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Analysis Of Hydroquinone Levels In Skin-Lightening Creams Available In Kuala Kurun City, Gunung Mas Regency, Using Uv-Vis Spectrophotometry

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Abstract

The growing public interest in skincare products has coincided with an increase in the use of skin-lightening creams. However, hydroquinone an ingredient banned in cosmetics due to its potential to cause side effects such as ochronosis, dermatitis, and other skin disorders is still found in some skin-lightening creams. Therefore, analysis of hydroquinone content is necessary to ensure product safety in accordance with BPOM regulations. To determine the hydroquinone content and concentration of skin-lightening creams available in Kuala Kurun City, Gunung Mas Regency, and to assess whether these levels comply with the limits set by BPOM. This study was an observational analysis using UV-Vis spectrophotometry. Qualitative analysis was measured based on the maximum wavelength of compound absorption to confirm the presence of samples, while quantitative analysis was measured based on light absorption intensity (absorbance) proportional to the concentration of hydroquinone compounds in the samples using a calibration curve. The results of the study of facial whitening creams circulating in Kuala Kurun City, Gunung Mas Regency, found hydroquinone in all five samples, with concentrations of 0.334% in sample A, 0.392% in sample B, sample C at 1.902%, sample D at 1.920%, and sample E at 2.553%. Hydroquinone was detected in all samples of skin-lightening creams, with concentrations ranging from 0.334% to 2.553%. This violates BPOM regulations, as hydroquinone is prohibited in cosmetics and is permitted only at a maximum concentration of 0.02% in artificial nails; therefore, these products do not meet cosmetic safety requirements.

Keywords: Hydroquinone, Spectrophotometry, Skin-Lightening Cream.

INTRODUCTION

In the digital era and amid ever-changing beauty trends, the desire to have bright, white, and clear skin has become an aesthetic standard aspired to by many people, especially women. Cosmetics are products applied to external body parts with the purpose of cleansing, perfuming, changing appearance, and improving or maintaining the body in good condition (Zain et al., 2024). This situation has driven increasing demand for cosmetic products, particularly facial whitening creams. Whitening creams are a type of cosmetic that contain active ingredients able to suppress or inhibit melanin formation, thereby producing lighter-colored skin (Adriani & Safira, 2019).

However, not all whitening creams circulating in the market are safe for use. Many products are still found to contain hazardous active ingredients such as hydroquinone, tretinoin, and mercury, which can cause serious side effects for skin and overall health (BPOM, 2023). Hydroquinone works by inhibiting the activity of tyrosinase enzyme in melanocytes, thus reducing melanin production (Charimawati et al., 2021). Although effective as a skin-lightening agent, the use of hydroquinone at high concentrations or for prolonged periods can lead to various adverse effects.

These side effects include ochronosis, epidermal atrophy, eczema, bacterial and fungal infections, dermatitis, warts, and acne. Moreover, excessive use of hydroquinone can lead to exogenous ochronosis, a condition in which the skin turns blue-black or darkened in a permanent and difficult-to-treat manner (Kurniawan et al., 2022). Therefore, the use of hydroquinone in cosmetics must be strictly monitored.

As a form of supervision, the National Agency of Drug and Food Control (Badan Pengawas Obat dan Makanan/BPOM) has issued Regulation No. 23 of 2019 on Technical Requirements for Cosmetic Ingredients, which prohibits the use of hydroquinone as a whitening or lightening agent in

cosmetics, except in artificial nails with a maximum concentration of 0.02%. Nevertheless, violations of this regulation continue to be frequently found in practice. According to the 2024 Annual Report of the Balai Besar POM Palangka Raya, among 106 cosmetic establishments inspected, 18 did not meet applicable requirements (TMK), and 3 cosmetic samples tested positive for hydroquinone and retinoic acid.

Similar cases have also been found at national level. In the second quarter of 2025, BPOM withdrew 34 cosmetic products from circulation because they contained hazardous and/or prohibited ingredients, including hydroquinone (BPOM, 2025). Moreover, in August 2025, BPOM revoked 21 cosmetic marketing authorizations due to composition mismatches compared with notified data, both in terms of ingredient type and concentration (BPOM, 2025). This indicates that, despite existing regulations, many cosmetic products circulating on the market still fail to meet safety and legal requirements.

Several previous studies also support these findings. Research by Fahira et al. (2021) in Mataram City showed that, out of 10 whitening cream samples, 8 contained hydroquinone at concentrations ranging from 3.13% to 4.29%. Another study by Putriani et al. (2024) in Bangkinang City found that, out of 5 samples, 2 tested positive for hydroquinone at concentrations between 1.59% and 1.96%. In addition, Fitriani et al. (2025) investigated whitening creams in Pasar Badak Satu, East Kalimantan, and found that all tested samples were positive for hydroquinone at concentrations ranging from 4.63% to 4.88%. These research results demonstrate that violations regarding the use of hazardous ingredients in cosmetics still occur widely across various regions.

Kuala Kurun District, as one of the areas in Gunung Mas Regency, Central Kalimantan Province, has a broad circulation of cosmetic products. Various facial whitening creams are available freely in cosmetic shops, both products with marketing authorization and those without. However, consumers still tend to choose products based on immediate visible results, without paying attention to safety aspects or ingredient content. This lack of awareness potentially increases the risk of using cosmetics containing hazardous ingredients such as hydroquinone. To date, studies on hydroquinone content in whitening creams circulating in this area remain limited, therefore further investigation is needed.

To detect and determine hydroquinone levels in cosmetic products, UV-Vis spectrophotometry is one of the analytical methods commonly used, due to its high sensitivity, relatively rapid procedure, and relatively low cost. Hydroquinone has a maximum absorption wavelength in the range of 289–294 nm, which makes it possible to quantify this compound accurately (Saraswati et al., 2022).

Based on the above description, this study aims to analyze the presence and concentration of hydroquinone in whitening creams circulating in Kuala Kurun City, Gunung Mas Regency, using the UV-Vis spectrophotometric method, as well as to evaluate their compliance with the provisions set by BPOM. This research is expected to provide scientific information and to increase public awareness in selecting safe cosmetic products.

RESEARCH METHODS

The research method used in this study is an analytical observational design with a purposive sampling technique. The study was conducted at the Pharmaceutical Chemistry Laboratory, Faculty of Health, Universitas Sari Mulia, Jl. Pramuka No. 2, Pemurus Luar, East Banjarmasin District, Banjarmasin City, South Kalimantan. The population used in this study consists of whitening creams circulating in Kuala Kurun City, Gunung Mas Regency. The samples for this study were collected from cosmetic shops in Kuala Kurun City, comprising 5 samples of locally branded facial whitening creams obtained from 5 different cosmetic shops. Sample collection was carried out according to the inclusion and exclusion criteria established by the researchers.

The instrument used in this study is a UV-Vis spectrophotometer for the analysis of hydroquinone concentration in whitening creams.

Materials and Equipment

The instruments used in this study are an analytical balance (Ohaus), a hot plate, a graduated cylinder (Iwaki Pyrex), a beaker glass (Iwaki Pyrex), a funnel (Iwaki Pyrex), a volumetric flask (Iwaki Pyrex), a watch glass, a stirring rod, a micropipette (Socorex), tips, a glass cuvette, filter paper, test tubes, a test-tube rack, a microplate, a spatula, a dropper pipette, aluminum foil, and a UV-Vis spectrophotometer (Genesys 10S UV-Vis).

The materials used in this study are whitening cream samples circulating in Kuala Kurun City, Gunung Mas Regency; analytical-grade hydroquinone standard (Sigma); analytical-grade methanol; and distilled water (Saraswati & Perwitasari, 2022).

Research Procedures

Qualitative Test

Each sample of whitening cream (25 mg) was weighed and suspended in 50 mL of methanol, then shaken until homogeneous. Three milliliters were pipetted into a cuvette and measured using a UV-Vis spectrophotometer at a specific wavelength. For the qualitative test, the resulting spectrum was examined to determine whether it resembled the spectrum of a hydroquinone standard solution absorbed at a specific wavelength (Irnawati et al., 2016).

Quantitative Test

The quantitative analysis in this study was carried out through several stages as follows:

Sample Preparation

Sample preparation was carried out by weighing 25 mg of each whitening cream sample and suspending it in 50 mL of methanol, followed by heating and shaking until homogeneous, and then filtering the solution (Julan et al., 2023).

Preparation of the Hydroquinone Standard Solution

A 50-ppm hydroquinone solution was prepared by dissolving 5 mg of hydroquinone standard in 5 mL of methanol, transferring the solution into a 100-mL volumetric flask, and adding methanol up to the mark until a 50-ppm hydroquinone standard solution in methanol was obtained (Julan et al., 2023).

Preparation of the Standard Calibration Curve

The 50-ppm hydroquinone standard solution was then diluted to concentrations of 0, 2, 4, 6, 8, and 10 ppm in 10-mL volumetric flasks using methanol as the diluent, and measured at its maximum wavelength. The maximum wavelength was determined by scanning the 10-ppm hydroquinone solution across the wavelength range of 200–400 nm (Julan et al., 2023).

Measurement of Hydroquinone Concentration in the Sample

The hydroquinone content in the samples was analyzed quantitatively using a UV-Vis spectrophotometer. The absorbance of each sample was measured using an ultraviolet spectrophotometer at a wavelength of 293 nm. The hydroquinone concentration in the samples was calculated using the linear regression equation $y = bx \pm a$ derived from the hydroquinone standard curve (Julan et al., 2023).

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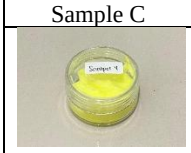
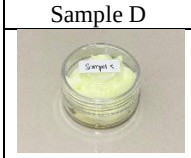
RESULTS AND DISCUSSION

The organoleptic testing showed results as presented in the following table:

Table 1. Organoleptic Test Results

Sample Image	Color	Texture	Aroma
 Sample A	Off-white	Homogeneous	Fragrant
 Sample B	White	Homogeneous	Odorless
 Sample C	Off-white	Contains granules, sticky	Fragrant
 Sample D	Bright yellow	Homogeneous	Pungent
 Sample E	Pale yellow	Homogeneous	Pungent

Qualitative Analysis

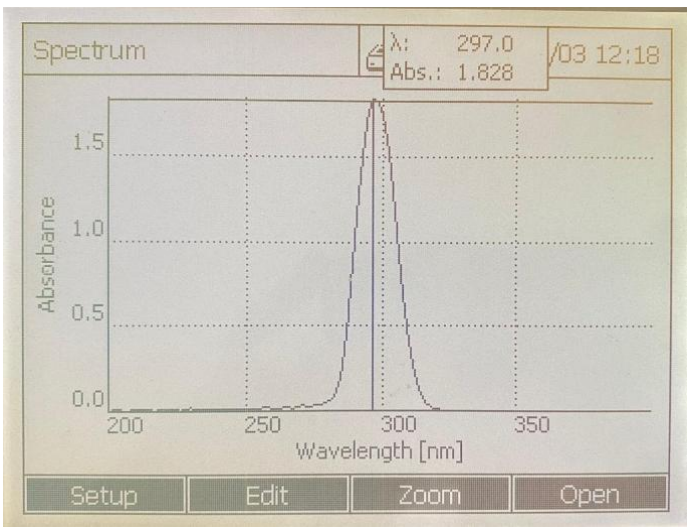


Figure 1. Maximum Wavelength

Quantitative Analysis

Table 2. Comparison Between Concentration and Absorbance

Concentration	Absorbance
2 ppm	0,098
4 ppm	0,198
6 ppm	0,287
8 ppm	0,371
10 ppm	0,493

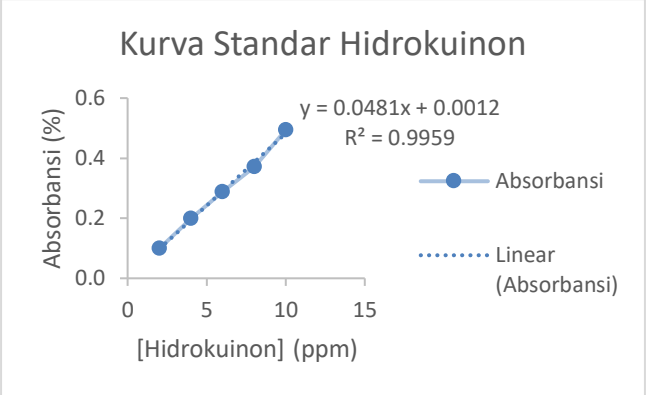


Figure 2. Standard Absorbance-Concentration Curve

Table 3. Determination of Hydroquinone Concentration

No	Cream Sample	Absorbance	Hydroquinone Concentration (µg/ml)	Hydroquinone Concentration (%)
1.	A (1) A (2) A (3)	0,080 0,082 0,083	1,6729	0,334%
2.	B (1) B (2) B (3)	0,094 0,096 0,097	1,9640	0,392%
3.	C (2) C (2) C (3)	0,458 0,459 0,459	9,5107	1,902%
4.	D (1) D (2) D (3)	0,462 0,463 0,464	9,6008	1,920%
5.	E (1) E (2) E (3)	0,615 0,615 0,616	12,7678	2,553%

Note: The number 123 in the sample cream table is a duplicate.

Table 4. Validity Test Results

Validation	Results
Linearity	0,9959
Precision	<2%
Accuracy	96-102%
LOD	0,7021
LOQ	2,3412

Discussion

The analysis of hydroquinone levels in this study was conducted on five samples of facial whitening creams circulating in Kuala Kurun City using the UV-Vis spectrophotometric method. This method was selected because it is simple, rapid, and sensitive, and is suitable for hydroquinone, which contains chromophore and auxochrome groups that enable it to absorb ultraviolet light at specific wavelengths (Saraswati & Perwitasari, 2022).

Preliminary testing through organoleptic evaluation revealed variations in color, odor, and texture among the samples. Some samples exhibited a strong odor and non-homogeneous texture.

These conditions are presumed to be associated with the addition of certain substances, either to enhance product appeal or to mask the odor of chemical components. These findings are consistent with the study by Maria (2023), which reported similar characteristics in whitening creams circulating in City X.

Furthermore, a strong odor in cream products may indicate the presence of substances added to mask the characteristic smell of active ingredients or other chemicals. In general, cream formulations consist of emulsifiers to improve consistency, humectants and emollients as moisturizers, as well as antimicrobial preservatives and emulsifying agents, which typically do not have a strong odor and are white in color. Therefore, such creams generally do not contain strongly odorous substances (Charismawati, Erikania, & N, 2021). However, physical characteristics cannot be used as definitive indicators of the presence of hydroquinone, thus requiring further qualitative and quantitative analysis.

Sample preparation was carried out using pro analysis (p.a.) methanol because hydroquinone is highly soluble in polar organic solvents. The heating and stirring processes aimed to optimize dissolution, followed by filtration to obtain a clear solution prior to measurement (Prautari, 2022).

Qualitative analysis was conducted by determining the maximum wavelength (λmax) of hydroquinone. The results showed a λmax at 297 nm, which is consistent with the theoretical range and previous studies (Fahira et al., 2021). All samples showed absorbance at this wavelength, indicating that they were positive for hydroquinone (Irnawati, Sahumena, & Dewi, 2016).

Quantitative analysis was performed using a calibration curve with concentration ranges of 2 ppm, 4 ppm, 6 ppm, 8 ppm, and 10 ppm, resulting in a linear regression equation of $y = 0.0481x + 0.0012$ with a correlation coefficient (r) of 0.9959. This value indicates a very strong linear relationship between concentration and absorbance and is consistent with the Lambert-Beer law (Saraswati & Perwitasari, 2022; Rahman, 2025).

Method validation demonstrated results that met the required criteria. Precision was obtained with %RSD < 2%, in accordance with ICH acceptance criteria. Accuracy ranged from 96–102%, indicating good accuracy and still within the acceptable range according to SNI (85–115%). The LOD and LOQ values were 0.7021 ppm and 2.3412 ppm, respectively (Kurniawan, Nugraha, & Kurniawan, 2022; Fahira, Ananto, & W, 2021; Puspita, 2024).

The results of hydroquinone content determination showed that all analyzed whitening cream samples A, B, C, D, and E were confirmed to contain hydroquinone, with concentrations of 0.334%, 0.392%, 1.902%, 1.920%, and 2.553%, respectively. These variations are consistent with previous studies reporting the presence of hydroquinone in whitening creams with varying concentration ranges across different regions (Julan, Leswana, & Linden, 2023; Kurniawan, Nugraha, & Kurniawan, 2022; Fahira, Ananto, & W, 2021).

The presence of hydroquinone in all samples is a serious concern because, based on BPOM Regulation No. 23 of 2019, this compound is prohibited in cosmetic products. The use of hydroquinone can cause side effects such as skin irritation, hyperpigmentation, and potential long-term health risks (BPOM, 2019; Permani, 2022). Although hydroquinone may still be used in medical practice within certain limits under a doctor's supervision, its presence in freely distributed cosmetic products indicates non-compliance with applicable regulations (Puspita, 2024).

Therefore, all analyzed whitening cream samples do not meet cosmetic safety requirements. This indicates the need for stricter supervision of cosmetic distribution and increased public awareness regarding the risks of using products containing hazardous substances.

CONCLUSION

Based on the research results, it can be concluded that the experiments successfully demonstrated the presence of hydroquinone in the facial whitening cream preparations circulating in Kuala Kurun City, as indicated by positive test results for all analyzed samples. The determined hydroquinone concentrations showed variation among samples: samples A, B, C, and D had levels below 2%, while sample E exceeded this limit. Even though some samples were below 2%, the presence of hydroquinone in facial whitening creams remains prohibited under BPOM regulations, except for specific therapeutic uses under medical supervision. Therefore, these findings indicate that using hydroquinone-containing facial whitening creams without medical supervision poses potential health risks, and stricter monitoring and control over the circulation of cosmetics in the community are urgently needed.

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