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Description of Knowledge and Attitudes as Well as the Use of Artificial Sweeteners (Cyclamat and Saccharin) Around the Laweyan District Elementary Schools

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ABSTRACT

Introduction: The addition of food additives, especially artificial sweeteners, by food manufacturers is inseparable from the manufacturer's knowledge and concern about these food additives. The addition of food additives, especially artificial sweeteners, to food or beverages is influenced by several factors, including the low knowledge of traders and the relatively cheaper price of artificial sweeteners compared to sugar. The purpose of this study is to find out the overview of the knowledge and attitudes of traders about the use of artificial sweeteners (cyclamat and saccharin) around the Laweyan District Elementary School. **Method:** quantitative descriptive research, namely describing the knowledge and attitudes of traders about the use of artificial sweeteners (cyclamate and saccharin) in drinks sold around the Laweyan District Elementary School. The variables in this study are the knowledge and attitude of traders about sweeteners (cyclamate and saccharin), artificial sweeteners. The sample used in this study was beverage traders around SD Laweyan District as many as 17 traders and snack drinks sold as many as 24 drinks. The sampling technique used was total sampling, namely the subjects were taken by all traders and snack drinks around the Laweyan District Elementary School. **Results:** The results of the study showed that 24 samples (100%) were positive for cyclamate and saccharin, out of 24 drink samples, 23 samples (95.8%) of the levels of cyclamate and saccharin exceeded the limit recommended by BPOM RI No. 11 of 2019. Knowledge and attitude of elementary snack drink traders Most of them showed good results, but in understanding the recommended limits for the use of cyclamate and saccharin, as many as 16 traders (94.1%) did not know. **Conclusion:** The trader's knowledge is lacking in the limits of saccharin and cyclamate, so the use of saccharin and cyclamate in the drinks sold also exceeds the recommended limit.

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INTRODUCTION

Food consumed by humans on a daily basis generally must go through a processing process. In this food processing process, it is not uncommon to add food additives to maintain the quality of food so that it is more attractive so that the food will be preferred by consumers. Food additives such as preservatives, additives, and food coloring are found in many types of food and beverages. These additives are used by both the factory industry and the household industry. The safety of school snacks needs to be considered because it is related to student safety. These additives are deliberately added to enhance the taste, aroma, and physical appearance of food or beverages (Joseph *et al*., 2015). One type of food additive that is often used is sweeteners. Sweeteners (*sweetener*) is a food additive in the form of natural sweeteners and artificial sweeteners that give a sweet taste to food products (BPOM, 2014). These artificial sweeteners are chemically processed and the compounds are not found naturally.

The use of artificial sweeteners is increasingly widespread in various foods and beverages because it is able to provide an equally sweet, even stronger taste than natural sweeteners (Elfariyanti & Risnayanti, 2019). These artificial sweeteners are found in children's snacks, both in packaged foods and in foods sold by street food sellers, so children are most vulnerable to the negative effects of artificial sweeteners. The results of the research on the content of cyclamate and saccharin in ice cendol sold in traditional markets there were 2 samples of ice cendol that were positive for cyclamate (Sagala & Dunggio, 2023).

Knowledge and attitudes are two important components that shape a person's behavior, including in the context of economic activities such as trading practices. For food and beverage traders, an adequate understanding of the types of sweeteners both natural and artificial greatly determines their behavior in choosing and using these additives. Traders who have sufficient knowledge about the side effects of dangerous artificial sweeteners (such as saccharin, cyclamate, and others that do not meet safe limits) are likely to be more selective and cautious in their use (Pramono) *et al*., 2018).

Elementary schools are the most potential places to be the target for the sale of sugary drinks. Laweyan District has a fairly large number of elementary schools, this causes the number of non-packaged beverage traders to also be large. There are also quite a lot of non-packaged drinks sold around the Laweyan District Elementary School because some elementary schools do not have canteens so that students can buy snacks around the school. Based on the above background, the formulation of the problem in this study is how to describe the knowledge and attitude about the use of artificial sweeteners (Cyclamat and Saccharin) around the Laweyan District Elementary School.

LITERATURE REVIEW

The types of artificial sweeteners are very diverse, including saccharin, cyclamate, aspartame, dulsine and synthetic sorbitol. The use of food additives, especially sweeteners, must always be supervised, especially artificial sweeteners, because they can pose a danger to health. Effects caused by excessive use of artificial sweeteners include tremors (nerve diseases), migraines and headaches, memory loss, confusion, insomnia, irritability, asthma, hypertension, diarrhea, abdominal pain, allergies and sexual disorders, baldness and brain cancer (Harningsih) *et al*., 2020). Children are most vulnerable to the negative effects of artificial sweeteners, for children it can interfere with children's cognitive development and

health because the brain is still in the development stage and accumulates in the nervous tissue.

The use of artificial sweeteners in Indonesia in food or beverages is regulated in BPOM RI Regulation No. 11 of 2019, in which the regulation regulates the limits or levels of use of artificial sweeteners, especially saccharin and cyclamate in certain types of foods. The maximum level of cyclamate in sugar and syrup for ice is 500 mg/kg and the maximum level of saccharin in sugar and syrup for ice is 300 mg/kg (BPOM, 2019). However, the use of saccharin and cyclamate in drinks sold by traders is still found to exceed the recommended limit.

The misuse of food additives, especially artificial sweeteners, by food producers is inseparable from the knowledge and concern of producers regarding these food additives. The addition of food additives, especially artificial sweeteners, to food or beverages is influenced by several factors, including the low knowledge of traders and the relatively cheaper price of artificial sweeteners compared to sugar (Melinda *et al*., 2022). A trader's knowledge regarding the use of good artificial sweeteners is not in line with the actions taken in using artificial sweeteners in the beverages sold (Jamil *et al.*, 2019).

METHODS

The type of research is a descriptive that describes the knowledge and attitudes of traders about the use of artificial sweeteners (cyclamat and saccharin) as well as the use of saccharin and cyclamate in drinks sold around the Laweyan District Elementary School. The variables in this study are the knowledge and attitude of traders about sweeteners (cyclamate and saccharin), artificial sweeteners (saccharin and cyclamat). Knowledge variables were categorized as good if ≥mean (8.61) and less if <mean, Attitude was categorized as good if ≥mean (6.41) and less if <mean, cyclamate was categorized as eligible if ≤500 mg/kg and not qualified >500 mg/kg, while saccharin was categorized as eligible if ≤ 300 mg/kg and ineligible if >300 mg/kg. The variables of knowledge and attitudes are categorized referring to the mean result because the data is normally distributed.

The sample used in this study was 17 beverage traders around the Laweyan District Elementary School to be measured by questionnaire and snack drinks sold as many as 24 drinks were measured by laboratory tests. The sampling technique used is *total sampling*, namely the subjects are taken by all traders and snack drinks sold around the Laweyan District Elementary School. The criteria for snack drink samples include drinks sold by mobile traders around the elementary school area of Laweyan District, not packaged drinks.

Data collection was carried out by laboratory examinations for the variables of saccharin and cyclate use, questionnaires for knowledge and attitude variables. Saccharin and cyclamate examinations were carried out at the BPSMB Surakarta Testing Laboratory using the Titrimetry method for saccharin testing and Gavitri for Siklamat testing, this test was carried out to determine the presence of saccharin and cyclamate content and to determine the level of use of saccharin and cyclamate in snack drinks.

The research analysis was carried out by univariate analysis and compared the levels of artificial sweeteners in accordance with BPOM No. 11 of 2019. Univariate analysis is used to describe the variables studied to determine the frequency distribution and to describe the characteristics of the variable sample. This research has met the research ethics with No. 5348/A.2/KEPK-FKUMS/IX/2024.

RESULTS AND DISCUSSION

The snack drinks sold around the Elementary School are very diverse and attractive to Elementary School children. The study was conducted on 17 street vendors selling snacks for elementary school children in Laweyan District by taking samples of sugary drinks other than branded packaged drinks. The number of drinks taken as a sample was 24 drinks. The study was conducted to find out the picture of traders' knowledge and attitudes by using questionnaires and testing artificial sweeteners on drinks sold to determine saccharin and cyclate levels.

Characteristics of respondents

The frequency distribution of respondent characteristics which includes age, gender, education, service period can be shown in the following table:

Table 1. Frequency distribution of respondent characteristics (N= 17)

Respondent Characteristics	Categories	Total	
		Frequency (n)	Percentage (%)
Age (years)	12 – 25	1	5.9
	26 – 45	9	52.9
	46 - 65	7	41.2
Gender	Women	7	41.2
	Male	10	58.8
Education	Not in school	1	5.9
	Elementary School	4	23,6
	Junior High School	3	17,6
	High School	6	35.3
	Diploma/bachelor's degree	3	17.6
Tenure	≤5 years	11	64.7
	>5 years	6	35.3

Based on the respondent characteristics table, it can be seen that the most respondents are between 26-45 years old as many as 9 traders (52.9%), the most gender is male with 10 traders (58.8%), the last education is the most high school graduates as many as 6 traders (35.3%), and the most working period has a working period of ≤5 years as many as 11 traders (64.7%).

The sweetener levels of cyclamate and saccharin in drinks

Drink samples taken from mobile traders in the Laweyan District Elementary School area of Surakarta after testing for saccharin and cyclamate levels were obtained as in Table 2. Based on the results of saccharin examination in the laboratory using titrimetry and cyclamate methods using the gravimetric method, it was obtained that out of 24 drink samples taken as samples, 24 positive drinks contained saccharin and cyclamate. Testing samples of snack drinks sold around Laweyan District Elementary School also measured the level of use of artificial sweeteners, both saccharin and cyclamat. Based on the examination of the level of artificial sweeteners of cyclamate, it was found that the lowest level of 500 mg/kg was found in iced tea A and the highest level of 18,800 mg/kg was found in green banana ice. Meanwhile, in the examination of the level of saccharin artificial sweeteners from 24 drink samples, it was found that the lowest level of 190 mg/kg was found in green banana ice and the highest level of 18,970 mg/kg was found in milk ice syrup B.

The results of the analysis test on cyclamate and saccharin levels in elementary school snack drinks around Laweyan District Elementary School showed that from 24 drink

samples taken, all (100%) were positive for containing cyclamate and saccharin with the highest levels in each artificial sweetener being cyclamate as much as 18,800 mg/kg found in green banana ice and saccharin as much as 18,970 mg/kg in milk syrup B ice Often used by beverage merchants in adding sweetness. The maximum level of use of cyclamate and saccharin in drinks has been regulated in BPOM RI No. 11 of 2019 that the maximum level of cyclamate in sugar and syrup for ice is 500 mg/kg and the maximum level of saccharin in sugar and syrup for ice is 300 mg/kg (BPOM, 2019). Testing of cyclamate levels on 24 drink samples obtained 23 samples (95.8%) with cyclamate levels exceeding the maximum limit and 1 sample (4.2%) was right at the maximum limit, while for 24 samples of saccharin artificial sweeteners, there were 23 samples (95.8%) exceeding the maximum level and 1 sample (4.2%) below the maximum level.

Table 2. Results of Artificial Sweeteners of Cyclamate and Saccharin

Item	Sample Name	Cyclamat Rate (mg/kg)	Saccharin Levels (mg/kg)
1.	Mixed Ice	3,000	13,810
2	Ice milk syrup A	1,800	14,860
3.	Yakult milk ice	2,500	14,500
4.	Iced Tea Tarik	1,600	12,140
5.	Is lemon tea	1,000	18,940
6.	Sweet Iced Tea A	500	17,290
7.	Pure fresh milk	5,100	12,820
8.	Fresh milk melon	3,800	12,630
9.	Melon kopyor ice	3,200	18,350
10.	Strawberry kopyor ice	3,000	11,670
11.	Ice gum	6,500	10,210
12.	Green banana ice	18,800	190
13.	It's mango jelly	5,600	9,820
14.	Sweet Iced Tea B	2,800	13,810
15.	Orange Ice	5,400	14,880
16.	Sweet Iced Tea C	12,000	14,490
17.	Iced Kampul Tea	3,200	12,160
18.	Ice milk syrup B	4,300	18,970
19.	Sweet Iced Tea D	2,000	17,320
20.	Guava juice	5,000	12,840
21.	Sweet E Iced Tea	2,300	12,640
22.	Sweet Iced Tea F	4,400	11,580
23.	Sweet Iced Tea G	6,300	12,550
24	It's five	2,500	15,760

Artificial sweeteners of cyclamate and saccharin are types of sweeteners that are made by chemical processes. These food additives are allowed to be used, but their use is regulated by the maximum limit that is allowed to be added to food. High levels of cyclamate and saccharin use in food or beverages are still commonly found among traders, even if they exceed the recommended limits.

The snack drink that contains the highest levels of cyclamate is green banana ice, one of the ingredients used to make green banana ice is concocted syrup. The syrup is made by yourself and sometimes added more sweeteners to make the sweetness stronger. Another study also showed that the use of cyclamate in drinks sold in elementary schools as much as 56.36% showed positive results and as many as 40% cyclamate levels exceeded the recommended limit (Singapore) *et al.*, 2021).

Cyclamate added in food or beverages exceeds the maximum recommended limit and if consumed too often can be harmful to health. The effects caused by the consumption

of cyclamate do not appear directly but will appear for a long time because they accumulate in the human body (Islam *et al*., 2024). Health problems that arise as a result of cyclamate consumption such as allergies, diarrhea, hypertension, irritation, memory loss, insomnia, headaches, impotence, and baldness (Hernaningsih & Jayadi, 2021).

The highest use of saccharin artificial sweeteners was found in samples of type B syrup milk ice drinks, in the syrup drinks tested, there were other ingredients in the drinks that made saccharin levels high. Saccharin added to drinks or foods with levels exceeding the recommended limit can also be harmful to health. The effects that can be caused by consuming saccharin exceeding the maximum limit over a long period of time can lead to allergies, bladder disease, brain tumors, lupus, Alzheimer's, mental disability, birth defects, Parkinson's, and diabetes (Pratomo, 2021). The effects of the sucralose and saccharin-cyclamate mixture can cause severe inflammation of the liver, kidneys, pancreas and bladder (El-Hadad *et al*., 2022).

The use of cyclamate and saccharin is already banned in the United States but in Indonesia, these synthetic additives are not banned and can be used with certain daily intake limits that have been set for each food and beverage. Given the dangers that can be posed by these synthetic additives, the supervision and regulation of the use of synthetic additives for commercial food and beverages needs to be tightened (Hasan *et al*., 2023).

Overview of traders' knowledge and attitudes

School children's snack vendors around the Elementary School in the Laweyan District area have different characteristics. The trader's knowledge and attitude about artificial sweeteners can be seen in the following table:

Table 3. Results of Overview of Traders' Knowledge and Attitudes

Variable	Categories	Total	
		Frequency (n)	Percentage (%)
Knowledge	Good	10	58.8
	Less	7	41.2
Attitude	Good	6	35.3
	Less	11	64.7

Based on the description of traders' knowledge and attitudes about artificial sweeteners, respondents' knowledge was mostly good as much as 58.8%, and traders' attitudes were mostly lacking as much as 64.7%. The knowledge of traders is good, but the attitude still shows a lack in the use of artificial sweeteners in snack drinks sold in elementary school environments (Table 4).

Based on the results of interviews with elementary school snack traders in the Laweyan District of Surakarta it is known that traders' knowledge about the use of artificial sweeteners both saccharin and cyclamate as many as 12 respondents (70.6%) understand the function of food additives, as many as 15 respondents (88.2%) understand that excessive use of cyclamate and saccharin can be harmful to health, as many as 15 respondents (88.2%) do not understand that cyclamate artificial sweeteners are limited in their use, A total of 17 respondents (100%) understood that the effects of artificial sweeteners on children can have an effect on mental retardation, and as many as 16 respondents (94.1%) did not understand that cyclamate and saccharin should not be added to food in large quantities (Table 4).

The attitude of snack drink traders for elementary school children shows that as many as 9 respondents (52.9%) stated that the use of artificial sweeteners, both cyclamate and saccharin, can still be added to sweetened foods such as cut ice, packaged powdered

drinks and sweet foods, as many as 10 respondents (58.8%) use artificial sweeteners of cyclamate and saccharin because the price is cheaper.

Table 4. Distribution of Frequency of Answers Knowledge and Traders' Attitudes (N= 17)

Item	Question Variables	True		False	
		n	%	n	%
	Knowledge				
1	Function of Food Additives (BTP)	12	70.6	5	29.4
2	Artificial sweetener of one type of BTP	11	64.7	6	35.3
3	Artificial sweeteners are chemically processed	15	88.2	2	11.8
4	Cyclamate is 30 times sweeter than regular sugar	13	76.5	4	23.5
5	Excessive use of cyclamate and saccharin does not harm health	15	88.2	2	11.8
6	Acute side effects of saccharin and cyclamate use	14	82.4	3	17.6
7	Artificial sweeteners are prohibited for babies, toddlers, pregnant women and breastfeeding mothers	15	88.2	2	11.8
8	Beverage manufacturers/sellers use cyclamate and saccharin because they are cheap	10	58.8	7	41.2
9	The effects of cyclamate appear over a long period of time	9	52.9	8	47.1
10	The use of cyclamate is limited to a maximum of 250 mg/kg	2	11.8	15	88.2
11	Saccharin has a white, crystalline color, has a distinctive aromatic smell, tastes very sweet	7	41.2	10	58.8
12	Effects Artificial sweeteners for children have the potential to stimulate mental retardation	17	100	0	0
13	Cyclamate and saccharin can be used in large quantities	16	94.1	1	5.9
14	Cyclamate and saccharin are used for people affected by diabetes, so that their blood sugar does not rise	11	64.7	6	35.3
15	The use of cyclamate and saccharin should not be limited	17	100	0	0
	Attitude				
1	Prohibition of using artificial sweeteners in large quantities	17	100	0	0
2	The use of artificial sweeteners in large quantities is harmful to health	17	100	0	0
3	Artificial sweeteners are used because they are cheaper	13	76.5	4	23.5
4	Artificial sweeteners can be mixed on food and beverages	8	47.1	9	52.9
5	It is allowed to use artificial sweeteners in large quantities	13	76.5	4	23.5
6	Artificial sweeteners can cause bladder cancer	16	94.1	1	5.9
7	Artificial sweeteners have nutritional value	15	88.2	2	11.8
8	Artificial sweeteners in food and beverages can attract buyers	10	58.8	7	41.2
9	Artificial sweeteners can be for babies, toddlers, pregnant women and breastfeeding mothers	17	100	0	0
10	Addition of artificial sweeteners in the recommended amount	11	64.7	6	35.3
11	The use of cyclamat for school children's snacks	12	70.6	5	29.4
12	Saccharin and cyclamate are used together with refined sugar	16	94.1	1	5.9

Knowledge is information that is received by a person and makes it easier to understand something. Knowledge can influence a person's attitude in acting. Food or beverage traders' knowledge can be an important factor in determining the attitude and behavior of traders to use food additives such as artificial sweeteners.

Knowledge and good attitude in the use of artificial sweeteners in accordance with BPOM's recommendations greatly affect the safety of food consumed by elementary school children. Based on the results of interviews with traders, it is known that many respondents already understand the artificial sweeteners cyclamate and saccharin. Traders already understand that cyclamat and saccharin added to drinks or food and consumed

continuously will have an impact on human health. However, there are still traders who do not understand that artificial sweeteners of cyclamate and saccharin should not be added in large quantities. This can be seen from the trader's answer that they do not understand what the maximum limit for the use of cyclamat and saccharin is allowed according to the recommendations of BPOM RI. Lack of knowledge about the maximum limit of cyclamate and saccharin levels allowed to be mixed in beverages affects traders in using artificial sweeteners cyclamate and saccharin in higher doses. Traders consider that adding large amounts of cyclamate and saccharin can add sweetness to the drinks they sell.

A person's knowledge can be influenced by the level of education, the higher the level of education, the better a person's knowledge. Based on the results of the latest education research, the most traders are high school graduates as many as 9 (52.9%) traders and there are still traders who only graduated from elementary or junior high school, with the level of education that traders have shown that traders have gained enough knowledge. A person's level of education can affect knowledge and behavior, the higher the level of education, the easier it is to receive information and the wider the respondent's understanding.

Research in line with this study states that traders' knowledge is related to the use of artificial sweeteners, traders who have knowledge use artificial sweeteners more or less than traders who have sufficient knowledge (Nurpratama & Kinayungan, 2023). Knowledge can affect a person's attitudes and behaviors/practices, another study that shows that knowledge is related to practice is that less knowledge can influence poor food safety practices in elementary schools (Nurfajri & Kurnia, 2021).

The knowledge of snack drink traders around elementary schools who do not understand the limits of the use of sweeteners made by cyclamate and saccharin affects the attitude of traders. The attitude of traders in the use of cyclamate and saccharin in drinks is still lacking, namely traders add cyclamate or saccharin to sugary foods/drinks such as cut ice. Traders also use cyclamate or saccharin in the drinks they sell because they have a cheaper price compared to sugar. Although the use of artificial sweeteners has been regulated in BPOM Regulation No. 11 of 2019, if traders use this artificial sweetener with the aim of getting profits because the price is relatively cheaper so that its use is excessive, it will be able to endanger health, especially these consumers are elementary school children. Continuous consumption of artificial sweeteners and levels that exceed the recommended limit will interfere with children's health and growth because they can interfere with children's cognitive development and health.

Attitude is a view of objects that can be influenced by knowledge. The attitude of traders who are still lacking can change if additional information is given, especially the use of artificial sweeteners. A person's attitude can generally determine behavior, but it is not necessarily the attitude of a good trader that behaves well. This is shown from the results of the trader's attitude interview with the results of the cyclamate and saccharin level examination test, the trader's attitude is mostly good, but the results of the cyclamate and saccharin level testing 95.8% of the drink samples exceeded the recommended limit. In theory, attitude can determine behavior, but not always attitudes and behaviors go hand in hand. Attitudes can be influenced by factors of people who are considered important such as friends, parents, mass media which can affect self-confidence. Inconsistent attitudes and behaviors are caused due to traders' lack of knowledge about permitted food additives, traders justify themselves even though traders know what they are doing is wrong (Jamil *et al*., 2019). Therefore, there is a need to increase knowledge and attitudes to traders about the use of food additives. The health office and the Food and Drug Supervisory Agency need to play a role in improving understanding of traders. In addition to education, periodic monitoring of the content of food additives in school snacks is needed, as well as

practical training for traders on how to read labels, measure doses, and recognize health risks.

CONCLUSION

The results of the study showed that 24 samples (100%) of the drinks sold around the elementary school in the Laweyan District of Surakarta were positive for cyclamate and saccharin, 23 out of a sample of 24 samples (95.8%) exceeded the limit recommended by BPOM RI No. 11 of 2019. The results of knowledge and attitudes of elementary snack drink traders Most of them showed good results, but in understanding the recommended limits on the use of cyclamate and saccharin, as many as 16 traders (94.1%) did not know. The trader's knowledge of the limits of cyclamic and saccharin use is not proven by the results of testing saccharin and cyclamate levels of 95.8% exceeding the recommended limit.

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