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The Effect of Heating on Accorbate Acid Levels (Acidum Ascorbicum) Invitamin C Planar Joints That Spread in Jambi's Pharmacy by Iodatometry Method

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ABSTRACT
Ascorbic acid (Acidum ascorbicum) is an active component of vitamin C planar joints that spread in Jambi City. The planar jointsform is more than the tablet. Ascorbic acid can turn into an inactive form because it is easily oxidized and accelerated by heat, this research was done to know the effect of heating ascorbic acid content. This research was used three types of vitamin C samples (2 tablets and 1 solution) were obtained randomly from three different pharmacies. Samples were given a heating treatment of 300 C, 600 C, 800 C and 1000C each at 0, 60, 120 and 180 minutes with 3 repetitions and vitamin C levels were known to use the Iodatometric titration method. The highest vitamin C tablet content was found in preparations heated at 300C with the percentage of sample I = 99.8%, sample II = 96.3% and sample 3 = 90.17%. The lowest vitamin C content was carried out at 1000C with the percentage of sample I = 74.6% and sample II = 74.4% and sample 3 = 70.2%. The statistical test results show the value of sig. smaller than 0.05, it is means that there are differences the result of heating effect from three samples tested.

Keywords: Vitamin C Planar Joints, Vitamin C Levels, Effect of Heating Temperature, iodatometry

INTRODUCTION

Vitamin C preparations with the content of the active substance ascorbic acid are available on the market in the form of tablets, syrups, injections and capsules (Hossain & Wahid, 2019). In ISO volume 49, 2014-2015 listed 16 types of vitamin C preparations with indications as ascorbic acid avitaminosis (IAI, 2019),

By its nature, ascorbic acid is unstable where increased temperature and humidity can accelerate its degradation process (Kemenkes RI, 2020) . In the form of dry finished preparations such as tablets or capsules, it is relatively safe and the quality can be maintained during storage in accordance with the rules on the packaging (Hu et al., 2024). While liquid forms such as solutions are easily damaged because they are oxidized into inactive forms (Agarwal, 2020).

Research I Made Khasma, Akfar Saraswati Denpasar Bali, 2013 entitled "The Effect of Storage Temperature on Vitamin C Tablet Levels measured using the UV-VIS Spectrophotometry method" concluded that storage temperature affects the content of vitamin C tablets, where storage at excess temperatures can reduce vitamin C levels in tablets. In 2013, Nova Lestari researched on "The Effect of Drug Storage Conditions on the Quality of Vitamin C Tablets at the

Pontianak Kota Sub-District Health Center" concluded that differences in storage conditions affect ascorbic acid levels in vitamin C tablets.

This study aims to determine the effect of heating on rising temperature levels on ascorbic acid levels in vitamin C tablets and syrup preparations on the market (Abdraboh & Arfa, 2024). Determination of levels is carried out by using iodatometric titration method (Harris, 2021) with KIO3 pentiter.

Iodatometric titration is an indirect titration method that uses an iodate pentiter (KIO3) from the result of changing I2 to I+ in an acidic atmosphere (Harris, 2019). Potassium iodate can be obtained in a pure and stable state so that this solution does not need to be re-standardized. The raw solution of potassium iodate does not use normality but molarity because normality can vary according to the reaction (Kini & Flowers, 2021).

The stages of the reaction that occur as follows:

a. KIO3 in ascorbic acid solution will liberate I_2

b. I2 will react with ascorbic acid, and the excess I2 at the end point of titration will be blue in the organic solvent, CHCl3

Reaction equation:

$$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$$

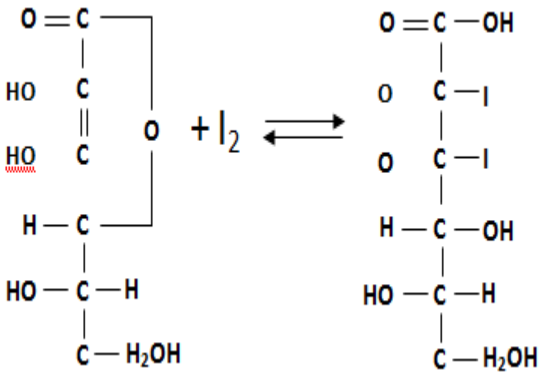

Figure 1. The equation of the reaction of ascorbic acid with iodine

Effect of temperature

Oxidation reactions in a drug can occur due to the presence of high temperatures. The effect of temperature on the rate of oxidation reactions is expressed by the Arrhenius equation(Houston, 2001) :

$$k = A\, e^{-\Delta E/RT}$$

$$\log k = \log A - \frac{\Delta E}{2.303}\frac{1}{RT}$$

k = reaction rate constant; ΔE = activation energy; R = gas constant; and T = temperature.

The reaction rate will increase 2-3 times for every 100 C temperature increase By determining the value k at various temperatures and describing 1/T vs log k, obtain ΔE from the slope of the line and A from the intercept.
The value of k is determined from the determination of the reaction order.

METHODOLOGY

Research Design

The research was conducted in the Jambi Poltekkes Pharmaceutical Chemistry laboratory. Research This is quasi-experimental with a quantitative approach by measuring ascorbic acid levels after heating at temperatures of 600, 800 and 1000C(R. Patel, 2015) and measurements were made at intervals of 0, 60, 120 and 180 minutes at respective temperatures. Determination of ascorbic acid levels using the Iodatometric titration method with KIO3 as a pentiter. The end point is determined by the formation of purple color in the chloroform layer. The effect of temperature on ascorbic acid levels is determined using the Arrhenius equation.

Material

The ingredients used in this study were vitamin C tablet sample 1 (50 mg / tab), vitamin C tablet sample 2 (100 mg / tab) and vitamin C syrup sample 3. The samples used were taken from pharmacies in Jambi City using the random sampling method .

Determination of Vitamin C Levels(Harris, 2021)

a. Take a preparation of vitamin C, equivalent to 1125 mg of ascorbic acid, put in a glass beaker, add Aqua Dest 250 ml.
b. Strain the solution using filter paper, put the filtered solution in a 250 ml measuring flask, Add aquades up to 250 ml, gently corner.
c. Pipette 10 ml in erlenmayer, tutup with plastic. Heat on a bath done inside the Erlenmeyer at a predetermined temperature (60, ^{0}, 800 and 1000 C
d. Then take 4 erlenmeyer after 0 minutes of warm-up, 4 erlenmeyer after 60 minutes of warm-up, 4 erlenmeyer after 120 minutes of warm-up and 4 erlenmeyer after 180-minute warm-up
e. Cool with ice and then Acidify with 25 ml HCl 2 N, then add 5 ml
f. Titrate with 0.1 M KIO 3 solution until $CHCl_{3\ layer}$ turns purple. Record the required volume of KIO_3 0.1 M, Do the same at each specified temperature and time.

Regression analysis to calculate the influence of temperature.
Calculation of levels:
1ml KIO3 0.1 M is equivalent to 5.18 mg ascorbic acid

Table 1. The weight of ascorbic acid from 3 vitamin C preparations

Temperature (^{0C})	Time (Minutes)	Sample (mg)		
		1	2	3
30	0	44.08	43.68	41.44
60	0	44.02	43.34	40.58
	60	44.00	42.99	40.06

	120	43.51	41.96	39.54
	180	43.17	41.61	39.20
80	0	40.23	41.09	39.02
	60	39.71	40.23	38.50
	120	39.02	39.54	38.16
	180	37.12	39.02	37.47
100	0	37.12	37.81	36.61
	60	33.81	36.61	33.81
	120	32.53	35.40	31.81
	180	30.04	33.15	31.60

The calculation of changes in ascorbic acid levels is tested with the initial levels in each sample. This calculation is to see how much the change in levels due to the effect of heating under the same test conditions for all three samples (Guo et al., 2023). The results show changes and the changes differ from one sample to another. The details of these changes are as follows:

Determination of reaction rate constant

Statistical analysis with linear regression between temperature and concentration yields the value of the reaction rate constant as follows:

Table 2. K value of sample at experimental temperature of vitamin C tablets

Sample	Temperature (^{0} C)	Price k
Sample 1	60	1.96.10-7
	80	2.18.10-7
	100	4.79.10-7
Sample 2	60	1.85.10-7
	80	2.29.10-7
	100	7.10.10-7
Sample 3	60	1.47. 10-7
	80	1.58. 10-7
	100	5.05. 10-7

Regression results of the effect of temperature on the reaction rate of Vitamin C

Log k versus 1/t regression analysis to the three test samples yielded line equations and statistical values such as sig and t stat values. The complete graph and regression equation are as follows:

Table 3. Line equation between temperature and k value and R2 value Ascorbic acid levels in vitamin C tablets

No	Sample	Press. Line Temperature and reaction speed	R2
1	Sample 1	Y = - 1186.7 X – 3.1939	0.812
2	Sample 2	Y = -1787.4 X – 1.4328	0.841
3	Sample 3	Y = -1635.4 X - 2.0006	0.766

RESULTS AND DISCUSSION

Determination of ascorbic acid levels in vitamin c is determined by measuring the volume of KIO_3 needed to react with ascorbic acid (Evana & Barek, 2021). From the calculation of ascorbic acid levels of 3 samples of vitamin C at variations in temperature and time showed the content of ascorbic acid in the three samples gave different results (Amaro et al., 2024). At the experimental temperature storage, the ascorbic acid content of sample 2 showed higher results than sample 1 and sample 3. The difference was statistically significant at a 95% confidence level ($\alpha = 0.05$, $p = 0.00$). The difference is more pronounced after treatment at higher temperatures, namely $60^{0c,\ 800c\ and\ 1000c.}$

The effect of temperature will be clearly seen from the percentage decrease in levels, compared to the initial level before heating at various set times (Lee et al., 2023). Ascorbic acid differed between the vitamin C tablets tested. Treatment at a temperature of 100 °C$^{0C\ at}$ 180 minutes compared to room temperature levels showed that the percentage decrease was highest in vitacimin tablets at 33.24% from the initial level followed by IPI tablets at 24.1% and enervon C23.75% tablets. Average drop in levels at 60°C$^{0C\ is\ 2.99\%,\ 800C\ is\ 9.02\%\ and\ 1000C\ is\ 20.89\%.}$ The same result was obtained by Septiany etc.(Septyani, 2021) Here's the full percentage reduction of the three vitamin C tablets tested. The magnitude of the rate of change due to temperature can be seen from the value of the reaction speed constant. From the k value obtained, the value will be higher with the increase in temperature. The speed of lowering levels occurred highest in vitacimin tablets with a value of $k = 7.10 . 10^{-7}$.

The magnitude of ascorbic acid levels after temperature treatment 60^0, 800 and 1000C showed increased temperature affected ascorbic acid levels in all three tablets tested. The research of Damayanti et al showed the same results(Septyani, 2021). With a sign value, 0.000 in the anova test, it means that there is a significant difference in the results of the ascorbic acid levels tested. The test stage was carried out by calculating Vitamin C levels at temperatures of 0 ° C, , 60 ° C, 80 ° C and 100 ° C at 0, 30 minutes and 60 minutes. How the quantitative temperature effect of each sample can be seen from the relationship as follows:

Every 10 degree temperature increase of sample 1 will cause a decrease in ascorbic acid levels by 25.6 %, every 10 degree temperature increase in sample 2 causes a decrease in ascorbic acid levels by 2.3%. And for sample 3 each time the temperature increase was 10 degrees, causing a decrease in levels by 6%. The results of statistical tests with ANOVA showed a difference in the results of the influence of temperature from the three samples tested. Sig value. Small than 0.05,

indicating that the null hypothesis is accepted, meaning that there is a different temperature influence of the three samples tested

CONCLUSION

Each time the temperature rises by 10 degrees, it causes a decrease in levels by 6%. The results of statistical tests with ANOVA showed a difference in the results of the influence of temperature from the three samples tested. Sig value. Small than 0.05, indicating that the null hypothesis is accepted, meaning that there is a different temperature influence of the three samples tested

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