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EFFECT OF STORAGE TEMPERATURE TO DETERMINE HYDROQUINONE IN FACE CREAM BY SPECTROPHOTOMETRY

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Abstract— Hydroquinone is often used as a bleach in face creams. Hydroquinone is an effective substance against skin whitening but has damaging side effects if used long term. Basically hydroquinone does not work as a skin whitener, but inhibits the production of skin melanin. The purpose of this study was to determine differences in hydroquinone levels in face cream before and after treatment with different storage temperatures. This study was conducted using spectrophotometry at a maximum wavelength of 280 nm. As for this study using variations in storage temperatures are 24°C, 31°C and 3°C, and before treatment at 28°C. Hydroquinone levels were obtained with the lowest levels of 0.113 ppm in sample C stored at 24°C and the highest levels of 0.518 ppm in sample A without treatment at 28°C. Based on this study, it was concluded that in sample A there was a difference between the sample before and after treatment. While in sample B and sample C there is no difference between the samples before and after treatment.

Keywords— Hydroquinone, Face Cream, Spectrophotometry

I. INTRODUCTION

Cosmetics are preparations that are applied to the body with the aim of cleaning and improving appearance [1]. One of the current cosmetic trends is face whitening cream [2]. Whitening cream is one type of cosmetic that contains active substances that can suppress or inhibit the formation of melanin so that it will give a whiter skin color [3]. Based on an examination by the Food and Drug Monitoring Agency (BPOM), there are whitening cosmetic products in circulation containing hydroquinone with levels >2%. Cosmetics in the form of creams containing hydroquinone are widely used to remove patches on the skin and face [4].

Hydroquinone (HQ) is a phenol group compound that is easily oxidized if left in the open air and can change color due to the formation of oxidation products. Hydroquinone is also an effective substance for skin whitening but has damaging side effects if used in the long term [5]. The mechanism of action of hydroquinone is as a lightening agent by inhibiting the enzymatic oxidation of tyrosine to become 3,4-dihydrophenylalanine (DOPA), inhibiting the activity of the tyrosinase enzyme in melanocytes and reducing the amount of melanin directly [6]. Futhermore HQ is considered to be one of the strongest inhibitors of melanin production and for more than 25 years it has been established as the most effective ingredient for treating melasma [7]. However, its long-term application has numerous adverse effects, including irritative dermatitis, melanocyte destruction, contact dermatitis, and ochronosis

The stability of HQ is influenced by temperature, HQ is stable at normal pressure and temperature and is sensitive to light and air. HQ will darken when exposed to light and air because of its nature as a reducing agent. The hydroquinone level in the cream is only allowed to be 2%, if the hydroquinone level is > 2% then it is included in the group of hard drugs that can be used based on a doctor's prescription [8]. Therefore, the use of HQ with high levels in cosmetics has been prohibited [9].

Taking into consideration both benefits and risks of using HQ-containing cosmetics, the quantitative determination of the HQ level in bleaching creams is imperative. For this purpose, many studies on HQ determination in different cosmetics are reported. The employed analytical methods are based on the specific properties of HQ exploited by chromatographic (HPLC [10-13] , capillary electrochromatographic [14] , voltammetric [15] , and spectrometric techniques [16]. The advantages of the spectrometric techniques consist in the fact that they use

accessible and simpler equipment, have shorter analysis time, and are cheaper than the chromatographic techniques. The use of UV-Vis spectrometry has enhanced rapidly over the last few years. Some of the advantages of these methods are precision, short analysis time, and less reagent consumption [17] . The spectrometric determinations of HQ in cosmetic products were based on direct measurement of UV absorbance of HQ [18, 19], besides that hydroquinone compounds have chromophore groups so that they meet the criteria for compounds that can be analyzed by spectrophotometry [20].

Based on the description above, a problem can arise, namely does the storage temperature of the face cream affect the hydroquinone level in the face cream which was analyzed using the spectrophotometry method. The purpose of this study was to determine the level of hydroquinone in face cream which was analyzed by spectrophotometry method, and to determine whether there was an effect of storage temperature of face cream on hydroquinone levels which were analyzed by spectrophotometry method.

II. METHODS

Preparation of 100 ppm Hydroquinone Mother liquor

Weighed 0.01 g of hydroquinone powder using an analytical balance and dissolved with 96% ethanol, after that it was transferred quantitatively to a 100 ml volumetric flask to the mark, then the solution was homogenized. Thus, the concentration of the hydroquinone mother liquor is 100 ppm.

Determination of Maximum Wavelength

0.1 ml was taken and put into a 100 ml volumetric flask and then 6 drops of 4N HCl was added then 96% ethanol was added to the mark and homogenized then put into a cuvette and the absorbance was measured at a wavelength between 260-400 nm.

Preparation of Hydroquinone Standard Standard Solution

100 ppm hydroquinone mother liquor was put into a 50 ml burette, then 0.1 ml was taken; 0.2 ml ; 0.3 ml ; 0.4 ml; and 0.5 ml, each was put in a 100 ml volumetric flask, then 6 drops of 4N HCl were added, then 96% ethanol was added to exactly 100 ml and homogenized. Obtained a solution with a concentration of 0.1 ppm; 0.2 ppm ; 0.3 ppm ; 0.4 ppm ; and 0.5 ppm.

Sample Preparation

Face cream samples A, B, and C were stored at 24°C 31°C, and 3°C for 24 hours and before treatment stored at 28°C, the sample storage temperature was measured first. using a thermometer. After the sample was stored for 24 hours, then measure the level of hydroquinone.

Determination of Hydroquinone Levels

Each sample was weighed as much as 0.01 g and then diluted with 5 ml of 96% ethanol.

The solution was transferred to a 100 ml volumetric flask and added 96% ethanol to exactly 100 ml and then homogenized. Then 30 ml of pipette was put into a 100 ml volumetric flask, then 6 drops of 4N HCl and 96% ethanol were added to exactly 100 ml to obtain a concentration of 30 ppm. Then measured one by one by means of spectrophotometry at the maximum wavelength.

III. RESULTS AND DISCUSSION

Three samples of face cream were purchased from several sellers in the market and each sample was coded A, B, and C. The samples were prepared by storing the samples at 24°C, 31°C, and 3°C for 24 hours then quantitative analysis was performed using spectrophotometry.

The standard hydroquinone solution was used for determining the maximum wavelength of hydroquinone and making a calibration curve of hydroquinone. Hydroquinone standard solution with a concentration of 0.1 ppm; 0.2 ppm; 0.3 ppm; 0.4 ppm; and 0.5 ppm was made, wherein a standard solution with a concentration of 0.1 ppm was selected as the determination of the maximum wavelength. Determination of the wavelength was carried out in the range of 260-400 nm and obtained the maximum wavelength of hydroquinone in this study of 280 nm which is shown in Figure 1.

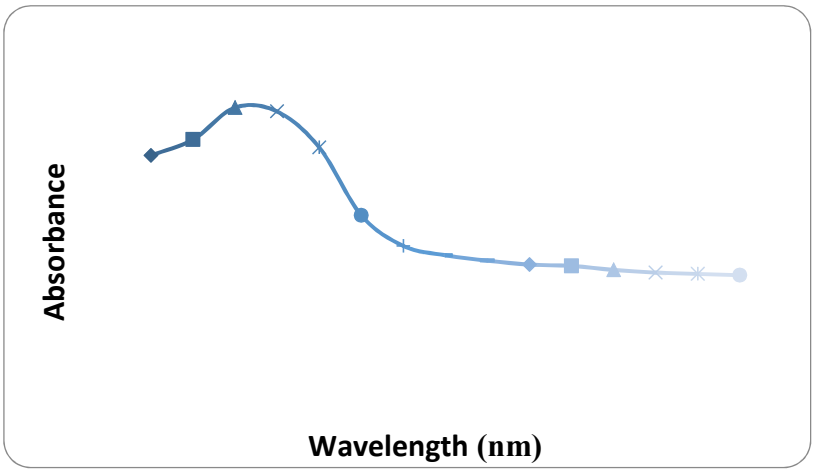

Figure 1. Maximum wavelength of hydroquinone

The calibration curve of hydroquinone was made by measuring the absorbance of the hydroquinone standard solution at a maximum wavelength of 280 nm. The concentration of the calibration curve for absorbance forms a straight line (linear) and produces a regression equation y = 0.106x + 2.223 with a correlation coefficient (R^2) of 0.9696 which is shown in Figure 2. The sample concentration can be calculated based on the calibration curve of hidroquinone equation obtained.

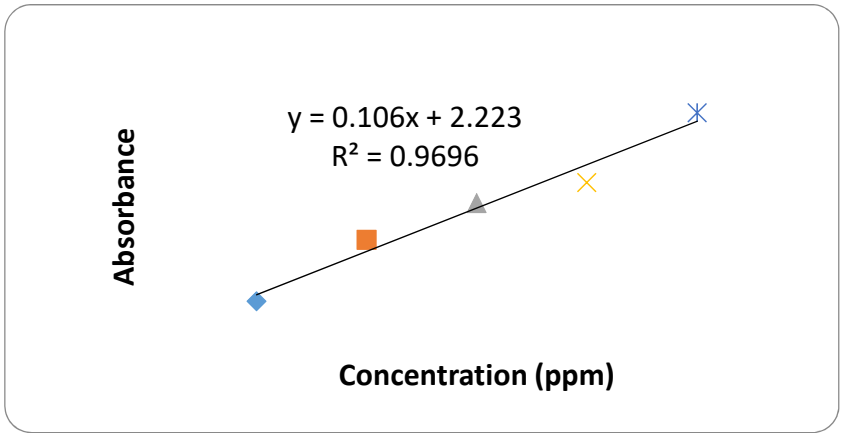

Figure 2. Calibration curve of Hidroquinone

IV.

Determination of hydroquinone levels in face cream samples was carried out using the same method as measuring the standard hydroquinone solution, where the absorbance of the prepared sample solution was measured using spectrophotometry at wavelength of 280 nm. The measurement results are shown in Table 1 data of the hydroquinone levels in the face cream samples without treatment at 28°C and different storage temperatures, namely at 24°C, 31°C and 3°C. The absorbance value is used to calculate the sample concentration in ppm. The levels of hydroquinone in sample A were 0.518, respectively; 0.367; 0.330; 0.264 ppm, and in sample B of 0.358, respectively; 0.330; 0.283; 0.311 ppm, as well as on the sample C in a row of 0.226; 0.113; 0.150; 0.188 ppm.

Quantitative analysis of the highest hydroquinone content was found in sample A without treatment, which was 0.581 ppm. The results of this study indicate that the overall level of hydroquinone in the whole sample is still within the safe limits, because the hydroquinone level is 2% ($2x10^4$ ppm)

Table 1. Data of the hydroquinone levels in the face cream

Sample	Treatment	Absorbance	Levels of Hydroquinone (ppm)
A	-	2.278	0.518
	24°C	2.262	0.367
	31°C	2.258	0.330
	3°C	2.251	0.264
B	-	2.261	0.358
	24°C	2.258	0.330
	31°C	2.253	0.283
	3°C	2.256	0.311
C	-	2.247	0.226
	24°C	2.235	0.113
	31°C	2.239	0.150
	3°C	2.243	0.188

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V. CONCLUSION

From the results of this study that the three samples contained hydroquinone compounds but did not exceed the maximum limit determined by BPOM of 2%.

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