Analysis Of Artificial Sweetener Content Of Sodium Cyclamate In Sugar Syrup Of Dawet Ice Sold at PPS Gresik Regency

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Abstract

Many food and beverage sellers intentionally add hazardous chemicals to gain profits. For sweetening food or beverages, the chemical sodium cyclamate is sometimes added to reduce sugar consumption. Sodium cyclamate as an artificial sweetener will have a negative impact on health if consumed above the established threshold. One of the side effects of excessive consumption of sodium cyclamate is digestive disorders and kidney damage. This study aims to determine the presence of artificial sweeteners (sodium cyclamate) in the sugar syrup of dawet ice sold at the PPS Gresik Regency. The method for identifying the presence of sodium cyclamate uses qualitative tests. The precipitation test and the test kit are two types of qualitative tests used. Both tests will reveal a white precipitate if sodium cyclamate is detected. There were three samples of dawet ice sugar syrup tested. The test results showed that the three samples tested did not contain sodium cyclamate. This is because there was no formation of white sediment in both test methods. Thus, the sugar syrup of dawet ice sold at the PPS Gresik Regency is declared safe from the use of sodium cyclamate.

Keywords: precipitation, sweet drink, test kit**,** norit

1. INTRODUCTION

The consumption of sweetened beverages is a common habit in Indonesia. Sweetened beverages are any beverage containing sugar, whether natural or artificial. There are two types of sweeteners on the market: natural and artificial (Marliza et al., 2020). Natural sweeteners are substances that provide a sweet taste and are made from plant or animal sources, while artificial sweeteners are additives that provide a sweet taste and are made synthetically in a laboratory (Mulyati et al., 2023).

Sodium cyclamate, an artificial sweetener, has a sweeter taste than sugar (sucrose) and is less expensive (Hartini & Simorangkir, 2020). The use of the artificial sweetener sodium cyclamate is regulated by Regulation of the Food and Drug Supervisory Agency Number 11 of 2019 concerning Food Additives, which limits the use of sodium cyclamate to 250 mg/kg (Kepala BPOM RI, 2019). Consuming sodium cyclamate in excess of the recommended limit can cause tremors, migraines, tumors, and bladder cancer (Suparmi *et al*., 2023).

Research related to the identification of the presence of sodium cyclamate was conducted in boba drinks and the results were positive for the presence of sodium cyclamate, and the amount exceeded the maximum limit of BPOM in 2019, namely 1293.10 mg/kg, 827.60

mg/kg, 931.00 mg/kg, and 543.00 mg/kg (Khasanah & Sya'bana, 2023). Other research related to the identification of the presence of Sodium cyclamate was also carried out in packaged tea drinks and the results proved that it was present, but still had levels below the permitted limit (0.3% for soft drinks) (Rasyid et al., 2011).

A survey in the PPS area, Manyar District, Gresik Regency, identified three sellers of traditional dawet iced drinks. Previous research identified the presence of the artificial sweetener sodium cyclamate in sweetened drinks. This prompted researchers to identify the artificial sweetener content in the dawet iced sugar syrup sold at the Gresik PPS. The presence of sodium cyclamate can be tested using the precipitation method (Devitria & Sepriyani, 2018) and the cyclamate test kit (Pininfarina & Mahmudiono, 2023). Both methods for qualitative testing for the presence of sodium cyclamate are relatively easy for the general public to perform, so the hope of this research is that it can be applied independently by the community.

2. METHOD

In the Gresik PPS area, there are three dawet ice sellers. The brown sugar from these three sellers will be tested for sodium cyclamate content. A total sampling technique was used to determine the research sample, so the brown sugar from all three dawet sellers will be sampled. The three brown sugar samples from the three dawet ice sellers will be coded A, B, and C. Testing for the presence of sodium cyclamate in brown sugar dawet ice will be replicated three times for each sample.

Tools and Materials

The tools used in this study were droppers, test tubes, 100 mL beakers, 100 mL Erlenmeyer flasks, 50 mL graduated cylinders, 10 mL graduated cylinders, 100 mL graduated cylinders, 50 mL graduated flasks, filter paper, a hotplate, a spoon, a stirring rod, parchment paper, a glass funnel, and an analytical balance.

The materials used in this study were brown sugar syrup, sodium cyclamate (positive control), distilled water, activated charcoal (norit), 37% HCl (pro-analyst), 10% $BaCl_2$ (technical), $NaNO_2$ (Merck KGaA), and an AOAC (Association of Official Analytical Chemists) reference cyclamate test kit.

Procedures

Positive control for the precipitation method

Clean and dry tools and materials were prepared. Place 5 grams of sodium cyclamate in a beaker and dissolve it in 10 mL of distilled water. Transfer the solution to a 50 mL volumetric flask and add distilled water to the mark. Shake until homogeneous. Pipette 5 mL of the solution into a test tube. Then, add 2 mL of 10% HCl solution and 2 mL of 10% $BaCl_2$ solution and let it stand for 30 minutes. Afterward, filter using filter paper, and then add 2 mL of 10% $NaNO_2$ solution. The solution is heated on a hotplate at 125-130°C and left for 20-30 minutes. If a white precipitate forms, the sample is positive for sodium cyclamate.

Negative control for the precipitation method

Prepare clean and dry equipment and materials. Measure out 5 mL of distilled water and transfer it to the test tube. Then, 2 mL of 10% HCl solution and 2 mL of 10% $BaCl_2$ solution were added and allowed to stand for 30 minutes. Afterward, the mixture was filtered using filter paper, followed by 2 mL of 10% $NaNO_2$ solution. The solution was heated on a hotplate at 125-130°C and allowed to stand for 20-30 minutes. The negative control results showed no sediment in the sample.

Precipitation method

Clean and dry equipment and materials were prepared. Put 5 mL of brown sugar into a beaker. The sample was diluted with distilled water at a 1:1 ratio. Zero point zero four grams of activated charcoal (norit) was added to decolorize the sample until it dissolved, then filtered using filter paper. The 5 mL filtrate was transferred to a test tube. Two mL of 10% HCl was added to the filtrate, followed by 2 mL of 10% $BaCl_2$ and shaken. The mixture was allowed to stand for 30 minutes. After 30 minutes, the mixture was filtered using filter paper, then 2 mL of 10% $NaNO_2$ was added. The solution was heated on a hotplate at 125-130°C and left for 20-30 minutes. If a white precipitate forms, the sample is positive for sodium cyclamate.

Positive control for cyclamate test kit

Prepare clean and dry equipment and materials. Place 5 grams of sodium cyclamate in a beaker and dissolve it in 10 mL of distilled water. Transfer the solution to a 50 mL volumetric flask and add distilled water to the mark. Shake until homogeneous. Pipette 1 mL of the solution into a test tube. Measure 10 mL of the sample and transfer it to the beaker. Add 0.040 grams of activated charcoal (norit) to decolorize the sample until it dissolves, then filter it using filter

paper. Measure 2 mL of the sample and transfer it to the test tube that had previously added the sodium cyclamate solution. Then, three drops of reagent 1 were added, homogenized, and left for 3 minutes. Three drops of reagent 2 were added, homogenized, and left for 3 minutes. Three drops of reagent 3 were added, homogenized, and left for 3 minutes. If a white precipitate forms, the sample is positive for sodium cyclamate.

Negative control for cyclamate test kit

Prepare clean and dry equipment and materials. Measure 2 mL of distilled water and place it in a test tube. Then, add three drops of reagent 1, homogenize, and leave for 3 minutes. Then, add three drops of reagent 2, homogenize, and leave for 3 minutes. Three drops of reagent 3 were added, homogenized, and left for 3 minutes. The negative control results showed no precipitate in the sample.

Cyclamate test kit

Prepare clean and dry equipment. Measure 10 mL of sample and place it in a beaker. 0.040 grams of activated charcoal (norit) was added to remove the sample's color until it dissolved, then filtered using filter paper. The sample was measured as 2 mL. Then, three drops of reagent 1 were added, homogenized, and waited for 3 minutes. Then, three drops of reagent 2 were added, homogenized, and waited for 3 minutes. After that, three drops of reagent 3 were added, homogenized, and waited for 3 minutes.

3. RESULTS AND DISCUSSION

The results and discussion section will present the results of qualitative tests for the presence of sodium cyclamate. Qualitative testing included precipitation tests and kit tests. Each test was replicated three times for each sample.

Precipitation method

In the precipitation method, a sample will be declared positive for sodium cyclamate if a white precipitate forms (Devitria & Sepriyani, 2018). The results of this test can be seen in Table 1.

Table 1. Results of the precipitation method

Sample	Observation Result		
	R1	**R2**	**R3**
Positive control	+		
Negative control	-		
A	-	-	-
B	-	-	-
C	-	-	-

Note:
+: White precipitate forms
-: No white precipitate forms
R: Replication

Based on Table 1, it can be concluded that all three tested samples were negative for sodium cyclamate. This is because none of the tested samples showed any white precipitate after the precipitation method. Documentation of the precipitation method test can be seen in Figure 1.

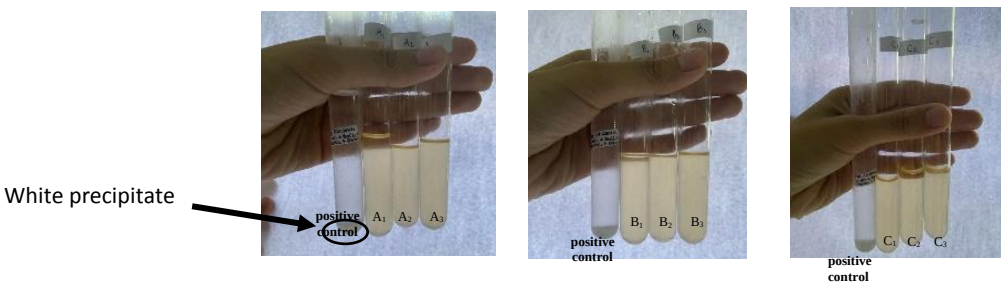

Figure 1. Results of the precipitation method

In the precipitation method, a positive control was performed with a sodium cyclamate solution. This solution was treated according to the steps. The positive control resulted in the formation of a white precipitate, i.e., Barium sulfate ($BaSO_4$), indicating that the reagent was working properly. A negative control was also performed with distilled water without the addition of sodium cyclamate solution. The negative control showed no white precipitate, indicating the absence of contamination.

The precipitation method procedure begins with taking a sugar syrup sample solution, diluting it with distilled water, and adding activated charcoal (norit) to clarify the sample, making it easier to observe the reaction. Activated carbon does not precipitate with sodium cyclamate, so the addition of norit in this study did not affect the results (Fahamsya *et al*., 2024). The filtrate was then filtered, and a 10% HCl solution was added to the filtered solution to create an acidic

environment, facilitating the reaction (Zarwinda *et al*., 2021), Then, a 10% $BaCl_2$ solution was added and allowed to stand for 30 minutes.

The 10% $BaCl_2$ solution precipitates impurities in the sample (Anggreani & Pangestu, 2023). Next, the solution was filtered using filter paper and a 10% $NaNO_2$ solution was added. The addition of the 10% $NaNO_2$ solution breaks the sulfate bonds in the primary aliphatic amines in cyclamate (Fahamsya *et al*., 2024). The final step involved heating the solution on a hotplate at 125-130°C for 20-30 minutes. Nitrogen gas, a product of the reaction, was detected by its pungent odor during heating (Zarwinda *et al*., 2021). If the sample contains sodium cyclamate, a white precipitate will form.

Cyclamate test kit

In the analysis of sodium cyclamate using the cyclamate test kit, a solution is considered positive for sodium cyclamate if a precipitate is present. A large amount of precipitate in the sample indicates a high concentration of cyclamate (Pininfarina & Mahmudiono, 2023). The results of the test can be seen in Table 2.

Table 2. Cyclamate test kit results

Sample	Observation Result		
	R1	**R2**	**R3**
Positive control	+		
Negative control	-		
A	-	-	-
B	-	-	-
C	-	-	-

Note:
+: White precipitate forms
-: No white precipitate forms
R: Replication

Based on Table 2, it can be concluded that the three tested samples tested negative for sodium cyclamate using the test kit method. This finding aligns with previous research that found no sediment in the test kit method for sodium cyclamate content in boba drinks (Pininfarina & Mahmudiono, 2023). Documentation of this test can be seen in Figure 2.

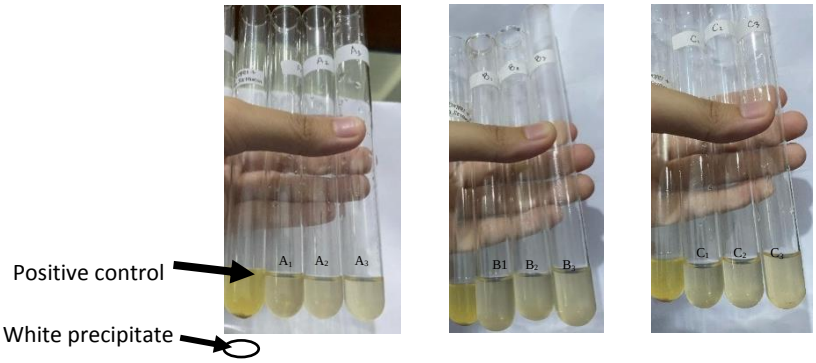

Figure 2. Cyclamate test kit results

In the cyclamate test kit method, a positive control was performed using a sample containing sodium cyclamate solution. This solution was then added to reagents 1, 2, and 3 according to the procedure. The positive control resulted in the formation of a white precipitate at the bottom of the test tube, indicating that the reagents in the test kit were functioning properly. The negative control was performed by adding distilled water that did not contain sodium cyclamate and treated in the same manner. The negative control showed no white precipitate, indicating that the test system was clean from contamination.

The test kit method procedure begins by preparing a sugar syrup sample in a beaker, adding activated charcoal, and filtering it. After filtering, the sample was placed in a test tube. Three drops of reagent 1 were then added, mixed, and allowed to stand for 3 minutes. Three drops of reagent 2 and three drops of reagent 3 were added, each time mixing and allowed to stand for 3 minutes. If sodium cyclamate is present in the sample, a white precipitate forms at the bottom of the test tube. This white precipitate forms due to a reaction between the cyclamate compound in the sample and a special reagent in the test kit. A solution is considered positive for sodium cyclamate if a white precipitate is present. The absence of cyclamate in the three dawet ice samples indicates that this product is safe for public consumption.

The addition of artificial sweeteners is more likely to damage organs (such as the liver) (Utomo et al., 2012), rather than causing pain or a sore throat. Sore throats can also be caused by viruses and bacteria due to a weakened immune system (Gayatri *et al.*, 2022). The bacteria that usually cause sore throats are the streptococcus group (H & Yuliyani, 2023).

4. CONCLUSION

Based on this research, it was concluded that the sugar syrup from dawet ice vendors at the PPS in Gresik Regency did not contain the artificial sweetener sodium cyclamate. This was confirmed by qualitative tests using the precipitation method and the cyclamate test kit. The

cyclamate test kit method is a method that can be used without a laboratory scale, making it easy and practical for the public to identify the presence of sodium cyclamate.

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