

Stability Studies on Ascorbic Acid (Vitamin C) From Different Sources

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Abstract: Ascorbic acid (Laboratory grade), grape juice and vitamin C tablet (a pharmaceutical product) were either packaged in different materials or exposed to air or stored at different temperature were used to study stability of ascorbic acid using titrimetric analytical method with 2,6-dichlorophenolindophenol. Results of analysis showed that packaging materials, exposure to air and storage temperature condition significantly affected the stability of the vitamin. A significant negative correlation exists between ascorbic acid decline and time of storage and of exposure to air. Ascorbic acid content was more stable in the three sources when stored under refrigeration condition (4-5^oC) as obtained in the investigation.

Keywords: Stability, ascorbic acid, packaging materials, refrigeration condition, exposure, sun.

I. Introduction

Vitamin C, otherwise known as ascorbic acid content of fruits varies with the type of fruits, exposure to the sun and other growing condition (Franke et al., 2004). It is likely to be higher in early fruits than in late fruit [1]. The stability of ascorbic acid decreases with increase in temperature and pH as reported by Emese *et al.*, [2]. This destruction by oxidation is a serious problem in that a considerable quantity of the vitamin C contents of food is lost during processing, storage and preparation [2,3]. Ascorbic acid decreases gradually during storage especially at temperature above 0^oC [4]. Various ways by which we administer fruits or leafy vegetables containing ascorbic acid decreases their ascorbic acid retention, for instance, bruising, peeling, cutting into pieces and exposure to air decreases ascorbic acid retention [5,6]. Peeling apples may results in the loss of 8-25% of their ascorbic acid. It is evident that the vitamin C retention of fruits varies with the treatment but in general, fruits are valuable when they are used raw and have the minimum of bruising, cutting, peeling and exposure to air [7,8,9].

Various sources of ascorbic acid for example, citrus fruits, vegetables and pharmaceutical products (tablets) in Nigeria markets are handled should be of concern to nutritionist. All these sources are exposed to sun during their distribution and marketing. Pharmaceutical products are also not distributed in a way better than that of fruits. They are packaged in different materials ranging from paper, nylon, plastic to bottles of different shades. It appears no concern is shown for the stability of the active ingredients in such products. The present study aims at investigating the effects of temperature, exposure to air and packaging materials on the vitamin C content of pharmaceutical product (vitamin C tablet), laboratory grade (pure vitamin C) and grape juice (natural source) with a view to providing useful information towards effective utilization of the vitamin under investigation.

II. Materials and Methods

2.1 Collection and Preparation of Samples

Pharmaceutical product (vitamin C tablet) used for this research work were obtained from Borepo Pharmacy Store, Osogbo. The natural source (Grape juice) were collected from Akanle's farmland in Odeomu, Osun state while the pure source (laboratory grade of vitamin C) were obtained from the Chemistry Laboratory, Department of Science Laboratory Technology, Osun state Polytechnic, Iree, Nigeria. All the samples were collected same day and used to study the effect of temperature, exposure to air and packaging materials on the Vitamin C content of the different sources

2.2 Effect of Temperature

Different sources of vitamin C were maintained at varying temperature conditions refrigeration (4-5^oC), 35^oC, 55^oC, 75^oC and 95^oC for a maximum of 240 minutes. Vitamin C content was estimated at the beginning of the experiment and subsequently at 60 minutes interval.

2.3 Effects of Exposure to Air

Different sources of vitamin C were left in open in the laboratory at room temperature for a maximum

of 240 minutes during which vitamin C content was determined at regular interval of 60 minutes.

2.4 Effect of Packaging Materials

Only pharmaceutical product was subjected to this test. The vitamin C tablet was packaged in paper (white and brown) and nylon envelopes and in bottles (transparent and brown) for a maximum period of 20 days. the vitamin C content was assayed at interval of 4 days.

2.5 Analytical Procedure

Vitamin C content in the experimental design above were assayed using titrimetric analysis with 2,6-dichlorophenolindophenol (AOAC, 1990). All determinations were done in triplicates and results obtained were subjected to analysis of variance and regression analysis in accordance with the procedure of Stell and Torrie (1980).

III. Results and Discussion

Table 1: Effect of packaging material and storage time on ascorbic acid contents of Vitamin C tablet (a brand of pharmaceutical products) in mg/tablet.

Packaging Material	Storage time (days)						±SEM
	0	4	8	12	16	20	
Bottle							
Brown	84.50a	63.40b	62.30b	62.10b	60.80b	58.90b	6.14
Transparent	84.50a	65.40b	64.50b	63.90b	63.70b	61.90b	5.49
Envelope							
Nylon	84.50a	69.60b	69.60b	69.60b	69.40b	62.60b	4.67
White Paper	84.50a	69.10b	68.70b	68.30b	68.10b	60.80b	5.03
Brown Paper	85.50a	63.90b	62.30b	61.90bc	61.70bc	55.10c	6.50

*Means are denoted by different subscripts in a column are significantly different at P (0.05)

Stability of ascorbic acid in vitamin C tablet packaged in different materials is presented in Table 1. The results indicated a significant influence of packaging materials on stability of ascorbic acid irrespective of the packaging materials, there was a significant negative correlation between length of storage and the ascorbic acid content. The relationship is described by the regression equation shown in Table 2.

Table 2: Regression line showing the relationship between ascorbic acid and the different parameters

Parameter	Regression line ⁺	r -value	t-value
Storage time(days)	Y=76.82285714-0.915285714x	-0.800*	-0.089n.s
Time of exposure to air (min.)	Y=115.9-0.151966666x	-0.996*	-0.79n.s
Holding time (min) at refrigeration			
4-5 ⁰ C	Y=81.71-0.013x	0.858n.s	-0.098n.s
35 ⁰ C	Y=95.525-0.22075x	-0.960*	-2.379n.s
55 ⁰ C	Y=83.3-0.148916666x	-0.981*	-1.774n.s
75 ⁰ C	Y=75.1-0.15425x	-0.936*	-2.393n.s
95 ⁰ C	Y=72.28-0.187783333x	-0.971*	-3.664n.s

+Y: ascorbic acid content (mg)

*: significant at P (0.05)

X: Parameter

n.s: not significant at P (0.05)

The result also indicated that vitamin C was significantly higher at zero than at between the fourth and twenty day. It therefore suggested that there was a rapid loss of vitamin C initially which later stabilized as from the fourth day and is graphically represented in Fig. 1. Similar result of vitamin C stability packaged in different materials tended to suggest that light had no significant effect on the vitamin.

Table 3: Changes in ascorbic acid contents of different sources exposed to air at room temperature

Sources	Exposure time (min)		
	Tablet (mgAA/tablet)	Grape-Juice (mgAA/100ml)	Laboratory Grade Vitamin (mgAA/g)
0	84.50*a	58.20a	205.34a
60	72.70b	51.93b	199.45a
120	70.90b	36.28cd	179.56bc

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180	67.40bc	30.76d	168.51c
240	65.00c	28.73d	146.78d
±SEM	4.78	8.32	15.02

AA- Ascorbic acid (Vitamin C), * means (denoted by different subscripts in a column) are significantly different at P (0.05).

Table 3 depicts changes in ascorbic acid content of different sources exposed to air at room temperature and is graphically represented in Fig 2. The results of analysis indicated that there was marked reduction in the ascorbic acid content of the sources with length of exposure. The negative correlation between both variables is described by regression equation shown in Table 2 above. The result also indicated that while a significant reduction in ascorbic acid contents was noticed within 60 minutes of exposure in tablet and grape juice no such significant change was observed in the laboratory grade until 120 minutes. However, rapid loss of the vitamin was noticed at 180 minutes of exposure. For tablet and grape juice, rapid losses was noticed at 240 minutes respectively. The delay in the rapid loss of this vitamin in the tablet may be due to small surface area exposed or presence of binder which probably must have been added during manufacturing. On the other hand, the juice and the laboratory grade vitamin C, have more surface area for exposure and at the same time have no protector.

Table 4: Changes in ascorbic acid contents of different source stored at either refrigeration condition or exposed to different temperature

Source/holding time (min)	Storage Condition				
	Refrigeration (4-5 ⁰ C)	35 ⁰ C	55 ⁰ C	75 ⁰ C	95 ⁰ C
Tablet					
0	84.50a	84.50a	84.50a	84.50a	84.50a
60	84.50a	77.53b	72.93b	69.98b	61.69b
120	84.50b	75.88b	63.35c	59.30c	48.99c
180	84.50b	69.80bc	60.04c	48.62d	36.83d
240	84.50b	62.98c	52.30d	38.67c	30.94
±SEM	0.09	5.15	7.87	11.33	13.53
Grape Juice					
0	58.20a	58.20a	58.20a	58.20a	58.20a
60	46.00b	42.50b	40.50b	31.90b	29.30b
120	46.00b	40.30b	39.80b	30.20b	26.90cb
180	46.00b	37.80b	37.80bc	28.90b	24.30cb
240	45.86b	37.00b	33.90c	26.30b	19.30c
±SEM	3.46	5.49	5.94	8.27	9.69
Laboratory Grade					
0	205.34a	205.34a	205.34a	205.34a	205.34a
60	114.00b	113.26b	108.66b	108.47b	102.03b
120	107.74b	105.89b	99.26b	63.35c	61.88c
180	107.37b	70.53c	62.43c	59.85c	53.22c
240	106.81b	62.43c	60.59c	58.01c	39.89d
±SEM	27.32	35.95	37.25	39.85	42.51

Effects of storage temperature on the ascorbic acid content of the different sources are shown in Table 4 and the result is graphically represented in Fig 3, 4 and 5. The result indicated that with the exception of the tablet stored under refrigeration condition, ascorbic acid was affected by storage time, in all cases there was ascorbic acid reduction. Indeed there were negative correlation between holding time and ascorbic acid content at different temperature (Table 2). However, the negative correlation between the variables was not significant under refrigeration condition. This result therefore is suggestive of refrigeration condition for storage of vitamin C source.

IV. Conclusion

The results of the analysis showed that packaging materials, exposure to air and storage temperature condition significantly affected the stability of the vitamin. It was observed that a significant negative correlation exist between ascorbic acid and time of storage and exposure to air and ascorbic acid was more stable in the three sources when stored under refrigeration condition (4-5⁰C). It is therefore recommended that refrigeration condition would be suitable storage condition for the vitamin under investigation.

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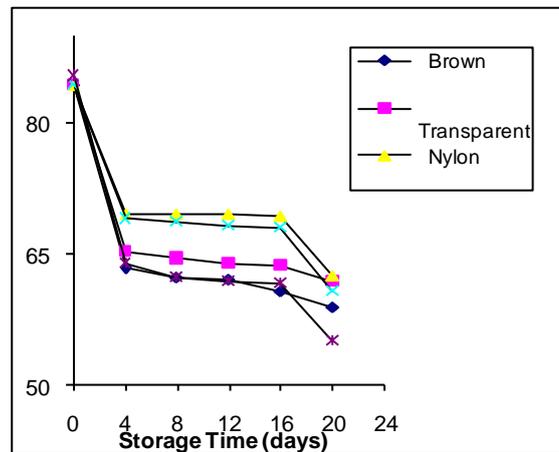


Fig 1: Changes in ascorbic acid contents of Vitamin C tablet on storage.

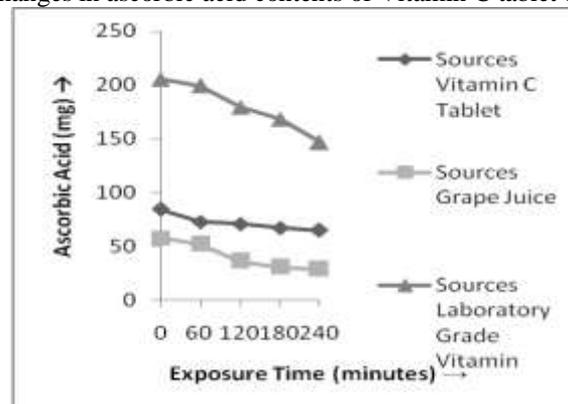


Fig 2: Changes in ascorbic acid contents of different source exposed to air.

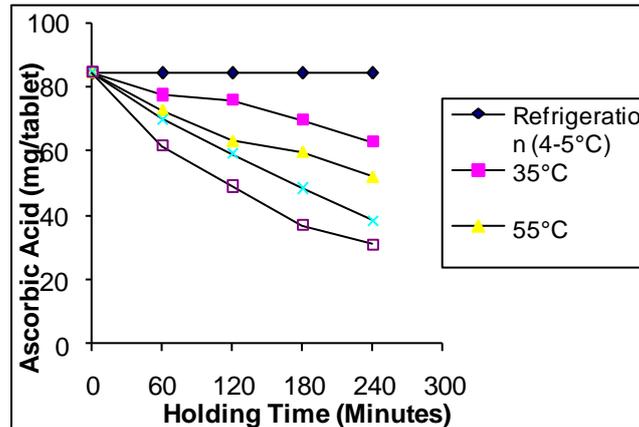


Fig 3: Changes in ascorbic acid contents of vitamin C tablet holds at different temperature.

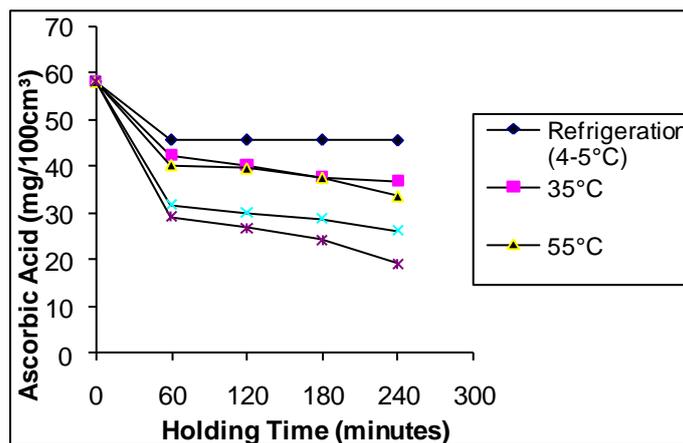


Fig 4: Changes in ascorbic acid contents of grape juice holds at different temperature.

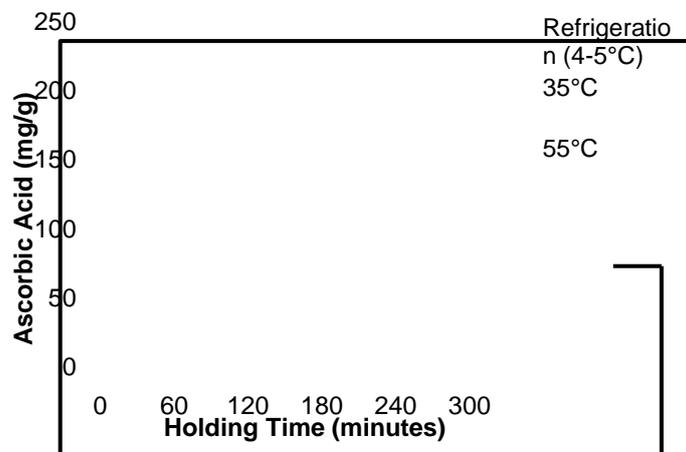


Fig 5: Changes in ascorbic acid contents of laboratory grade holds at different temperature.