	43.2
2.0	8.4	10.0	42.0	11.8	49.6
2.0	5.0	20.0	50.0	18.5	45.0
5.0	9.7	20.0	39.1	26.2	51.2
5.0	7.2	30.0	43.6	33.8	49.2
10.0	32.1	4.0	12.8	17.1	55.1
10.0	49.9	1.5	7.0	8.6	43.1
10.0	60.0	0.5	3.2	6.1	36.8

TABLE III

Solubility Data for 3-Component System, Jojoba-Dimethylformamide-Toluene

Jojoba oil		Dimethylformamide		Toluene	
ml	Vol %	ml	Vol %	ml	Vol %
10.0	38.5	2.0	7.7	14.0	53.8
10.0	23.0	10.0	23.0	23.4	53.9
10.0	8.8	50.0	44.1	53.4	47.1
2.0	14.0	5.0	35.2	7.2	50.7
2.0	8.5	10.0	42.7	11.4	48.7
2.0	4.9	20.0	49.1	18.7	45.9
25.0	50.0	2.5	5.0	22.5	45.0
25.0	60.5	0.8	2.0	15.5	37.5

burette in 0.5 ml increments while the flask contents are stirred at room temperature. The mixture initially is hazy while at the equilibrium point the solution becomes clear. In this way the amounts of toluene necessary at equilibrium have been determined and recorded for the jojoba-methanol-toluene system in Table II and for the jojoba-dimethylformamide-toluene system in Table III.

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