JCNaR
Journal of Chemical Natural Resources
Journal homepage: https://jcnar.usu.ac.id

Analysis of Sodium Cyclamate Content in Brown Sugar Coffee Drinks in Mobile Coffee Vendor at Central Klaten District Using UV-Vis Spectrophotometry

Isna Aulia Astika, Dessy Ratna Sari* and Muhammad Anugerah Alam Waris
Department of Pharmacy, Poltekkes Kemenkes Surakarta, Surakarta, 57127, Indonesia
*Corresponding Author: dessy.rs97@gmail.com

ARTICLE INFO

Article history:
Received 08 August 2026
Revised 03 September 2026
Accepted 14 September 2026
Available online 09 October 2026

E-ISSN: 2656-1492

How to cite:
Isna Aulia Astika, Dessy Ratna Sari and Muhammad Anugerah Alam Waris. Analysis of Sodium Cyclamate Content in Brown Sugar Coffee Drinks in Mobile Coffee Vendor at Central Klaten District Using UV-Vis Spectrophotometry. Journal of Chemical Natural Resources. 2026.8(1):61-67.

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International.
https://doi.org/10.32734/jcnar.v8i1.26924

ABSTRACT

Sodium cyclamate is an artificial sweetener widely used in food products due to its high sweetness level and economical cost. However, excessive consumption may pose health risks such as liver disorders, the formation of cyclohexylamine metabolites that are carcinogenic, and potential organ damage. Mobile coffee beverages are processed drink products that often contain food additives such as sweeteners to enhance their flavor. The use of these sweeteners may involve artificial sweeteners like sodium cyclamate; therefore, analysis is needed to confirm its presence and safety in accordance with BPOM Regulation No. 11 of 2019, which sets a maximum limit of 350 mg/kg. This study is an experimental research with a descriptive design. Qualitative analysis was carried out using a precipitation test to detect sodium cyclamate through the formation of a white precipitate. Samples showing positive results were then quantitatively analyzed using the UV-Vis spectrophotometry method. The precipitation test results showed that there was one sample, namely Sample B, that tested positive for containing sodium cyclamate. The sodium cyclamate level found in the sample was 448.0833 mg/kg, which exceeds the limit set by BPOM Regulation No. 11 of 2019 concerning Food Additives.

Keyword: Mobile Coffee, Precipitation Test, Sodium Cyclamate, UV-Vis Spectrophotometry

ABSTRAK

Natrium siklamat merupakan pemanis buatan yang banyak digunakan dalam produk pangan karena rasa manisnya yang tinggi serta harganya yang ekonomis. Konsumsi berlebih dapat menimbulkan risiko kesehatan seperti gangguan hati, pembentukan metabolit sikloheksilamin yang bersifat karsinogenik, serta potensi kerusakan organ. Kopi keliling merupakan produk olahan minuman yang mengandung bahan tambahan pangan seperti pemanis dalam meningkatkan cita rasanya. Penggunaan pemanis tersebut berpotensi melibatkan pemanis buatan seperti natrium siklamat, sehingga diperlukan analisis untuk memastikan keberadaan serta keamanannya sesuai Peraturan BPOM No. 11 Tahun 2019 dengan batas maksimal 350 mg/kg. Penelitian ini merupakan penelitian eksperimental dengan rancangan deskriptif. Analisis kualitatif dilakukan menggunakan uji pengendapan untuk mendeteksi kandungan natrium siklamat melalui terbentuknya endapan putih. Sampel yang menunjukkan hasil endapan putih kemudian dianalisis secara kuantitatif menggunakan metode spektrofotometri UV-Vis. Hasil penelitian uji pengendapan menunjukkan terdapat satu sampel yaitu sampel B yang positif mengandung natrium siklamat. Kadar natrium siklamat yang terkandung dalam sampel tersebut adalah 448,0833 mg/kg yang dimana hasil tersebut melebihi Peraturan BPOM No. 11 Tahun 2019 tentang Bahan Tambahan Pangan.

Kata Kunci: Kopi Keliling, Natrium Siklamat, Spektrofotometri UV-Vis, Uji Pengendapan

1. Introduction

Food additives are substances that are not typically used as daily food and are not natural components of food ingredients, but are intentionally added to enhance the properties, shape, and taste of food [1]. One type of food additive commonly added to food is sweeteners. Sweeteners are divided into two types: natural and

artificial [2]. The use of artificial sweeteners was initially intended to meet the needs of diabetes patients or individuals requiring low-calorie nutrition, but their use has now expanded widely across various processed food and beverage products due to their more economical price and sweetness level exceeding that of sugar. One of the artificial sweeteners used is sodium cyclamate, which has a sweetness level approximately 30 times higher than sucrose [3]. This sweetener also has high-temperature resistance properties, making it widely used in processed products that undergo high-temperature processing [1].

Sodium cyclamate is permitted for use as a food additive; however, excessive consumption can have negative health impacts. Cyclamate can be metabolized in the body into cyclohexylamine, which acts as a carcinogenic promoter and has the potential to trigger tumor growth [4]. Some studies have shown that excessive cyclamate consumption can increase the risk of bladder cancer and cause chromosomal changes and testicular atrophy [5]. Furthermore, research by Enci et al. (2012) demonstrated that oral administration of cyclamate to mice at a dose of 15 mg/kgBW/day for 30 days caused liver organ damage in the form of degeneration and necrosis [6]. Therefore, the National Agency of Drug and Food Control (BPOM) has established a maximum limit for sodium cyclamate use in coffee beverage products at 350 mg/kg to ensure food safety [7].

Coffee has currently become part of the lifestyle of modern society and has a broader function, not only as a beverage to relieve drowsiness but also as a means of social interaction [8]. Along with the increasing coffee consumption, innovations in coffee sales have emerged with mobile carts offering more affordable prices, practicality, and easy accessibility to the public. This trend is developing rapidly in Central Klaten District, which is the center of community activity and a strategic location for the development of various businesses, including mobile coffee [9].

The diversity of mobile coffee brands circulating raises the possibility of artificial sweetener use, including sodium cyclamate. Therefore, research is needed to analyze the sodium cyclamate content in mobile coffee beverages in this area. This research is expected to provide scientific information related to food safety and serve as evaluation material for consumers and business actors in the use of food additives [10].

2. Methods

2.1. Research Design

This study employed an experimental method using UV-Vis spectrophotometry with a quantitative approach. The design used was descriptive research, which is a method aimed at presenting research results systematically. This descriptive approach focuses on presenting descriptions, explanations, and accurate evidence of the phenomenon being studied

2.2. Materials and Equipment

The materials used in this study included samples of brown sugar coffee drinks, 10% HCl, 10% $BaCl_2$, 10% $NaNO_2$, distilled water, 30% H_2SO_4, cyclohexane, 4% hypochlorite, 0.5 N NaOH, and sodium cyclamate standard. The equipment used included Erlenmeyer flasks (Herma), analytical balance (Radwag), measuring cylinders (Pyrex), volumetric pipettes (Herma), micropipettes (Hitech), stirring rods, dropper pipettes, Whatman 42 filter paper, glass funnels (Herma), beaker glass (Herma), volumetric flasks (Pyrex), watch glasses, water bath, separating funnels, UV-Vis spectrophotometer (INNOVA C-5000UV, single beam), and cuvettes.

2.3. Sample Collection

Brown sugar coffee drinks were obtained from mobile coffee vendors circulating in Central Klaten District, totaling 5 samples. Sample collection was conducted using purposive sampling technique, where samples were selected based on specific criteria: brown sugar coffee drinks from different mobile coffee brands circulating in Central Klaten District.

2.4. Solution Preparation

Several solutions were prepared prior to the analysis. The 10% HCl solution was prepared by pipetting 27.02 mL of 37% concentrated HCl into a 100 mL volumetric flask and diluting to the mark with distilled water, then homogenized [11]. The 10% $BaCl_2$ solution was made by dissolving 10.0 g of $BaCl_2$ in a 100 mL volumetric flask and filling to the mark with distilled water, followed by homogenization [12]. Similarly, the 10% $NaNO_2$ solution was prepared by dissolving 10.0 g of $NaNO_2$ in a 100 mL volumetric flask and diluting to the mark with distilled water. The 0.5 N NaOH solution was obtained by diluting 5 mL of 10 N NaOH to

100 mL with distilled water [13]. The 30% H_2SO_4 solution was prepared by pipetting 15.78 mL of 95% H_2SO_4 into a volumetric flask and adding distilled water up to 50 mL [14]. A 1,000 ppm sodium cyclamate stock solution was prepared by dissolving 50 mg of sodium cyclamate standard in a 50 mL volumetric flask with distilled water.

2.5. Qualitative Analysis (Precipitation Test)

The qualitative analysis was carried out using a precipitation test. A 10 mL sample was placed in an Erlenmeyer flask, then 10 mL of 10% HCl solution and 10 mL of 10% $BaCl_2$ solution was added. The mixture was allowed to stand for 30 minutes, then filtered using Whatman 42 filter paper. The filtrate was then mixed with 10 mL of 10% $NaNO_2$ solution and heated in a water bath at 100°C until a white precipitate formed, approximately 15–30 minutes [15]. A positive result was indicated by the formation of a white precipitate.

2.6. Quantitative Analysis (UV-Vis Spectrophotometry)

The quantitative analysis was performed using UV-Vis spectrophotometry. For the blank solution, 25 mL of distilled water was placed in a separating funnel, then 2 mL of 4% hypochlorite solution, 5 mL of 30% H_2SO_4 solution, and 10 mL of cyclohexane were added and extracted for 2 minutes. The cyclohexane layer (upper phase) turned yellow, and the lower phase was discarded. The upper phase was then added with 25 mL of 0.5 N NaOH and extracted for 2 minutes. The lower phase was discarded, and the upper phase was washed with 25 mL of distilled water, extracted again for 2 minutes, and the upper phase was taken for absorbance measurement. The maximum wavelength was determined by diluting the 1,000 ppm stock solution to 300 ppm (7.5 mL in 25 mL) and extracting it. The extract was measured at wavelengths of 280–360 nm [13]. For the calibration curve, standard solutions at concentrations of 200, 250, 300, 350, and 400 ppm were prepared from the 1,000 ppm stock solution. Each solution (5 mL, 6.25 mL, 7.5 mL, 8.75 mL, and 10 mL) was placed in a 25 mL volumetric flask, diluted to the mark, and homogenized. Each solution was then extracted and the absorbance was measured at the maximum wavelength [16]. For sample analysis 2.5 g of coffee sample was diluted to 25 mL with distilled water. The solution was placed in a separating funnel, then 2 mL of 4% hypochlorite solution, 5 mL of 30% H_2SO_4 solution, and 10 mL of cyclohexane were added and extracted for 2 minutes. The lower phase was discarded, the upper phase was added with 25 mL of 0.5 N NaOH and extracted for 2 minutes. The lower phase was discarded, the upper phase was washed with 25 mL of distilled water, extracted for 2 minutes, and 5 mL of the upper phase was taken for absorbance measurement at the maximum wavelength [16]. All measurements were performed in triplicate. It should be noted that this study focused on quantitative analysis of positive samples and did not include determination of accuaracy/recovery, LOD and LOQ, as the primary aim was to measure cyclamate content in samples that exceeded the regulatory limit. Future validation studies are recommended to establish these parameters

3. Results and Discussion

3.1. Qualitative Analysis (Precipitation Test) Result

The qualitative analysis was conducted using a precipitation test on 5 samples of mobile coffee drinks (Sample A, B, C, D, and E) along with positive and negative controls. The results are presented in Table 1. Based on Table 1, among the 5 samples of mobile coffee drinks, 1 sample (Sample B) tested positive for sodium cyclamate, indicated by the formation of a white precipitate. Samples A, C, D, and E did not form white precipitates, indicating that these samples did not contain sodium cyclamate.

Table 1. Qualitative test result of sodium cyclamate in brown sugar coffee drinks

Sample	Result	Description
Positive Control (Standard)	 White precipitate formed	Positive
Negative Control (Distilled water)	 No precipitate formed	Negative
Sample A	 No precipitate formed	Negative

Sample B	 White precipitate formed	Positive
Sample C	 No precipitate formed	Negative
Sample D	 No precipitate formed	Negative
Sample E	 No precipitate formed	Negative

The formation of white precipitate originates from the reaction of cyclamic acid contained in the sample with 10% HCl, 10% $BaCl_2$, and 10% $NaNO_2$. This is supported by the theory stating that the presence of sodium cyclamate is indicated by the formation of a white precipitate in the sample during the precipitation test [1]. The 10% HCl solution functions to provide an acidic environment, $BaCl_2$ functions to precipitate impurities and break the sulfate bond (SO_4^{2-}) in cyclamate, which will form a white precipitate. The broken sulfate bond will bind with Ba^{2+} ions from the $BaCl_2$ solution to form $BaSO_4$ compound in solid form (precipitate) [5]. The chemical reaction of the precipitation test is as follows in Figure 1.

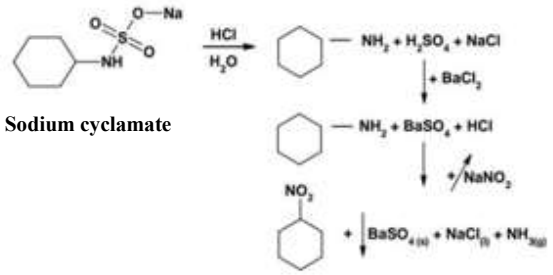


Figure 1. Chemical Reaction of Precipitation Test [11]

3.2. Quantitative Analysis (UV-Vis Spectrophotometry)

3.2.1. Determination of Maximum Wavelength

The maximum wavelength was determined by diluting the 1,000 ppm stock solution to 300 ppm in 25 mL. The solution was extracted and measured at wavelengths of 280–360 nm. The maximum wavelength obtained was 314 nm with an absorbance of 0.436 that presented in Figure 2. This wavelength is consistent with research conducted by Azizah et al. (2022) in the analysis of cyclamate levels in powder drinks with a maximum wavelength of 314 nm [17]. Determination of this wavelength aims to identify the absorption region that can be read by the UV-Vis spectrophotometer and to produce absorbance from a test solution.

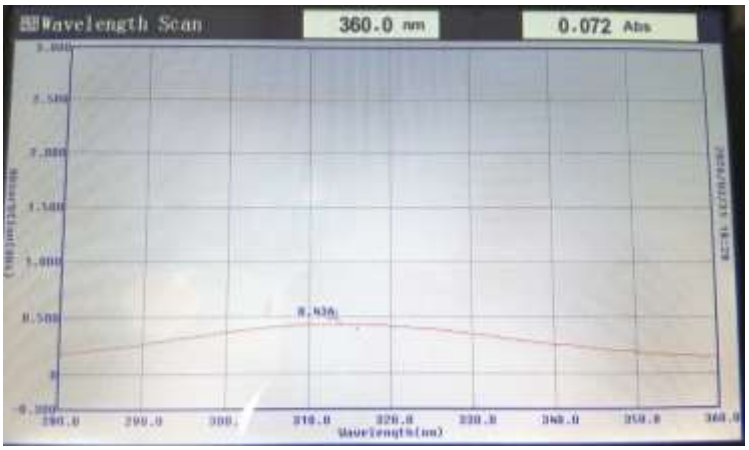


Figure 2. UV-Vis absorbance spectrum of sodium cyclamate standard solution (300 ppm) at Wavelength 280-360 nm

3.2.2. Calibration Curve

The calibration curve was prepared using five concentration variations of standard solutions: 200, 250, 300, 350, and 400 ppm. Each solution was extracted, and the absorbance was measured at the maximum wavelength of 314 nm. The results are presented in Figure 3.

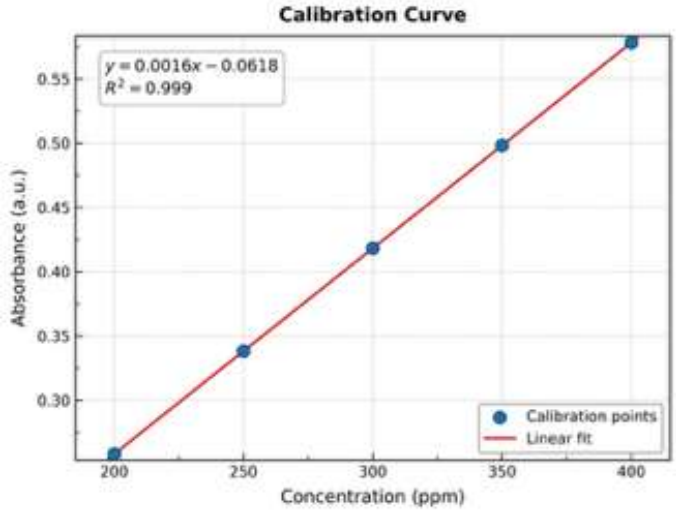


Figure 3. Calibration curve of sodium cyclamate

Based on the absorbance results from each concentration, it was found that the higher the concentration of the solution, the higher the absorbance value, indicating a proportional relationship between concentration and absorbance as described by the Beer-Lambert law. The linear regression equation obtained from the calibration curve was y = 0.0016x - 0.0618 with a correlation coefficient R^2 = 0.999. The correlation coefficient value of 0.999 indicates a very good linear relationship, showing that the method has excellent linearity within the concentration range tested [18].

3.3. Sodium Cyclamate Content in Samples

The positive sample (Sample B) was then analyzed quantitatively using UV-Vis spectrophotometry. The sample analysis was conducted by weighing 2.5 g of coffee sample and diluting it to 25 mL. The sample was then extracted and measured at 314 nm with three replications. The results are presented in Table 2. The sodium cyclamate content in the sample was calculated using the following Equatioan 1.

$$Content\ \left(\frac{mg}{kg}\right) = \frac{C\ .V.D}{W} \quad (1)$$

where:
C = Concentration obtained from calibration curve (ppm or mg/L)
V = Volume aliquot (5 mL = 0.005 L)
D = Dilution factor (D = 1 because 2.5 mL sample was diluted to 25 mL, then extracted)
W = Weight of sample (2.5 g = 0.0025 kg)

Table 2. Sodium cyclamate content in sample B

Sample	Replication	Abs	Content (mg/kg)	Mean ± SD	Maximum Limit (mg/kg)	Description	RSD (%)
B	1	0.296	447.25	448.08 ± 1.44	350	Exceeds Limit	0.3221 %
	2	0.298	449.75				
	3	0.296	447.25				

The analysis showed that the average sodium cyclamate content in Sample B was 448.08 mg/kg, which exceeds the maximum limit set by BPOM Regulation No. 11 of 2019 for cyclamate use in beverages, which is 350 mg/kg [7]. During the extraction process, the addition of hypochlorite solution serves as an oxidizer to form a yellowish-green color in the solution. 30% H_2SO_4 solution functions to convert sodium cyclamate into cyclamic acid, and the addition of cyclohexane serves as a cyclamate extractor [19]. The cyclohexane layer (upper phase) turns yellow. The addition of 0.5 N NaOH functions to provide an alkaline environment and reform sodium cyclamate. The addition of distilled water serves as washing to produce a clear extract [19].

The use of cyclohexane liquid-liquid extraction is particularly important given the complex matrix of brown sugar coffee, which contains various native colorants (such as melanoidins from the Maillard reaction), organic acids, and other UV-absorbing compounds that could potentially interfere with the absorbance measurement at 314 nm. The extraction procedure effectively separates the cyclamate compound from these interfering matrix components through differential partitioning. Cyclamate is extracted into the cyclohexane phase after acidification with H_2SO_4, while the polar colorants and organic acids remain in the aqueous phase. The subsequent washing step with distilled water further removes any remaining water-soluble impurities, ensuring that the yellow-colored cyclohexane layer primarily contains the cyclamate derivative. This extraction approach is critical for obtaining reliable absorbance readings, as direct measurement of the sample without extraction would likely produce significant spectral interferences from the dark-colored matrix.

The RSD value of the sodium cyclamate content in Sample B is 0.3221%, which means the measurement results have excellent precision because the deviation between data is small, less than 2%. The excellent linearity ($R^2 = 0.999$) and precision (RSD < 2%) obtained in this study also support the effectiveness of this extraction method in mitigating matrix effects. This high precision indicates that the analytical method used is reliable and reproducible. Excessive cyclamate consumption can cause migraines, headaches, memory loss, confusion, insomnia, irritation, asthma, hypertension, diarrhea, abdominal pain, allergies, impotence, sexual disorders, baldness, and can cause tumors and cancer [14]. Based on the side effects caused, foods and beverages containing cyclamate should be monitored and avoided, especially when the content exceeds the permitted limit [17].

4. Conclusion

Based on the research that has been conducted, the following conclusions can be drawn that the qualitative test results on brown sugar coffee samples from mobile vendors circulating in Central Klaten District using the precipitation test showed positive results for Sample B, indicated by the formation of a white precipitate, indicating that the sample contained the artificial sweetener sodium cyclamate. The quantitative test results on Sample B showed that the sodium cyclamate content was 448.08 mg/kg. This content exceeds the maximum limit for sodium cyclamate use in beverages according to BPOM Regulation No. 11 of 2019 concerning Food Additives, which is 350 mg/kg

5. Acknowledgements

The authors would like to express their sincere gratitude to Department of Pharmacy Poltekkes Kemenkes Surakarta for providing the facilities and support necessary to conduct this research.

6. References

[1] Cahyadi W. *Analisis & Aspek Kesehatan Bahan Tambahan Pangan*. Edisi ke-2. Jakarta: Bumi Aksara; 2023.

[2] Estiasih T, Putri WDR, Widyastuti E. *Komponen Minor & Bahan Tambahan Pangan*. Jakarta: Bumi Aksara; 2022.

[3] Sugiarty AM, Fithriyani D, Wahyuningtyas A. Analisis Kandungan Siklamat dan Sakarin pada Minuman Es Kopi Susu Gula Aren di 5 Coffee Shop, Kota Bandar Lampung. *Communication in Food Science and Technology*. 2022;1(1):1-8.

[4] Lidiawati D, Pare Rombe Y, Sarera Surbakti P. Penetapan Kadar Siklamat dalam Teh Kemasan Siap Minum di Kabupaten Sidenreng Rappang dengan Metode Gravimetri. *Sciences Education and Learning Journal*. 2022;2(1):102-108.
[5] Manoppo T, Sudewi S, Wewengkang DS. Analisis Pemanis Natrium Siklamat Pada Minuman Jajanan Yang Dijual Di Daerah Sekitar Kampus Universitas Sam Ratulangi Manado. *Pharmacon*. 2019;8(2):488.
[6] Utomo Y, Hidayat A, Dafip M, Sasi FA. Studi Histopatologi Hati Mencit (*Mus musculus*L.) yang Diinduksi Pemanis Buatan. *Jurnal MIPA*. 2012;35(2):122-129.
[7] BPOM. Peraturan Kepala Badan Pengawas Obat dan Makanan Nomor 11 Tahun 2019 tentang Batas Maksimum Bahan Tambahan Pangan Pemanis. Jakarta: BPOM; 2019.
[8] Amadea MB, Ariani M, Wibowo JM. Analisis Perilaku Konsumen Kopi Keliling Sebagai Gaya Hidup Modern Generasi Muda. *COSTING: Journal of Economic, Business and Accounting*. 2025;8(1):252-263.
[9] Karim AR, Darsono D, Harisudin M, Dharmawan B. Uncovering hidden determinants of millennial farmers' intentions in running conservation agriculture: An application of the Norm Activation Model. *Open Agriculture*. 2024;9(1):20220257.
[10] Novitasari M, Rahma N, Puspitasary K. Penetapan Kadar Pemanis Buatan (Na-Siklamat) pada Beberapa Minuman Serbuk Instan di Kota Surakarta. *Avicenna: Journal of Health Research*. 2022;2(2):135-141.
[11] Wattiheluw MH, Ramadhani D, Zahra A. Identifikasi Kandungan Natrium Siklamat pada Susu Bubuk Skim Yang di Jual Di Pasar Ngemplak Kota Tulungagung Dengan Metode Gravimetri. *Nutriture Journal*. 2024;3(1):26-31.
[12] Handayani T, Agustina A. Penetapan Kadar Pemanis Buatan (Na-Siklamat) Pada Minuman Serbuk Instan Dengan Metode Alkalimetri. *Jurnal Farmasi Sains dan Praktis*. 2015;1(1):1-6.
[13] Fatharani HN, Puspitasari D, Mar K. Deteksi dan Analisis Kadar Natrium Siklamat dalam Es Teh Manis yang dijual di Kawasan Pundung Nogotirto Gamping Sleman Yogyakarta. 2025;228-243.
[14] Hernaningsih M, Jayadi L. Analisis Kandungan Pemanis Buatan Siklamat pada Sirup yang Beredar di Pasar Besar Malang Secara Kuantitatif Menggunakan Metode Spektrofotometri UV-VIS. *Jurnal Riset Kefarmasian Indonesia*. 2021;3(3).
[15] Rahmayanti F, Sirajudin W, Mubarak S. Analisis Kadar Siklamat Pada Minuman Es Teh Yang Beredar Di Kelurahan Pangkajene Sidrap Dengan Metode Alkalimetri. *Jurnal Farmasi Al-Ghafqi*. 2019;1-7.
[16] Silfi. Analisis Kandungan Siklamat Jagung Rebus Yang Dijual Oleh Beberapa Kios Jagung Di Jalan Poros Takalar Menggunakan Metode Spektrofotometri UV-Vis. Karya Tulis Ilmiah. Makassar: Institut Ilmu Kesehatan Pelamonia; 2025.
[17] Azizah N, Gatera VA, Ratnasari D. Analisis Kadar Siklamat Dengan Metode Spektrofotometri UV-VIS Pada Minuman Serbuk Di Telukjambe Timur. *Jurnal Pendidikan dan Konseling (JPDK)*. 2022;4(6):1149-1155.
[18] Fadhilah R, Gatera VA, Saula LS, Sakiran. Uji Kadar Formalin pada Tahu yang di Jual di Kabupaten Karawang dengan Metode Spektrofotometer Visible. *Jurnal Ilmiah Wahana Pendidikan*. 2022;8(21):357-369.
[19] Pratiwi RRJ, Kurniawati N, Perwirahayu Aji Saputri IS. Analisis Kadar Siklamat Pada Es Oyen Di Kota Madiun Dengan Metode Spektrofotometri UV-Vis. *Jurnal Ilmiah Bakti Farmasi*. 2024;9(1):1-8.