Olive Oil as a Solvent for Certain Organic Vapors

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According to Henry's law the solubility of a gas (or vapor) in a liquid is proportional to its partial pressure above the solution, in accordance with the equation $p = KC$, where p is partial pressure of the vapor; C, its concentration in solution at equilibrium; and K, a constant. In certain toxicity studies at Edgewood Arsenal, olive oil was used as representative of the body fats, and in connection with proposed calculations of a theoretical nature it was desired to determine to what extent the solubility of the vapors of certain organic compounds in olive oil proceeds in accordance with Henry's law.

The organic compound (about 40 cc.) was contained in a bead bubbler with a diameter of about 40 mm. and capacity of about 80 cc. of liquid, which gave within 2 per cent of saturation at a moderately slow rate of air flow of about 50 cc./minute. Dry air was passed through the bubbler at a measured rate of flow and mixed with a second metered stream of dry air. The diluted vapor was then bubbled through olive oil of known weight, contained in parallel absorption tubes (for check results). The apparatus was all glass except for a few rubber connections, and except for the flowmeters was immersed in a water bath maintained at constant temperature. The concentration of vapor in the air stream was calculated from the flow rates. The saturation concentration in air, shown in Table 1, was based on the assumption that the vapor follows the ideal gas law.

Pompeiian brand olive oil was used from newly opened cans.

TABLE 1

ABSORPTION OF VAPORS* BY OLIVE OIL* AT 20° C.

Nitromethane		Chloroform	
Vapor pressure..... 28.4 mm. Saturation concentration..... 94.9 mg./l.		Vapor pressure..... 160 mm. Saturation concentration..... 1,046 mg./l.	
Saturation in air (%)	Mole fraction in oil†	Saturation in air (%)	Mole fraction in oil†
10.9	0.11	13.2	0.50
17.1	0.16	23.8	0.63
23.8	0.21	43.0	0.75
33.7	0.28		
42.8	0.32		

* In one experiment with menthol (v.p. = 0.021 mm. and saturation concentration = 0.18 mg./l.) it required 66 hours to reach equilibrium; the mole fraction in oil was 0.19 at 31.8 per cent of saturation in air.

† Molecular weight of olive oil taken as 885. Saponification value = 193.

This oil was brought to constant weight by passing dry air through it for 4 days at 20° C., at the end of which time it was found not to lose weight appreciably. In the solubility determinations (Table 1) at definite partial pressure of vapor it was found that equilibrium was reached in 11–14 hours, as determined by constancy of weight of the absorption tubes.

The solubility data for the two compounds in olive oil are plotted in Fig. 1 in such a way as to compare the experimental data with the ideal solution behavior (the broken line in Fig. 1) expressed by Raoult's law, $p = p_0x$. Since the data represent systems of two miscible liquids, no distinction need be drawn between solvent and solute. When plotted as indicated, chloroform, for example, would conventionally be considered as the solvent and olive oil as solute, with p_0 as the saturation pressure of chloroform; x, its mole fraction in the solution; and p, its pressure at the concentration x. The oil-chloroform system shows a great negative deviation (above-normal solubility of chloroform).

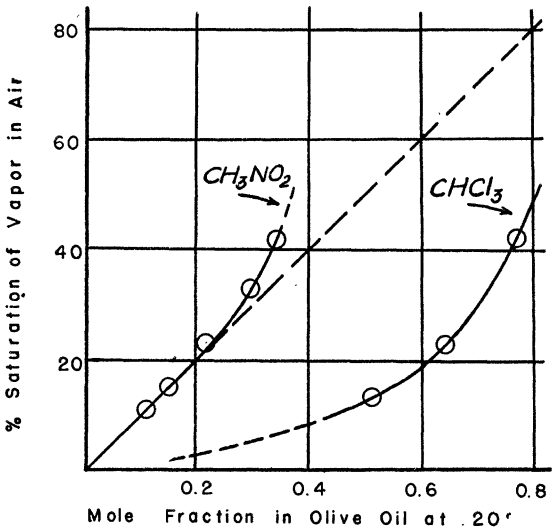

FIG. 1. Deviations from Raoult's law (olive oil as solute); deviations from Henry's law (olive oil as solvent).

TABLE 2

Concentration of nitromethane (grams/100 grams solution)	Temperature (°C.)
Solubility of nitromethane in olive oil	
9.31	3.0
10.79	17.1
11.94	24.5
14.65	41.2
Solubility of nitromethane in water	
9.32	0.7
10.39	15.8
11.29	25.7
13.17	40.5

The oil-nitromethane system, considering nitromethane as solvent, follows Raoult's law fairly well up to a concentration of about 0.2 mole fraction of nitromethane. At higher concentrations than this there is a pronounced positive deviation (below-normal solubility of nitromethane). Although the vapor solubility work was not carried out at higher concentrations than those shown in Fig. 1, it was found that nitromethane and olive oil form a two-liquid system at 20° C. when the mole fraction of nitromethane in the oil phase reaches 0.67 (interpolated from data in Table 2).

To interpret the data on the basis of Henry's law, olive oil

is regarded as the solvent, which corresponds with the experimental procedure. Dilute solutions with nitromethane as solute follow this law to the extent that Raoult's law is followed as stated above. As to chloroform as solute, data were not obtained at low enough concentrations to determine if the ratio between concentration in the oil phase and pressure in the vapor phase would be constant in dilute solution.

Solubility of nitromethane in olive oil and in water. The solubility determinations were made by the synthetic method, using total quantities of about 5 grams in sealed glass tubes. Temperatures at which turbidities appeared or disappeared could be determined over a range of about 0.5°. The data obtained are recorded in Table 2.

New Rectal Culture Tube[1]

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The importance of examining material obtained directly from the intestinal wall in the diagnosis of infectious diarrheas has been stressed in recent years by students of the subject. The sigmoidoscopic mucosal crypt aspirator has been described elsewhere (*1*). It is essentially a heavy-walled capillary tube 40 cm. in length, with the distal 2.5 cm. bent 15 degrees for better approximation of the tip to the intestinal mucosa. At the point of bending, the capillary canal is blown into a small elliptical-dilatation of sufficient size to hold two or three drops of aspirated material. This instrument requires the use of a sigmoidoscope, and it is applied to the mucosa by direct vision.

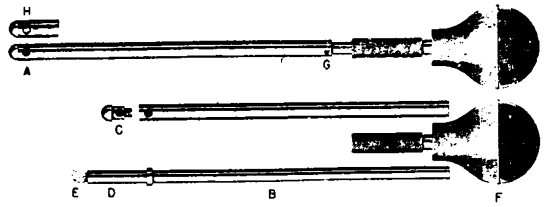

FIG. 1

The new rectal culture tube (Fig. 1) may be used without the aid of the proctoscope or sigmoidoscope. It consists of a metal outer tube 18 cm. in length with a round opening 0.5 cm. in diameter (A) near its distal end. An inner tube (B) screws into a detachable receptacle (C) with smooth tip 1.4 cm. in length and containing a shallow trough. When fitted together, the trough coincides with opening A in the outer tube and may be opened or closed by a quarter turn at D, which represents the proximal end of the inner tube, containing a cotton filter (E), to which a small aspirating rubber bulb (F) is attached.

In actual use, the sterile, assembled, rectal culture tube (without rubber bulb), contained in a stoppered sterile test tube, is removed and lubricated at its distal end (A) by dipping it into sterile glycerine. The rubber bulb is attached to the proximal end. The metal tube, with receptacle at A closed, is then inserted into the rectum for a distance of approximately 10 cm. The inner tube is given a quarter turn, indicated by an arrow at G and a small stop at H. This opens the receptacle at A, which is then applied to the rectal mucosa. The exudate is aspirated into the receptacle, which is promptly closed by a quarter turn in the reverse direction, and the instrument is removed from the bowel. The material may be cultured and wet smear studies made at once by opening the receptacle and blowing out the aspirated material on suitable culture media and slides; or the closed instrument can be dropped into the original test tube and transported to the laboratory. Sterilization and cleaning of the three simple components of the instrument are effected quickly, efficiently, and economically.

[1] The author wishes to acknowledge the assistance given him by Clay-Adams Company, 44 East 23rd Street, New York City, in the designing of this tube.

Reference

1. FELSEN, J. *J. lab. clin. Med.*, 1938, **23**, 630.

Comparison of Hematocrit Methods[1]

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In connection with a study on relative corpuscle and serum (plasma) volumes in blood, selection of a reliable hematocrit method has become a matter of primary concern. While the physical factors which affect the final volume of centrifugally packed corpuscles are well known (*4*, *5*, *6*), this information is frequently ignored in practice, with the result that many different forms of apparatus have been proposed and are in common use for routine work. In these experiments, three such methods were compared, first, as to their reliability in detecting known dilutions of blood, and second, as to differences among the absolute measurements obtained.

The comparisons were made on each of 10 samples of defibrinated beef blood, and on 3 dilutions of each sample with its own serum. The dilutions contained 90, 80, and 50 per cent of whole blood, respectively.

The types of hematocrit tubes employed and the details of centrifugation were as follows:

Method 1. Straight-walled glass tubes of the Daland (*1*) type, 50 mm. long with 1-mm. bore, were rotated in a standard Daland head at 12,000 r.p.m. and 4.7-cm. effective radius (centrifugal force, approximately 7,500 × G) until constant sediment volumes were obtained. This usually required less than 10 minutes of actual spinning and in every instance caused translucence of the sediment column (*3*).

Method 2. Straight-walled glass tubes of the Wintrobe (*7*) type, 11.5 cm. long with 3-mm. bore, sealed at one end, were rotated in an International centrifuge at 3,000 r.p.m. and 14-cm. effective radius (centrifugal force, approximately 1,400 × G) for one hour.

Method 3. Ordinary, tapered, graduated, 15-ml. centrifuge tubes, containing 10 ml. of blood, were rotated at the same time and under the same conditions as described for Method 2, following closely the recommendations of Haden (*2*).

All tests were in duplicate, the pairs being centrifuged simultaneously. Paired observations differed by 1.0 volume per cent or less in 95 per cent of the tests.

[1] Presented before the 31st Annual Meeting of the Federation of American Societies for Experimental Biology, Chicago, Illinois, May 18–22, 1947.