

## SOME OBSERVATIONS ON THE STABILITY OF VITAMIN C.

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It is well-known that Vitamin C rapidly undergoes oxidation on exposure to light and heat. It is also known that the oxidation is much more rapid in alkaline than in acid solution. This experiment was carried out in order to study the rate of deterioration of Vitamin C under different conditions and to find the conditions of its maximum stability. Even in well-known standard books conflicting records of observations have appeared. The B.P.C., 1934 states, "The zone of optimal stability at ordinary temperature is in the neighbourhood of the natural acidity of the lemon juice (pH 2.2) and natural lemon juice can be kept without loss of potency for as long as 14 months at room temperature without any addition". Whereas according to Extra Pharmacopoeia, 1943, the point of maximum stability lies at about pH 5.4.

In our experiments we have observed the following four facts. The results of observation have been given in tabular form. The estimation of Vitamin C was carried out by titration with a standard solution of Iodine.

### (1) Rate of deterioration of Vitamin C in aqueous medium.

(a) In one series a 0.543 per cent w/v solution of Vitamin C was prepared and kept in two separate glass stoppered bottles in the dark, in one of the bottles nitrogen was filled before storing. Samples were drawn after 3 hours and 22 hours from each bottle and the vitamin C was estimated and per centage of deterioration was calculated. Results are given in Table I.

(b) In a second series of experiments the percentage of deterioration at different concentrations of Vitamin C was determined after a fixed period of storage under the influence of atmospheric oxygen. Results are given in Table II. It will be observed that a dilute solution of Vitamin C deteriorates faster than the concentrated ones.

### (2) Rate of deterioration of Vitamin C in 10 per cent Phosphoric acid.

Various concentrations of Vitamin C in 10 percent phosphoric acid solution, were prepared and the experiments were carried out under atmospheric oxygen as well as that of nitrogen with constant stirring. The deterioration rate was much faster if the solution was stirred continuously when stored. Experiments were carried out both in darkness and under exposure to ultraviolet light of wave length 3650A. No appreciable difference in the rate of deterioration was observed in the presence and absence of the light of this wave length, within the short period of time of experiment. Results are given in Table III.

### (3) Rate of deterioration of Vitamin C in 1.9% metaphosphoric acid solution.

No deterioration was observed in this case under the influence of atmospheric oxygen. This is shown in Table IV.

### (4) Stability of Vitamin C at different pH.

The rate of deterioration of Vitamin C was studied at different pH values. A number of different buffers were used. The concentration of the solution was within the range 0.53%—0.62%. In table V are collected data of the rates of decomposition of Vitamin C at pH values ranging from 2.2 to 8 obtained by using three different types of buffer solutions.

From a study the table we find that the Vitamin C solution is most stable at pH 2.2 in all the buffers. But at higher pH values the stability depends on the chemical nature of the buffer solution used. For example, at pH 4 and 5 the solution shows no deterioration even after 70 hours when acetic acid—sodium acetate buffer are used but in the citrate buffer about 6.7% decomposition is observed even after 23 hours, the decomposition being higher still, about 16.17% in the same period, for Clark and Lubbs buffer solution.

So it can be said that while preparing any liquid Vitamin C compound to be used as medicine, much care and consideration are needed.

TABLE I

Sample	Time of observation	Percentage of deterioration	Experimental conditions
Vitamin C solution kept in nitrogen.	After 3 hours	Nil	No stirring.
	After 22 hours	Nil	No stirring.
Vitamin C solution under atmospheric oxygen.	After 3 hours	2.76	No stirring.
	After 22 hours	22.1	No stirring.

TABLE II.

Time	Concentration of Vitamin C (per cent w/v)	Percentage of deterioration	Experimental condition
48 hours ..	0.5368	3.40	Stored in Darkness under the influence of atmospheric oxygen without constant stirring.
48 " ..	0.4270	3.05	
48 " ..	0.3188	7.60	
48 " ..	0.2102	7.42	
48 " ..	0.1016	16.04	
1 month ..	0.3188	24.02	
1 " ..	0.2102	50.20	
1 " ..	0.1016	95.80	

TABLE III.

Concentration of solution taken	Time allowed	Rate of deterioration (Per cent w/v)	Experimental conditions
(1) 0.0178% w/v.	$\frac{1}{2}$ hour	2.25	(1) Exp. was conducted under atmospheric oxygen with constant stirring and in darkness.
	1 "	15.17	
	1 $\frac{1}{2}$ "	22.47	
	2 "	23.61	
	2 $\frac{1}{2}$ "	41.01	
(2) 0.0214% w/v.	$\frac{1}{2}$ hour	6.08	(1) The exp. was conducted under atmospheric oxygen with constant stirring and in darkness.
	1 "	12.15	
	1 $\frac{1}{2}$ "	20.56	
	2 "	34.10	
	2 $\frac{1}{2}$ "	41.12	

(3) 0.0522% w/v.	$\frac{1}{2}$ hour	6.71	(1) The exp. was conducted under atmospheric oxygen with exposure in ultra-violet light with constant stirring.
	1 "	12.84	
	1 $\frac{1}{2}$ "	22.03	
	2 "	30.08	
	2 $\frac{1}{2}$ "	38.58	

(4) 0.0208% w/v.	$\frac{1}{2}$ hour	No deterioration.	(1) The exp. was conducted under nitrogen atmosphere and in darkness.
	1 "	"	
	1 $\frac{1}{2}$ "	"	
	2 "	"	
	2 $\frac{1}{2}$ "	"	

(5) 0.5056% w/v.	21 hours	No deterioration.	The exp. was conducted under nitrogen atmosphere and in darkness.
	45 "	"	
	69 "	"	
	113 "	"	
	127 "	"	

(6) 0.5056% w/v.	21 hours	1.89	(1) The exp. was conducted under atmospheric oxygen without stirring and in darkness.
	45 "	2.89	
	69 "	4.82	
	113 "	8.19	

TABLE IV.

Concentration of solution taken	Time allowed	Rate of deterioration (Per cent w/v)	Experimental conditions
0.5096% w/v.	22 hours	No deterioration.	The exp. was conducted under atmospheric oxygen and in darkness.
	46 "	"	
	70 "	"	
	144 "	"	

TABLE V.

pH	Mc Ilvaines Citrate buffer		Clark & Lubb's buffer			Acetic acid + Na-acetate buffer		
	% decomposition		% decomposition			% decomposition		
	23 hours	12 days	22 hours	46 hours	70 hours	22 hours	44 hours	70 hours
2.2	Nil	34.44	Nil	Nil	0.30	..	..	..
3.2	3.44	52.06	Nil	5.3	7.4	..	..	..
4.2	6.77	65.52	..	..	..	Nil	Nil	Nil
5.2	6.67	73.98	16.17	24.60	34.16	Nil	Nil	Nil
6.2	5.41	54.38	..	..	..	..	..	..
7.2	14.85	91.52	1.29	20.54	29.58	..	..	..
8.0	7.40	86.59	..	..	..	..	..	..