A STUDY OF THE SURFACE TENSION OF BLOOD SERUM BY THE DROP WEIGHT METHOD. DISSERTATION

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DISSERTATION

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN THE FACULTY OF PURE SCIENCE IN COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

BY

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CONTENTS

A Study of the Surface Tension of Blood Serum by the Drop Weight Method

Ascoli and Izar* have shown that the immunizing reaction in pathological blood serum is accompanied by a lowering of the surface tension of the serum. They used Traube's stalagmometer, working at room temperature, and observed the change in the number of drops in a given volume of the serum after the immunity reaction had taken place. It seemd advisable to confirm this change, which they cald the Meiostagmin reaction, by the more accurate drop weight apparatus of Morgan.† At the same time it was thought that an accurate study of the surface tension of normal and pathological blood serum might be valuable, and that there might be a normal value for the surface tension of the blood serum of all mammals.

In mesuring surface tension by such methods as capillary rise or the drop method (stalagmometer), the density of the liquid must be used to change the height of the liquid in the capillary tube or the drop volume to surface tension. But since drop weights from any one tip are proportional to surface tensions, for any liquid and any temperature, it is only necessary to get the weight of the falling drop, thus avoiding the error and difficulty of determining densities. From drop weights then we have

$$\gamma = \text{weight} \times \text{constant}$$

This work, which is necessarily rather fragmentary, is divided into the following parts,—

*Juhnke, *Interstate Medical Journal, 18*, 233, (Feb. 1911)
†Morgan, *Jour. Amer. Chem. Soc. 32*, 349 (1911)

I Surface tension of blood serum.
- A— Dog serum; the condition of the dog being controld.
- B— Human serum, normal and pathological.
- C— Comparison of different animal sera.

II The Meiostagmin reaction; the decrease in surface tension accompanying the union of antibody and antigen.

APPARATUS AND METHOD

The apparatus used is the same as described by Morgan.* For mesuring the drop weight of serum the apparatus was allowd to remain in a constant temperature bath regulated at 37°C. (body temperature) for nearly half an hour, then a drop of the serum was puld over and left hanging for five minutes in order that the air in the weighing vessel should be saturated with its vapor. This drop was then carefully forced back into the supply vessel, which containd about 5 cc. of serum, and a fresh drop was slowly puld over and allowd to fall of its own weight. The weighing vessel was then weighd as usual after condensing the vapor in it by water at room temperature for one minute. Next a blank was run in the same way, except that the drop was not allowd to fall, and by subtracting this weight from the other the correct weight of one drop of the serum was obtaind.

The determinations in the Meiostagmin reaction were made at o°C. as there is almost no evaporation at that temperature and in order that no reaction should go on in the solution during the determination. Five drops were taken and weighd, and no blanks were necessary.

As in the work on water and solutions, the tip had to be cleand after each determination or the results would be

Loc. cit.

too low. The cleaning was best done by alkalin permanganate solution followed by chromic acid in diluted sulfuric acid, then the tip was washt with distild water and dried by suction.

Standardization of Tip

One tip was standardized on benzene at 30°. The constant is found by means of a modified Ramsay and Shields equation,

$$K = \frac{W\left(\frac{M}{d}\right)^{2/3}}{t_c - t - 6}$$

in which W=drop weight in milligrams, M=78, d=.86824, and t_c=288 5. Surface tensions may be found from the ratio

$$W : \gamma :: K : K' \quad \text{or} \quad \gamma = \frac{K'}{K} W$$

γ will be in dynes per centimeter, and K′ is the surface tension constant from the Ramsay and Shields formula, K′ = 2.1148.*

Tip I gave the following results with benzene at 30°.

Vessel + 30 drops	Vessel + 5 drops		
11.7112	10.9695		
11.7113	10 9694	25 drops	= 0.74182 gram.
11.7114	10.9697		
11.7113	10.9695	1 drop	= 0.0296728
11.7114	10.9693		
11.7112			= 29.67 mg.
11.71130	10.96948		

$K = 2.3572$

$\gamma = \frac{2.1148}{2\ 3572} W = 0.8972\ W$

*Morgan and McAfee, *Jour. Amer. Chem. Soc.* **33**, 1275. (1911)