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Hazards of Food Additives in Primary Schools' Street Foods in Semarang City

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ABSTRACT

Background: Snacks mainly from street food, provide 20–31.1 percent of the energy that students need per day. Street food refers to ready-to-eat food and beverages prepared and served in public areas. In contrast, street food vendors frequently add hazardous substances such as formalin and borax, as well as cyclamate, rhodamine B, and methanyl yellow, which can be harmful to students' health. This study aimed to observing the current condition of street food vendors surrounding the schools in Semarang city. **Methods:** This was an observational study selected by consecutive sampling. Street food samples were collected from 37 schools in Semarang city, Indonesia. The hazardous substances such as formalin, borax, methanyl yellow, and cyclamate were qualitatively tested using easy testing kits. **Result:** This study showed that 78.3% of the street food samples had formalin, 19.1% contained rhodamin B, 3.3% included methanyl yellow, and 4.0% contained cyclamate. **Conclusion:** Street food has a high ratio of preservatives (formalin). Therefore, it is necessary to regulate the sale of street food, especially those containing hazardous food additives.

Introduction

Street food is ready-to-eat food and drink that is sold and prepared in public areas, especially on the side of the road (Alimi, 2016). Street food is popular among people, especially in metropolitan areas, because it is relatively low priced, tastes great, is easily accessible, and contributes to the cultural and social legacy (Rane, 2011). In Indonesia, consuming street food is common across almost all social backgrounds and age groups, including school-age children (Sari and Rachmawati, 2020). Up to 30.4% of students purchase food from food vendors near their schools (Anjani et al., 2020). Snacks can provide 20–31.1% of a student's daily energy requirements (Kristianto *et al.*, 2013, Purnawijaya *et al.*, 2018).

However, the street food industry in Indonesia is not formally regulated, which is often ignored by the government and leads to unethical food vendor behavior (Rakha *et al.*, 2022). Typically, food vendors would add harmful preservatives like formalin and borax. Whereas hazardous compounds like cyclamate, Rhodamine B, and methanyl yellow are added to street foods by the producers/suppliers as additives (Anjani *et al.*,

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2020). Our previous study in Semarang city revealed that a significant portion of the snacks sold near primary schools still contains dangerous preservatives like formalin and borax, artificial colors like rhodamine B and methanyl yellow, and artificial sweeteners like cyclamate and saccharin (Anjani *et al.*, 2020). The differences with the previous study are that the number of samples is larger and the distribution of sampling locations is wider. The use of harmful food additives can have serious adverse effects, such as gastroenteritis and other diseases like liver, kidney, and neurological disorders (Rather *et al.*, 2017).

These harmful substances are used because they are very cheap and enhance the appearance of food rather than natural dyes. Through Indonesian Drug and Food Authority (BPOM), the Ministry of Health, and the municipal and regional governments, policies pertaining to the regulation of street food in schools have been carried out centrally (Manalu and Suudi, 2016). Additionally, there are some products that do not need to be registered with BPOM, such as ready-to-eat food, street food, and food with a shelf life of less than seven days which are processed and packaged in front of the buyer . Therefore, this study was conducted with the aim of observing the current condition of street food vendors surrounding the schools in Semarang city.

Materials and Methods

This was an observational study conducted in August and September 2023 in Semarang city, Indonesia. Street food samples were collected from 37 schools in Semarang city, selected by consecutive sampling. The types of food sample were meatballs, bihun gulung, leker, martabak, mie gulung (fried-rolled-noodle), yellow noodle, milor, fried dumpling, papeda, pentol, roti bakar, papeda's sauce, sempolan, siomay, es lilin, shaved ice, batagor, fried-tofu, sauces, food seasoning, etc. The schools that sold the greatest amount of street food were chosen. The hazardous substances (formalin, borax, methanyl yellow, rhodamine B, and cyclamate) present in the food samples were qualitatively tested at the Chemical Laboratory of Nutrition Sciences, Diponegoro University, using easy testing kits. These easy testing kits (Labstest Reagent: Rapid Test Kit, Indonesia) used the colorimetric method to identify the hazardous substances.

Positive test

A positive test was carried out to find the rapid test kit used serves to detect the dangerous preservatives and colouring in street food samples. The procedure for the positive test was carried out by weighing 0.5 mg of borax powder, rhodamine b, and methanyl yellow. Then, the test was put into a beaker glass. After that, 100 ml of distilled water was added and mixed until it was dissolved using a spatula. 3 ml of solution and 3 ml of 37% formalin solution were put into the test tube; then, the test reagent was dropped and any color change is observed.

Formalin test shows a change of colour to purple which showed positive formalin. In the borax test, a drop on the paper changes colour, producing red spots that indicate a positive result for borax. Rhodamine b test shows a change of colour to purple which showed positive rhodamine b. Methanyl yellow test shows a change of colour to red which showed positive methanyl yellow. The cyclamate test shows a colour change from grey to black, indicating a positive result for cyclamate.

Negative test

Negative tests are used to compare the results of the positive street food samples. The procedure for the negative test was done by taking 3 ml of distilled water using a drop pipette and putting it into a test tube. After that, the researchers dropped each test reagent and shook it until it was mixed. The test reagent was added to the sample, and any colour change is observed. Negative tests for formalin, borax, rhodamine B, cyclamate and methanyl yellow showed no colour change. Negative results indicated that the rapid test kits to be used were functioning properly.

Formalin test

Three ml of the dissolved sample was taken, and then 1 drop of Reagent Formalin 1 and 3 drops of Reagent Formalin 2 were added to detect the

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formaldehyde content in street food samples. If a colour change to purple occurred, it indicated that the sample was positive for formalin.

Borax test

In this test, turmeric paper was used to find out Borax content in street food samples, taking 3 ml solution dripped with 5 drops reagent borax which was then mixed. The authors mixed the solution with a drop pipette and then dripped it onto turmeric paper. If the paper changed to red, the sample was positive for borax.

Rhodamine B test

In this test, 3 ml of the dissolved sample was taken and dripped with 1 drop reagent rhodamine 1 and 3 drops reagent rhodamine 2 that function to detect the rhodamine b content in street food samples. If the sample showed a colour change to purple, the sample was positive for rhodamine b.

Methanyl Yellow test

In this test, 3 ml of the dissolved sample was taken and dripped with 5 drop reagent methanyl yellow-1, that function to detect the methanyl yellow content in street food samples. If the sample showed a colour change of red, the sample was positive for methanyl yellow.

Cyclamate test

In this test, 3 ml of the dissolved sample was taken and dripped with 3 drop reagent cyclamate-1, 3 drop reagent cyclamate-2, and 3 drop reagent cyclamate-3 that function to detect the cyclamate content in street food samples. If the sample showed a colour change to grey until it became black, the sample was positive for cyclamate.

Data analysis

Data were analysed using SPSS (version 22, IBM, New York, USA). A univariate analysis was carried out to describe the number of positive and negative results of laboratory tests according to the type of street food.

Result

Formalin, borax, rhodamine B, methanyl yellow, and cyclamate were qualitatively analyzed using easy testing kit. The samples were identified as positive which contained hazardous substance if two of the repetitions showedpositives results.

Table 1 shows the amount of hazardous substance detected in the test regarding street food samples. Among the hazardous substances added to food, the most frequently used substance was formalin (78.3%).

Table 1. Characteristics of primary school snack foods

Hazardous substances	n	Positive n (%)	Negative n (%)
Formalin	106	83 (78.3)	23 (21.7)
Borax	106	0	106 (100)
Rhodamine B	68	13 (19.1)	55 (80.9)
Methanyl Yellow	60	2 (3.3)	58 (96.7)
Cyclamate	62	3 (4.8)	59 (95.2)

Tabel 2 shows street food's type containing hazardous substance which was obtained from 37 primary schools in Semarang city.

Table 2. Street food's type containing hazardous substance.

Hazardous substances	Street food's type
Formalin	Meatballs, *batagor, cilok,* fried *bihun, maklor, siomay,* fried dumplings, *milor, pempek, pentol, telurgulung, sempolan,* sausages, fried-tofu, *tempura*
Borax	-
Rhodamine B	Meatballs' sauce, *telur gulung's* sauce, *sempolan's*sauce, *tempura's* sauce, *batagor's* sauce, *cilor's* seasoning, iced syrup
Methanyl Yellow	Meatballs' sauce, sausages' sauce
Cyclamate	*Es lilin* guava flavour, es lilin cincau flavour

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Tabel 3 shows the types of snack foods tested positive for formalin. The list includes meatballs, bihun gulung, leker, martabak, mie gulung, yellow noodles, milor, fried dumplings, papeda, pentol, roti bakar, papeda sauce, sempolan, siomay, and fried tofu.

Table 3. Formalin positive foods.

Type of food	Total (n)	Positive		Negative	
		n	%	n	%
Meatballs	13	13	100	-	-
Batagor	8	6	75	2	25
Bihun gulung	1	1	100	-	-
Cilok	7	4	57.1	3	42.9
Cilor	7	3	42.9	4	57.1
Leker	1	1	100	-	-
Maklor	5	2	40	3	60
Martabak	1	1	100	-	-
Mie gulung	1	1	100	-	-
Yellow noodle	2	2	100	-	-
Milor	2	2	100	-	-
Fried dumplings	4	4	100	-	-
Papeda	1	1	100	-	-
Pempek	3	2	66.7	1	33.3
Pentol	4	4	100	-	-
Roti bakar	1	1	100	-	-
Papeda's sauce	1	1	100	-	-
Sempolan	2	2	100	-	-
Siomay	5	5	100	-	-
Sausages	10	9	90	1	10
Fried-Tofu	11	11	100	-	-
Telur gulung	2	1	50	1	50
Tempura	4	3	75	1	25

Tabel 4 shows the types of snack foods tested positive for rhodamine b. The results indicate that shaved ice, instant drinks, sauces, and seasoning powders were tested. The samples of shaved ice and instant drinks were found to be 100% positive for rhodamine B content.

Tabel 5 shows the types of snack foods tested positive for methanyl yellow. The result showed that 2 sauce samples were tested positive for methanyl yellow content of 5.4%.

Table 4. Rodamine B positive foods.

Type of food	Total (n)	Positive		Negative	
		n	%	n	%
Seasoning powder	13	1	7.7	12	92.3
Shaved ice	1	1	100	-	-
Instant drink	1	1	100	-	-
Sauce	40	9	22.5	31	77.5

Table 5. Methanyl yellow positive foods.

Type of food	Total sample (n)	Positive		Negative	
		n	%	n	%
Sauce	37	2	5.4	35	94.6

Tabel 6 shows the types of snack foods tested positive for cyclamate. Of the 2 *Es lilin* and 1 shaved ice sample tested for cyclamate content were found to be positive cyclamate 100 and 33.3%, respectively.

Table 6. Cyclamate positive foods

Type of food	Total sample(n)	n	Positive %	n	Negative %
Shaved Ice	3	1	33.3%	2	66.7%
Es Lilin	32	2	100%	-	-

In thirty-seven schools in Semarang city, practically all street food samples had positively tested positive for formalin. The environment in the chosen schools was typically clean, but some schools had unclean conditions. The distribution of street food sampling can be seen in **Figure 1**. In this picture, some colours function to show the sampling location.

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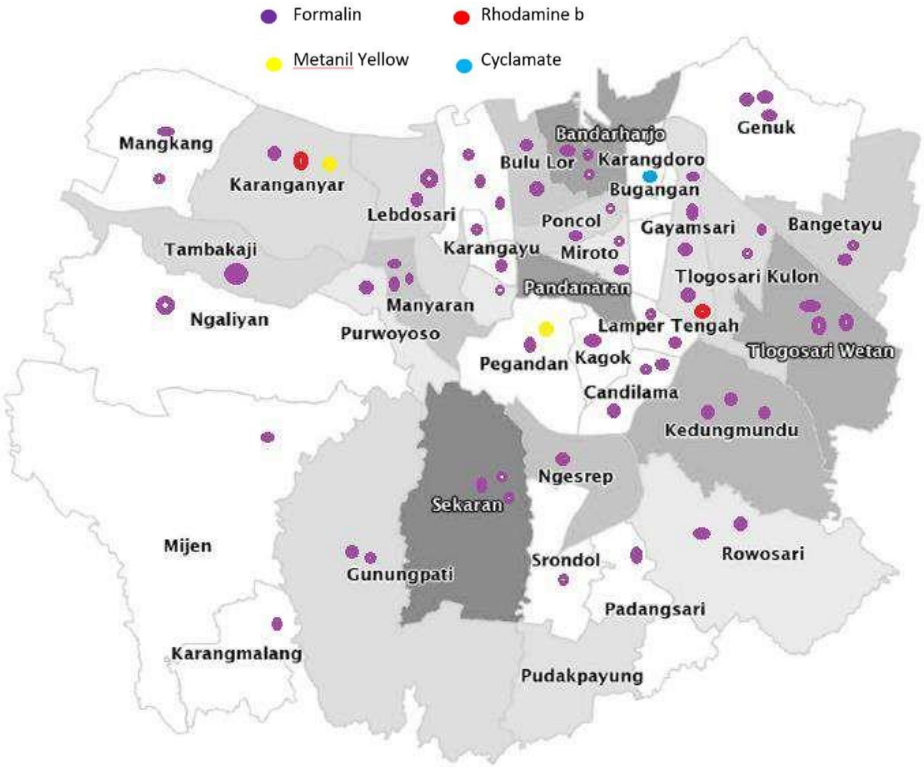

Figure 1. Sampling map.

Discussion

There are several types of snacks sold by street food vendors in the school environment such as drinks, sweet foods, and salty foods. Typically, th snacks such as a cilok, batagor, papeda and pempek are homemade. However, sausages, instant drinks, and sauces are manufactured by industry.

Food additives are frequently used to extend food's shelf life, enhance its flavor, and improve its appearance (Wu *et al.*, 2013; Zhong *et al.*, 2018). In order to prolong the shelf life of food, producers frequently add hazardous substances such as formalin and borax during the production process. This is particularly common for food products that are prone to damage. Hazardous food colourings like rhodamin B and metanyl yellow are frequently added to enhance appearance because they are inexpensive and have eye-catching colours.

Food safety issues, particularly those of street foods around the schools, have become a focus of the government in Indonesia. The government prohibits the use of formalin and borax in Regulation of Indonesian Minister of Health Number 033 Year 2012. According to Indonesian Minister of Health Regulation number 239/ Menkes/Per/V/1985, certain colouring substances that are designated as hazardous materials are prohibited from being used in food, including rhodamine B and metanyl yellow. Meanwhile, Food and Drug Supervisory Agency Regulation Number 11 of 2019 restricts the use of sweeteners such cyclamate.

In this study, formalin was found in 80 out of the 96 positive cases. Some snacks, including meatballs, bihun gulung, leker, martabak, mie gulung (fried-rolled-noodle), yellow noodle, milor, fried dumpling, papeda, pentol, roti bakar, papeda's sauce, sempolan, siomay, and fried-tofu were discovered to contain formalin. Formalin or *formaldehyde* 37-40% is a dangerous preservative and can cause burning of the eyes, nose, and lungs at high concentrations. It is genotoxic, carcinogenic, teratogenic and embryotoxic. Formalin is naturally produced in various types foods such as fruits,

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vegetables, meat, fish, crustaceans, and dried mushrooms as a result of metabolism with the content that varies according to the type of food. World Health Organization (WHO) reports formalin content ranging from 3.3 -60 mg/kg in fruits and vegetables, 8-20 mg/kg in meat, 1-3.3 mg/kg in milk, and 1-98 mg/kg in fish (Nowshad *et al.*, 2018, Peng *et al.*, 2013, Yeh *et al.*, 2013)

For borax, all 106 street food samples tested were negative. Borax or sodium tetra borate is a colourless clear crystal or white crystalline powder that is easily soluble in water. Borax has characteristic toxic and carcinogens which can cause health problems in humans. The dose of borax in humans is below 15 grams for elderly people and below 2-3 grams for infants and children. Consuming more than the recommended limit will lead to health problems and death (Jing *et al.*, 2021).

Meanwhile, to improve the colour, cunning producers add textile dyes, Rhodamine B and methanyl yellow, because it has a more concentrated colour with cheaper price than natural dyes (Lehto *et al.*, 2017, Rahman *et al.*, 2016). In this study 12 of the 55 positive contains Rhodamine B. The types of foods containing Rhodamine B were shaved ice, instant drink, sauce and seasoning powder. Rhodamine B is a dangerous dye commonly used as dyes in the manufacture of paper, textiles or ink. Rhodamine B is used for fluorescent labeling. Rhodamine B is toxic and is easily soluble in water, methanol, and ethanol (Soylak *et al.*, 2011, Su *et al.*, 2015).

On the other hand, methanyl yellow is frequently used in sauces. Methanyl yellow is a synthetic chemical included in azo dyes. In this study 2 of the 37 positive contains methanyl yellow. Consuming methanyl yellow can cause long-term toxicity. Methanyl yellow dyes can be abuse as a food colourings such as crackers, noodles, fried-tofu, or yellow snacks (Bhernama *et al.*, 2015, Setyawati and Mahmudiono, 2023).

In this study, 3 of the 5 snacks are positive for cyclamate. The types of foods containing were *Es lilin* and shaved ice. Cyclamate was used as a low calorie sweetener in United States in the 1950-1960. Cyclamate is very stable, but its sweetness is less intense than that of the other low-calorie sweetener. Cyclamate has a negative effect on health if it is continuously consumed for a long time. Takayama *et al* showed that cyclamate has carcinogenic effects that can lead to malignant cancer cells (Bhernama *et al.*, 2015, Roberts, 2016, Takayama *et al.*, 2000). In South Denpasar Sub district, cyclamate was found in coloured beverages sold in schools (Singapurwa *et al.*, 2021). In another study, cyclamate was also found in foods such as cracker snacks, biscuits, chocolate wafers, and powder drink flavors (Anjani *et al.*, 2019).

A strength of this study is its wide sampling coverage, including 37 schools, which enhances the generalizability of the findings. Additionally, the use of easy testing kits allowed for rapid and practical identification of hazardous substances. However, the study is limited by its qualitative testing approach, which may lack the precision of quantitative laboratory analyses. Furthermore, the cross-sectional design does not account for seasonal variations over time.

Conclusion

The percentage of street foods containing hazardous substances such as preservatives (formalin), colouring agents (rhodamine B), and sweeteners (cyclamate) are high. The types of foods containing hazardous preservatives identified in this study included meatballs and *batagor*, while Rhodamine B was found in shaved ice and instant powder. *es lilin are the* snacks that contain cyclamates. Therefore, further action and supervision are needed in this regard.

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Conflict of interests

The authors declared no conflict of interests.

Authors' contributions

Drafting of the manuscript was done by G Anjani, NB Pratiwi and Z Masruroh; study concept and design by G Anjani, A Syauqy

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and F Ayustaningwarno; data collection and analysis by NA Khusna, ER Noer and Z Masruroh; and critical revision of the manuscript by G Anjani, A Syauqy, NA Khusna and F Ayustaningwarno. All authors have read and approved the final revised manuscript.

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