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Research Article

Hydroquinone Levels in Whitening Body Lotion Circulating in Makassar City by the UV-Vis Spectrophotometry Method

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ABSTRACT: Hydroquinone is an active compound that is able to control pigment production to inhibit melanin formation and has activity as a skin whitening agent, so hydroquinone is widely used in cosmetic products. Hydroquinone has adverse side effects if used for a long time. BPOM RI has issued a regulation on the prohibition on the use of hydroquinone as a bleach in cosmetics. The purpose of this study was to identify the hydroquinone content in whitening handbody samples circulating in Makassar City and to find out the level of hydroquinone contained in the sample. Qualitative analysis is carried out using $FeCl_3$ reagents and quantitative analysis using the UV-VIS spectrophotometry method. The number of samples used in this study was as many as 4 samples that did not have a registration number from BPOM RI. The results showed that the 4 samples studied positively contained hydroquinone. The results of the sample test measured at a maximum wavelength of 292 nm, obtained hydroquinone levels at the sample code HB1 = 1.267%; sample code HB2 = 0.912%; sample code HB3 = 0.379% and sample code HB4 = 0.449%.

KEYWORDS: Whitening Handbody; Hydroquinone; $FeCl_3$; UV-Vis Spectrophotometry.

1. INTRODUCTION

Cosmetics are materials or preparations intended for use on the outside of the body, namely on the epidermis, hair, nails, lips and external genital organs or teeth and oral mucous membranes intended to clean, perfume, change appearance and eliminate body odor or protect and maintaining the body in good condition (BPOM, 2022). Cosmetic preparations that are most popular with the public, especially women, are cosmetic preparations that contain whitening ingredients such as whitening hand and body with the aim of instant skin whitening. The public or consumers do not know that the whitening cosmetics used contain chemical active substances, they don't even pay attention to whether the cosmetics already have a distribution permit from BPOM (Estyqomah et al., 2022). Lotion is defined as an immiscible two-phase mixture, stabilized by an emulsion system and in the form of a pourable liquid when placed at room temperature. Hand and Body Lotion is generally in the form of an oil-in-water (O/W) emulsion, where oil is the dispersed phase (Internal) and water is the dispersing phase or is referred to as the External phase (Hambali et al., 2019).

In Indonesia, the incidence of cosmetic side effects is quite high, this is evidenced by the many cases of cosmetic side effects found in dermatologists. The cosmetic side effects that occur are quite severe, this is due to the addition of addictive ingredients with the intention of increasing the whitening effect (Faisal et al., 2018). One of the active ingredients that is often found and added to many cosmetic products is hydroquinone (BPOM, 2018). Hydroquinone is a mercury compound derived from benzene, has the chemical formula $C_6H_6O_2$ and is classified as highly toxic. Hydroquinone is a substance that has activity as a skin lightener, but has adverse side effects if used for a long time. Meanwhile, hydroquinone is only allowed to be used for medicinal purposes and can only be obtained with a doctor's prescription (Suharyani et al., 2021).

According to the Regulation of the Head of the Drug and Food Control Agency Number 17 of 2022 concerning Amendments to the Regulation of the Drug and Food Supervisory Agency Number 23 of 2019 concerning Technical Requirements for Cosmetic Materials, hydroquinone may only be used in artificial nails provided that the hydroquinone content is not more than 0.02%. So, it can be said that hydroquinone should not be used in cosmetics including hand and body except for artificial nails (BPOM, 2022).

At the end of 2019, BPOM found 113 various kinds of dangerous cosmetics on the market, based on survey results, 33 of them were skin whitening cosmetics containing hydroquinone. Thus, it can be concluded that there are still many skins whitening cosmetics containing hydroquinone circulating in society even though BPOM has issued regulations prohibiting the use of hydroquinone (Putri and Wahyudiani, 2021).

2. EXPERIMENTAL SECTION

2.1 Sampling

The sample used in this study was a whitening hand and body taken in the southern city of Makassar. Samples were obtained by purchasing from different sellers and different brands. Sampling was carried out using purposive sampling technique. With this technique, 4 samples were obtained which were given the sample codes HB1, HB2, HB3 and HB4.

2.2 Materials and tools

The materials used were sample (Whitening Hand and body), aquadest, 96% ethanol, standard hydroquinone, $FeCl_3$, HCl 4 N, sodium sulfate. While the tools used were aluminum foil, stir bar, funnel, 100 ml Erlenmeyer, 10 ml measuring cup, watch glass, hotplate, filter paper, cuvette, 5 ml volumetric flask, 100 ml volumetric flask, micropipette, blue tip, drip plate, dropping pipette, horn spoon, UV-Vis spectrophotometer, analytical balance.

Preparation of hydroquinone standard solution. Weigh 100 mg of pure hydroquinone, put it into a 100 mL volumetric flask, and add 96% ethanol to the mark. The solution was homogenized until a standard concentration of 1000 ppm hydroquinone was obtained. Pipette 10 ml of the standard hydroquinone solution with a concentration of 1000 ppm, put it in a 100 ml volumetric flask, then add 96% ethanol up to the mark. The solution was homogenized until a standard hydroquinone solution with a concentration of 100 ppm was obtained (Rahmadari et al., 2021).

2.3 Qualitative Analysis

A small sample of the Hand and body whitening is taken and then placed on the drip plate. Each sample to be tested was reacted with $FeCl_3$. A positive identification result when $FeCl_3$ is added will produce a purple, orange-brown color (Putri and Wahyudiani, 2021; Fajariyani and Huwaid, 2022).

2.4 Wavelength Determination

A pipette as much as 0.5 ml of a 100 ppm hydroquinone standard solution, put it into a 5 ml volumetric flask. then add 96% ethanol up to the mark and obtain a standard solution of 10 ppm. A standard solution of 10 ppm is measured at a wavelength of 200-400 nm (Rahmadari et al., 2021).

2.5 Hydroquinone Standard Curve

From a standard hydroquinone solution of 100 ppm, concentration series of 15 ppm, 20 ppm, 25 ppm, 30 ppm, and 35 ppm were prepared. Each pipette is 0.75 ml; 1 ml; 1.25 ml; 1.5 ml; 1.75 ml; 2 ml. Put into a 5 ml volumetric flask then add 96% ethanol up to the mark. Each concentration was measured at the maximum wavelength that was obtained with a blank solution, namely 96% ethanol (Rahmadari et al., 2021).

2.6 Determination of Hydroquinone Levels

Prepare the sample by weighing 500 mg of the whitening hand and body sample and placing it in a 100 ml Erlenmeyer glass. After that, 12 drops of 4 N HCl and 100 ml of 96% ethanol were added. The solution is stirred, then heated over the hotplate until dissolved. After heating, the solution was filtered into a 100 ml volumetric flask using filter paper which had been filled with 1 g sodium sulfate. For samples coded HB1 and HB2, 1.5 ml was pipetted while for samples coded HB3 and HB4, 2.5 ml were pipetted from the filtered solution. Put it into a 5 ml volumetric flask, then add 96% ethanol up to the mark. The solution is homogenized, after which its absorbance is measured at the maximum wavelength that has been obtained before. Repeat 3 times (Rahmadari et al., 2021).

2.7 Data analysis

The data analysis was carried out by calculating the hydroquinone content in the whitening hand and body sample circulating in the city of Makassar which was included in the hydroquinone standard curve equation $y = bx + a$. After that, the % content is calculated using the formula:

$$\text{Content} = \frac{\text{Sample concentration (ppm) x Sample volume (L) x Fp}}{\text{Sample weight (mg)}} \text{ x } 100\%$$

3. RESULTS AND DISCUSSION

This research was conducted to determine the levels of hydroquinone in whitening hand and body circulating in the city of Makassar using the UV-Vis spectrophotometry method. The sample used in this study is a sample that does not have a registration number from BPOM RI which was obtained in the southern city of Makassar. The number of samples used were 4 samples and coded HB1, HB2, HB3, HB4 to facilitate analysis.

Qualitative analysis was carried out using the color reaction method, using $FeCl_3$ reagent. This aims to determine the presence or absence of hydroquinone content in the sample (Adriani and Safira, 2018). Qualitative analysis was carried out by adding a few drops of $FeCl_3$ to each sample. A positive result if it contains hydroquinone is marked by a change in purple, orange-brown color (Putri and Wahyudiani, 2021; Fajariyani and Huwaid, 2022). Positive samples containing hydroquinone are shown in **Table 1.**

Table 1. The results of qualitative analysis of hydroquinone using $FeCl_3$ reagent

Sample Code	Test result	Information
HB1	Purple	(+)

HB2	Purple	(+)
HB3	Purple	(+)
HB4	Orange Brown	(+)

The color change that occurs is caused by a reaction between hydroquinone and $FeCl_3$, namely an oxidation-reduction reaction. $FeCl_3$ will attack the OH^- group as a nucleophile, the positively charged H^+ group will attack the negatively charged Cl^- so that HCl will form. Then the bond is released with $FeCl_2$ to stabilize the charge. The released $FeCl_2$ will form a complex with hydroquinone (Fajariyani and Huwaid, 2022). A picture of the reaction structure between hydroquinone and $FeCl_3$ can be seen in **Figure 1.**

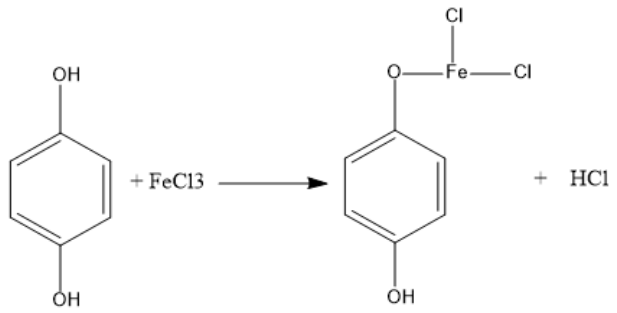

Figure 1. Hydroquinone + $FeCl_3$ reaction (Fajariyani and Huwaid, 2022)

Quantitative analysis is an analysis carried out to determine the levels of hydroquinone in a whitening hand and body sample, using the UV-Vis spectrophotometry method (Feladita et al., 2021). Quantitative analysis was carried out by measuring the absorbance of each sample which was identified as positive for containing hydroquinone at the maximum wavelength (Rahmadari et al., 2021). Based on the measurement results of a standard hydroquinone concentration of 10 ppm measured at a wavelength of 200-400 nm, the maximum hydroquinone wavelength is 292 nm. The purpose of determining the maximum wavelength is to find out the maximum absorption of hydroquinone, the wavelength obtained will be used in measuring the absorbance of the sample (Rahmadari et al., 2021).

The next stage is the preparation of the hydroquinone standard curve. The hydroquinone standard curve was made from 5 different concentration series, namely concentrations of 15 ppm, 20 ppm, 25 ppm, 30 ppm, and 35 ppm. The absorbance of the five concentrations was measured at a wavelength of 292 nm. The measurement results of the hydroquinone standard curve can be seen in **Table 2**. Based on the measurement results **(Table 2)**, it can be seen that the greater the concentration value of a standard solution, the greater the absorbance value. This is in accordance with Lambert Beer's law, namely concentration is directly proportional to absorption. So, the higher the concentration of a solution, the more light is absorbed (Estyqomah et al., 2022).

Table 2. Measurement results of the hydroquinone standard curve

Concentration (ppm)	absorbance
15	0.368
20	0.466
25	0.625
30	0.758
35	0.857

After measuring the standard curve, then a standard curve graph is made to obtain a linear regression equation. Based on the hydroquinone standard curve graph, a linear regression equation is obtained y = 0.0254x - 0.0202 with a correlation coefficient (r) = 0.9967. The correlation coefficient value (r) obtained in this study met the acceptance requirements, namely $r \geq 0.995$ (Ariq et al., 2022; Fawwaz et al., 2022). The value of y is the absorbance, x is the concentration, 0.0254 is the value of b (slope), 0.0202 is the value of a (intercept). The correlation coefficient value obtained shows that there is a linear relationship between absorbance and concentration because the correlation coefficient value is close to 1, meaning that the increase in the absorbance value of the analyte is directly proportional to the increase in its concentration (Fawwaz et al., 2020).

In determining the levels of hydroquinone, sample preparation must be carried out first. This aims to remove other compounds or impurities so that hydroquinone compounds can be obtained. Sample preparation was carried out by

weighing 500 mg of each sample and then putting it into a 100 ml Erlenmeyer glass, adding 12 drops of 4 N HCl and 100 ml of 96% ethanol. The purpose of adding HCl 4 N is to separate the hydroquinone compound from other compounds present in the bleach hand and body sample (Rahmadari et al., 2021). The sample solution is stirred and heated over the hotplate until dissolved. The purpose of heating is to dissolve and homogenize the sample (Rahmadari et al., 2021). After that, the sample was filtered using filter paper containing 1 gram of sodium sulfate. The purpose of using sodium sulfate is to attract water so that there is no more water phase (Rahmadari et al., 2021). 1.5 ml of filtering results were pipetted for samples coded HB1 and HB2 while for samples coded HB3 and HB4 pipetted as much as 2.5 ml then put into a 5 ml volumetric flask and added 96% ethanol to the mark limit. The absorbance of the solution was measured at a wavelength of 292 nm (Rahmadari et al., 2021). After obtaining the absorbance of the sample, the hydroquinone content was calculated using the linear regression equation y = 0.0254x - 0.0202. The results of calculating the hydroquinone levels of each sample can be seen in **Table 3.**

Table 3. Calculation Results of % Hydroquinone Content in the Sample

Sample Code	Repetition	absorbance	Content (%)	Average (%)
HB1	1	0.443	1.215	1.267
	2	0.471	1.289	
	3	0.475	1.299	
HB2	1	0.346	0.961	0.912
	2	0.334	0.929	
	3	0.303	0.848	
HB3	1	0.224	0.384	0.379
	2	0.221	0.379	
	3	0.218	0.375	
HB4	1	0.262	0.444	0.449
	2	0.265	0.449	
	3	0.269	0.455	

Based on the calculation results in **Table 3**, the samples coded HB1 had a higher % concentration compared to the other three samples, where the average % hydroquinone content was 1.267 %. While the average % hydroquinone content for samples coded HB2, HB3, HB4 was 0.912%, 0.379%, 0.449% respectively. The data obtained in this study were not in accordance with the regulations set by BPOM RI. According to BPOM Head Regulation Number 17 of 2022 concerning Amendments to BPOM Regulation Number 23 of 2019 concerning Technical Requirements for Cosmetic Materials, hydroquinone may only be used in artificial nails provided that the hydroquinone content is not more than 0.02%. Thus, it can be said that hydroquinone should not be used in cosmetics, including hand and body lotion.

Therefore, the four samples tested in this study should not be used and not traded to the public. Apart from the fact that the four hand and body do not have registration numbers from BPOM RI, BPOM RI has also issued regulations prohibiting the use of hydroquinone as a bleach in cosmetics.

4. CONCLUSION

Based on the research results and data analysis, it can be concluded that the four samples studied positively contained hydroquinone. The measurement results for the four samples that positively contained hydroquinone using a UV-Vis spectrophotometer obtained the % hydroquinone content for samples coded HB1, HB2, HB3, HB4 respectively 1.267%, 0.912%, 0.379%, 0.449%.

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Ethical Approval: -

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