typhi the limit of inhibition is somewhat less than 1:10,000 without serum and somewhat less than 1:5000 with serum.

4. Spores of *Trichophyton gypseum were readily inhibited, which fact was shown in* agar cup-plate tests by the formation of a clear zone of 20 m./m. width without serum and a zone of 14 m./m. when ten per cent serum was added.

5. Solutions in various mixtures of oils, using the spores of *Trichophyton gypseum*, gave clear zones of 4 and 5 mm. width according to the kinds of oil used. This fact demonstrates that solutions in oil may penetrate and inhibit growth of microörganisms. It should be noted in this connection that in agar cup-plate tests the size of the area of inhibition depends not only on activity of the antiseptic, but also on its ability to penetrate the agar jelly.

6. Spores of *Bacillus subtilis* were destroyed in five minutes or less in a concentration of 1 Gm. of the ammonium chloride compound in 500 cc. of aqueous solution.

7. Spores of two types of fungi were destroyed in five minutes or less by the same concentration 1:500.

8. A limited number of tests for disinfecting the human skin demonstrated that ten per cent solution in distilled water or in ethyl alcohol actually destroyed microbial life with no immediate or deferred irritation of the skin observed. Manifestly, this work should be extended in order to determine the exact concentration required to yield satisfactory results.

REFERENCES.

(1) Domagk, *Deut. Med. Wochschr.*, 21, 827 (1935).
(2) U. S. Department of Agriculture *Circular 198*.
(3) *The American Journal of Surgery*, 23, 371 (1934).

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p_H STUDIES OF MILK OF MAGNESIA WITH THE GLASS ELECTRODE.

BY J. A. C. BOWLES* AND E. C. MERRILL.[1]

It has been known for some time that Milk of Magnesia develops an unpleasant taste after standing in ordinary glass bottles for several months. This was thought to be due to the Milk of Magnesia attacking the silicates of the glass causing an increase in hydroxyl ions. Billheimer and Nitardy (1) found that the addition of a small amount of citric acid to Milk of Magnesia yielded a buffer of sufficient capacity to prevent, for a considerable time at least, any objectionable increase in hydroxyl ions. In their investigation they used only Milk of Magnesia made (private communication) by the double decomposition method.

The purpose of this work was (1) to study the change in p_H of Milk of Magnesia made by the direct hydration and double decomposition methods on standing in ordinary glass bottles; (2) to determine the p_H's of Milk of Magnesia made by

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both methods upon the addition of small amounts of citric acid; (3) to see if the p_H of Milk of Magnesia made by both methods and containing small amounts of citric acid changed upon standing in ordinary glass bottles; (4) to study the changes in viscosity of the milks upon the addition of citric acid; (5) to study the permanent effect of heat upon the viscosity of the two milks with and without citric acid present.

The p_H determinations were made at room temperature with a glass electrode and vacuum tube potentiometer. The glass electrode was calibrated each day against several standard buffer solutions.

The viscosity measurements were not only relative but significant. They were made with a MacMichael viscosimeter at room temperature. A standard No. 22 wire and big plumb bob were used. The Milk of Magnesia being tested was added to the 3-cm. mark on the spindle. The speed was 20 r. p. m.

Milk of Magnesia made by both methods and having a p_H of 10.55 was stored for nine months in ordinary glass bottles of different size, shape and color. At the end of nine months the Milk of Magnesia made by direct hydration had a p_H of 10.62, whereas the p_H of the Milk of Magnesia made by double decomposition had increased to 11.2.

Milk of Magnesia made by both methods was treated so that it contained 0.1% citric acid. The p_H was then 10.10. These treated milks were stored for nine months in the same kind of bottles mentioned above. At the end of nine months the p_H's of these milks were again determined, and found to be 10.15. See tabulation of results in Table I.

TABLE I.—CHANGE IN p_H OF MILK OF MAGNESIA ON STANDING IN ORDINARY GLASS BOTTLES.

Length of Time in Bottles (Years).	Milk of Magnesia Direct Hydration.	Milk of Magnesia Direct Hydration (0.1% Citric Acid).	Milk of Magnesia Double Decomposition.	Milk of Magnesia Double Decomposition (0.1% Citric Acid).
..	10.55	10.10	10.55	10.10
0.75	10.62	10.15	11.22	10.15
1.0	...	...	11.42	...
1.5	...	...	11.50	...
2.8	...	...	11.68	...
3.5	...	...	11.75	...

It would seem from the above results that the work of Billheimer and Nitardy (1) on Milk of Magnesia made by the *standard double decomposition method* has been confirmed. However, they did not study the effect of Milk of Magnesia made by the direct hydration process upon ordinary glass bottles. The impression one gets from their conclusions is that magnesium hydroxide is responsible for the attack upon the silicates of ordinary glass bottles resulting in a considerable increase of hydroxyl ions. Our p_H measurements lend no support to this view, because the p_H of Milk of Magnesia made by direct hydration was found not to increase appreciably upon standing in ordinary glass bottles. This work does support their conclusion that 0.1% of citric acid added to Milk of Magnesia made by double decomposition results in a buffer of sufficient capacity to insure against any increase in hydroxyl ions for a considerable time.

While adding solid citric acid to Milk of Magnesia, it was noticed that the viscosity of it was lowered appreciably. This proved to be beneficial in the case of Milk of Magnesia made by direct hydration because the viscosity of this milk tends to increase while in storage. The viscosity of Milk of Magnesia made by direct hydration and containing citric acid does not become constant for quite some time after the addition of the acid; whereas, in the case of Milk of Magnesia made by double decomposition the viscosity, although lowered with increased amounts of citric acid, becomes constant within an hour or so after the addition. However, what the final viscosities of the milks will be depends upon their original viscosities. Tables II and III are typical examples of the changes in viscosity with time of Milk of Magnesia, which have been made by the double decomposition and direct hydration methods and which contain small amounts of citric acid.

TABLE II.—CHANGE IN VISCOSITY AT ROOM TEMPERATURE OF MILK OF MAGNESIA (DIRECT HYDRATION) CONTAINING SMALL AMOUNTS OF CITRIC ACID.

	Viscosity of Milk of Magnesia Containing:						
Time after Addition of Acid (Days).	0.00% Citric.	0.02% Citric.	0.05% Citric.	0.08% Citric.	0.10% Citric.	0.15% Citric.	0.20% Citric.
1	57.0	52.0	52.0	49.0	45.0	43.0	33.0
3	58.0	53.0	50.0	46.0	43.0	36.0	..
6	59.0	49.0	47.0	44.0	40.5	32.5	19.5
12	60.0	49.0	46.0	..	40.3	30.0	15.0
25	..	..	45.5	41.0	38.5	..	..
37	63.0	53.0	..	40.0	..	30.0	15.0
51	..	53.0	..	39.0	..	..	..

TABLE III.—CHANGE IN VISCOSITY AT ROOM TEMPERATURE OF MILK OF MAGNESIA (DOUBLE DECOMPOSITION) CONTAINING SMALL AMOUNTS OF CITRIC ACID.

	Viscosity of Milk of Magnesia Containing:					
Time after Addition of Acid.	0.00% Citric.	0.02% Citric.	0.05% Citric.	0.08% Citric.	0.10% Citric.	0.15% Citric.
1 Hour	39.0	29.0	21.0	19.5	19.0	17.0
1 Day	38.0	29.0	20.0	..	..	..
2 Days	..	..	..	19.5	18.0	16.0
3 Days	39.0	29.0	20.0	..	..	..
5 Days	..	..	..	19.0	18.0	..
8 Days	39.0	30.0	21.0	..	..	..
15 Days	39.0	30.0	20.5	..	..	..

It was thought that by increasing the temperature the viscosity of the milk made by direct hydration and free from citric acid would increase and that containing the acid would decrease. This was found to be true.

The milks were heated to 90° C. in glass-covered pyrex Erlenmeyers. They were weighed at room temperature before and after heating to insure against any loss of water. The viscosity measurements were done at room temperature. A typical example of how the viscosity of a Milk of Magnesia made by direct hydration and free from citric acid increases when heated at the above temperature is the case where the viscosity rose from 72 to 87 after two hours of heating. The maximum viscosity is only attained after several hours of heating.

The lowering of the viscosity by increasing the temperature of a milk containing varying amounts of citric acid is shown in Fig. 1. It is to be noted that the greater the initial concentration of acid, the greater the decrease in viscosity.

Another result, which is considered of interest, was the determination of the p_H's of Milk of Magnesia made by both processes which contained different amounts of citric acid. The results tabulated in Tables IV and V show that the milks made by both methods and varying from 7.5 to 8.0 per cent of magnesium hydroxide had practically the same p_H after the same quantity of citric acid had been added.

Table IV.—Change in p_H and Viscosity of Milk of Magnesia (Direct Hydration) after Addition of Small Amounts of Citric Acid.

	Milk Assayed 7.52% $Mg(OH)_2$.		Milk Assayed 7.97% $MgOH_2$.	
Per Cent Citric Acid.	p_H.	Viscosity.	p_H.	Viscosity.
Plain	10.55	59.0	10.47	52.0
0.02	10.38	53.5	10.35	43.0
0.05	10.22	50.5	10.20	39.0
0.08	10.12	42.5	10.11	34.0
0.10	10.10	39.0	10.07	30.0
0.15	10.02	25.0	10.02	25.0
0.20	...	..	9.95	16.0

Table V.—Change in p_H and Viscosity of Milk of Magnesia (Double Decomposition) after Addition of Small Amounts of Citric Acid.

	Milk Assayed 8.02% $Mg(OH)_2$.	
Per Cent Citric Acid.	p_H.	Viscosity.
Plain	10.40	39.0
0.02	10.30	30.0
0.05	10.20	20.5
0.08	10.08	19.0
0.10	10.05	18.0
0.15	10.00	16.0

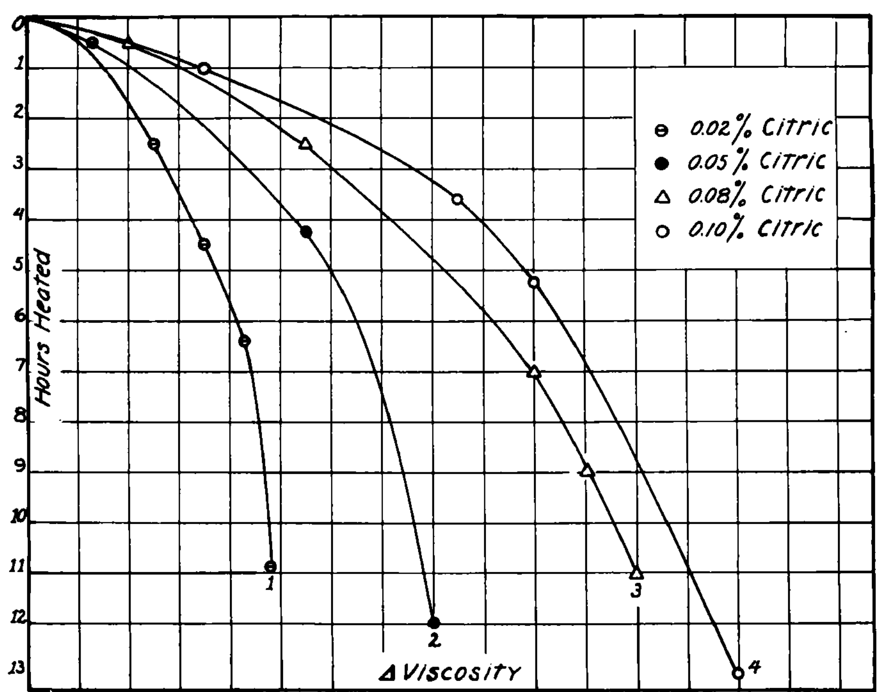

Fig. 1.—Change in viscosity of milk of magnesia (7.52% $Mg(OH)_2$) containing citric acid. Curves 1, 2, 3 and 4 represent milk of magnesia containing 0.02, 0.05, 0.08 and 0.10 per cent citric acid, respectively.

SUMMARY AND CONCLUSIONS.

The p_H studies on Milk of Magnesia made by the standard double decomposition and direct hydration methods have been made with the glass electrode and vacuum tube potentiometer.

The p_H of Milk of Magnesia made by direct hydration and stored in ordinary glass bottles for nine months increased but slightly—about 0.07 p_H.

The p_H of Milk of Magnesia made by the standard double decomposition method and stored in ordinary glass bottles for nine months increased considerably—about 0.6 p_H.

The p_H of Milk of Magnesia made by both methods and containing 0.1% citric acid was 10.10. These milks showed no appreciable change in p_H after standing in ordinary glass bottles for nine months.

The p_H determinations on Milk of Magnesia made by both methods and containing small amounts of citric acid have been made.

The addition of citric acid lowers the viscosity of both milks.

The viscosity of Milk of Magnesia made by direct hydration tends to increase while in storage. Citric acid prevents this.

The viscosity of Milk of Magnesia made by both processes and containing small amounts of citric acid are increasingly lowered by prolonged heating.

ACKNOWLEDGMENT.

We are indebted to E. C. Towle of these laboratories for many helpful suggestions.

REFERENCE.

(1) Billheimer, E. C., and Nitardy, F. W., JOUR. A. PH. A., 25, 36–38 (1936).

AN IMPROVED COLOR TEST FOR VITAMIN A.*

BY A. E. PACINI AND M. H. TARAS.[1]

The Carr-Price reaction which occurs when Vitamin A is added to a saturated solution of $SbCl_3$ has afforded a basis for computing the vitamin A potency of various fish and animal oils. This reaction is not specific for vitamin A, since carotenoids also show the blue coloration and it has the further disadvantage of changing color within thirty seconds. Various substitute tests have been offered among which are the $AsCl_3$-$CHCl_3$ solution (1), $SbCl_3$ plus *o*-dihydroxybenzene in $CHCl_3$ (2), H_2SO_4 (3), trichloracetic acid (4), pyrogallol (5), anhydrous $FeCl_3$ (6), anhydrous $SnCl_4$ (7), anhydrous H_3PO_4 (8), also colors produced by polyphenols and aromatic and heterocyclic amines. Most of the latter produce vague browns, yellows and intermediate shades which might be due solely to oxidation of the yellow colored cod or other fish liver oil (9).

It has been suggested that the color changes produced, especially in the presence of a phenol compound, are the result of a keto-enol rearrangement of the

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