AN INTERESTING EMULSION.*

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Some months ago there came to my attention an emulsion of cod-liver oil which differed in physical appearance from most pharmaceutical emulsions. It claimed to contain 40 per cent of cod-liver oil, and to be of particular advantage in preserving the vitamine content.

The emulsion was white, of smooth consistency, showed a slight separation of oil at the top (the bottle being filled into the neck, where about 2 cc. of clear oil showed) but no watery layer at the bottom, and was very limpid. In this last respect it resembled the viscosity of a thin cream more than the usual pharmaceutical emulsions.

It was slightly acid in reaction, diluted easily with water, and even when diluted with four or five volumes of water it did not separate a watery layer after standing several days. Alcohol in the proportion of 1 volume of emulsion to 5 volumes of alcohol only partially broke the emulsion, but the addition of hydrochloric acid broke it quickly. These reactions are the opposite of what one gets with the usual pharmaceutical emulsion.

An assay showed the presence of about 35 per cent (34.9%) of oil, and the aqueous portion did not respond to a test for gums, soaps, saponin or albuminous matter.

The emulsifying agent then became the object of curiosity, and in order to secure it in an unchanged condition, a portion of the emulsion was diluted with five times its volume of methyl alcohol and the oil extracted by repeated shakings with petroleum ether. The oil thus extracted showed the presence of considerable fatty acid, and was rather dark in color. The treatment it had received might account for this condition.

On evaporating the aqueous-alcoholic liquid, after extracting the oil, a creamy-white powder was obtained, which on ignition turned momentarily dark then became nearly white and appeared to suffer no change in character on ignition. About 0.5 Gm. of this powder was obtained, from 100 cc. of emulsion.

It was insoluble in hydrochloric acid of 10 per cent, 20 per cent or 37 per cent strengths (approximately) and was not soluble in warm solution of potassium hydroxide. After ignition with dry sodium carbonate, a considerable portion dissolved in water, indicating that it consisted largely of silica, or a silicate.

Emulsions were then made, using 40 cc. of cod-liver oil, 60 cc. of water and 0.5 Gm. of (*a*) kaolin, (*b*) silica gel and (*c*) Lloyd's reagent. Each made fairly good emulsions, but except that they were all very limpid they had little resemblance to the original emulsion. Each separated a watery layer at the bottom in a short time. The silica gel made the best emulsion, kaolin came next and Lloyd's reagent gave an indifferent product.

These experiments suggested that a finer silica might produce something nearer to that desired, and the following was tried.

Two and a half cc. of solution of sodium silicate was diluted to 60 cc. with water and 40 cc. of cod-liver oil added. On shaking, a smooth and thin emulsion

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formed at once, which had a consistency and appearance similar to that of the pattern. But it soon separated a watery layer, and, furthermore, it was strongly alkaline.

Glacial acetic acid was now added cautiously, with shaking. No effect was apparent at once, but after a number of hours the separation of water was markedly less. In the course of about a week, 0.57 cc. of the acid had been added, and only a thin layer of water separated after standing over night. The emulsion now had a slightly acid reaction. More acid caused a separation of oil, and the emulsion also thickened.

Corresponding experiments were tried, using 2 cc. and 3 cc., respectively, of solution of sodium silicate per 100 cc. of emulsion. The lesser amount produced a thinner emulsion which separates into layers more readily, and the larger amount makes a slightly thicker emulsion which is not quite so smooth, but scarcely separates. In each case the reaction proceeds slowly, requiring a week or more for results—the acid being used in proportionate amounts.

These results suggested that a different neutralizing agent might improve the product; aluminum sulphate, also normal aluminum acetate, were tried.

Solutions were made of these salts and the solutions were added cautiously to sodium silicate emulsions. The emulsions changed slowly in each case, they gradually thickened and less of watery layer separated.

My curiosity being now satisfied, I have not attempted to perfect the emulsion, which appears to be too close to the danger line of stability to exploit.

The following formulas gave the best results, and samples are shown herewith.[1]

(1)	Cod-Liver Oil	40 cc.
	Solution of Sodium Silicate	2 cc.
	Aluminum Sulphate	0.9 Gm.
	Water, to make	100 cc.
(2)	Cod-Liver Oil	40 cc.
	Solution of Sodium Silicate	2.5 cc.
	Glacial Acetic Acid	0.57 cc.
	Water, to make	100 cc.
(3)	Cod-Liver Oil	40 cc.
	Solution of Sodium Silicate	3 cc.
	Aluminum Acetate	1 Gm.
	Water, to make	100 cc.

Of these three, the one made with aluminum sulphate seems to be the most stable.

In some of the experiments the emulsion broke after adding a fresh portion of the neutralizing agent, and considerable oil separated, but on further repeated shakings the emulsion sometimes formed again. This again indicates that the non-separable emulsion is only secured by a very cautious neutralization of the sodium silicate solution whereby a balance is obtained between the saponifying effect and the gelatinizing point of the silicate solution.

[1] Shown at Portland.

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