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Analysis of *Escherichia coli* and *Salmonella* sp. Contamination in Snacks and Food Handlers of Elementary School Children in West Bekasi

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Abstract

Food safety is a preventive measure against the risk of disease caused by microorganisms, chemicals, and physical materials that can contaminate food. *Salmonella* sp. and *E. coli* is a common food poisoning agent found in school snacks. Elementary school students are a vulnerable group to microbial contamination due to their frequent snacking habits. Therefore, this study aims to analyze *E. coli* and *Salmonella* sp. contamination in school snacks in the West Bekasi school area, Bekasi City. The research design of this study was a laboratory-based experiment. Data collection method: Data was collected from three different locations: SDN Bintara 1, SDN Jakasampurna 1 and SDN Kotabaru 3. Snack food testing was carried out using TPC testing, to determine the presence of E. coli contamination using EMBA media and *Salmonella* sp. using SSA media. The result of TPC is above 71,4% of school children's snacks are classified as unsafe only 4 types of food are classified as safe, namely onigiri, papeda, cilor, and meatballs on skewers. There are 2 foods that grow in EMBA media, namely udang rambutan and cibay, it is possible that both foods are contaminated with *E. coli*.

Keywords: contamination; snack; food handlers; elementary school.

INTRODUCTION

Food safety is a preventive measure against the risk of disease caused by microorganisms, chemicals and physical materials that can contaminate food. According to Indonesian legislation, Law No. 18 of 2012 about food, food safety is defined as the condition and effort to prevent food from biological, chemical, and other possible objects that can disrupt, harm and endanger human. health, and do not conflict with religious beliefs, community culture, so that it is safe for consumption(Pemerintah Republik Indonesia, 2012).

Foodborne disease, or disease caused or originating from food contaminated by pathogenic microorganisms, is still a common problem in society. Foodborne disease is usually an infection or poison caused by an infectious source that enters the body through the food we consume (Todd, 2020). The danger of microorganisms to food safety hazards is substantial because they are invisible, living creatures that can reproduce and increase in number. Microorganisms not only damage products but can also produce toxins/poisons that are dangerous to health. The emergence of bacteria in food can be caused by a lack of cleanliness in raw materials, processing, and improper storage (Augustyn et al., 2018).

Based on BPOM data reported in the public poisoning information reporting system (SPIMKer KLB-KP) application in 2023, there were 6.042 cases of poisoning whose causes were divided into animals/microorganisms, chemicals, pesticides, and other. Based on the province where the drug and food poisoning cases occurred, the five highest provinces were DKI Jakarta with 416 cases (24,16%), east java with 297 cases (17,25%), west java with 293 cases (17,02%), the special region of Yogyakarta with 110 cases (6,39%) and north Sumatra with 71 cases (4,12%). The provinces with the most reported cases of poisoning in 2022 and 2023 were West Java with 265 and 293 cases, East Java with 196 and 297 cases, and DKI Jakarta with 174 and 416 cases (Badan Pengawas Obat dan Makanan, 2023). In Bekasi in 2024 there was a, case of poisoning from elementary school children's snacks in the form of spray candy, which caused nausea, vomiting, and dizziness after consuming the snacks (Media Satu, 2024).

Foodborne disease generally attacks the digestive tract or gastrointestinal, neurological, and gynecological. Symptoms caused by foodborne disease can include diarrhea, nausea vomiting, dizziness, fever, and even blurred vision. The Cause is due to poor/unclean sanitation and hygiene conditions, which allow bacteria or fungi to grow and contaminate food (Tamiru et al., 2024).

An investigation was held during *Salmonella* sp. outbreak in China. The incidence rates range from 23–

46% in kindergarten, elementary, and middle schools, and 0% in high schools. It was reported that salad consumed by children was contaminated due to cross-contamination due to improper cleaning of the processing equipment used(LIU et al., 2016).

An extraordinary case of food poisoning was also reported at an elementary school in Bantul, Yogyakarta. Investigations reported dizziness (66.67%), vomiting (56.67%), and nausea (46%). Meatballs were linked to the sample responsible for this outbreak (RR=1.49; 95% CI=1.22-1.81). The causative microorganism was suspected to be *Salmonella* spp., but laboratory investigation results were inconclusive due to contamination (Iskandar et al., 2024).

Besides *Salmonella* sp., *E. coli* is a common food poisoning agent found in school snacks. A study conducted in Jakarta found that 45% of 60 school snacks sampled were reported to contain *E. coli*. Sources of contamination in these snacks included processing equipment (OR = 5.00; 95% CI = 1.19 to 20.92; p = 0.044), storage location (OR = 6.11; 95% CI = 1.73 to 21.59; p = 0.007), and serving method (OR = 7.14; 95% CI = 1.43 to 35.57; p = 0.002)(Thoriqoh et al., 2020).

Elementary school students are a vulnerable group to microbial contamination due to their frequent snacking habits. Therefore, this study aims to analyze *E. coli* and *Salmonella* sp. contamination in school snacks in the West Bekasi school area, Bekasi City. This study is expected to provide information on microbial contamination in school snacks, which can then be a concern for parents and schools to encourage children to choose healthy and safe snacks.

MATERIALS AND METHODS

Study area

This study was a laboratory-based experiment. The experiment was conducted through analytical observation of food or beverage samples. The research object was the microbiology. Data collection method: Data was collected from three different locations: SDN Bintara 1, SDN Jakasampurna 1 and SDN Kotabaru 3. Equipment: Petri dishes, test tubes, test tube racks, incubators, droppers, Erlenmeyer flasks, safety cabinets, autoclaves, bunsen burners, hot plate stirrers, analytical balances, and watch glasses. Ingredients: Peptone Water Buffer 1%, Salmonella Shigella Agar, Food samples.

1. Total Plate Count Testing
   The total plate count test is a method for calculating the number of visible cells and is based on the belief that live bacteria will grow on the medium. The total plate count analysis procedure involves preparing plate count agar (PCA), then diluting the sample tenfold. The samples are poured into the agar medium in a petri dish, incubated at 37^0C for 24 hours and then observed and counted bacterial biochemical test are performed.
2. *Salmonella* sp. Testing
   For *Salmonella* sp. testing, the sample is first reduced in size and ground. Buffered Peptone Water is then added, diluted 10–fold, isolated on SSA media and incubated at 37^0C for 24 hours. Colony counts are then observed and counted. Bacterial biochemical test is performed.
3. *Escherchia coli* Testing
   For *E. coli* Testing, the sample is first reduced in size and ground. Then the sample is added to peptone water buffer, diluted 10-fold, isolated on EMBA media, and incubated at 37^0C for 24 hours. Colony counts are then observed and counted. Bacterial biochemical test is performed.

Before study was conducted the researcher's proposal already passed ethical clearance from the Health Ethics Commission of Universitas Muhammadiyah Purwokerto with registration numner: KEPK/UMP/210/V/2025. Study analysis was performed in the Microbiology Laboratory of STIKes Mitra Keluarga.

RESULTS AND DISCUSSION

The total plate count (TPC) test is a quantitative test expressed in CFU (Colony Form Units) per ml. This test can describe the number of microorganisms growing in food or beverages. In this study, samples were taken from three elementary schools: SDN Bintara 1, SDN Kotabaru 3, and SDN Jatisampurna 1 located in West Bekasi. The following are the results of the total plate count test on snacks sold by elementary school children in West Bekasi.

Table 1. The result of Total Plate Count (TPC).

No	Sample	Dilution			Aligned with SNI
		10^4	10^5	10^6	
1	*Onigiri*	0	0	0	Yes
2	*Udang Rambutan*	24	292	62	No
3	*Bakso Bakar*	2	1	22	No
4	*Spagheti*	1	3	26	No
5	*Chicken Mini*	3	2	3	No
6	*Takoyaki*	57	56	2	No
7	*Cibay*	102	103	0	No
8	*Otak-otak Telur*	TMC	TMC	TMC	No
9	*Cireng Isi*	266	100	0	No
10	*Papeda*	0	0	0	Yes
11	*Martabak Telur*	TMC	TMC	TMC	No
12	*Cilor*	0	0	0	Yes
13	*Bakso Tusuk*	31	20	0	No
14	*Batagor*	0	0	0	Yes

(Source: total plate count data, 2025)

The total plate count test was conducted to determine the microbiological quality test of a food ingredient. In

this study, the total plate count test was used NA media which was carried out on 14 types of school snacks. The total plate count test was carried out in 3 dilutions, namely: 10^4, 10^5, 10^6 from the results of observations, the majority of elementary school children's snacks were grown by microorganisms. The use of TPC was similar with the study to assess ready-to-eat food in India. The total plate count was used to determine the contamination of microorganisms, both bacteria, mold, and yeast. For the type of bacteria that can be identified by the total plate count are mesophilic aerobic bacteria (Sasikumar Nair et al., 2025). Based on SNI 7388:2009 concerning the limits of microbial contamination in school snacks, they are included in ready – to – eat/ready-to-eat foods with a safe limit of 1 x 105 CFU/gram (Badan Standarisasi Nasional, 2009).

If seen from the TPC results of the observations above 71,4% of school children's snacks are classified as unsafe only 4 types of food are classified as safe, namely *onigiri, papeda, cilor,* and *bakso tusuk*. Similar results were also demonstrated in a study analyzing elementary school children's snacks conducted in Bali. The study showed high microbial counts (TPC) in several snack samples. Reasons for the high microbial counts in snacks include poor sanitation in the environment where the snacks are sold, unhygienic presentation of the snacks, and unclean equipment(Vania et al., 2023).

Table 2. The result of *E. coli* analysis.

No.	Sampel	EMBA	Aligned with SNI
1	*Onigiri*	-	Yes
2	*Udang Rambutan*	+	No
3	*Bakso Bakar*	-	Yes
4	*Spaghetti*	-	Yes
5	*Chicken Mini*	-	Yes
6	*Takoyaki*	-	Yes
7	*Cibay*	+	No
8	*Otak-otak telur*	-	Yes
9	*Cireng Isi*	-	Yes
10	*Papeda*	-	Yes
11	*Martabak Telur*	-	Yes
12	*Cilor*	-	Yes
13	*Bakso Tusuk*	-	Yes
14	*Batagor*	-	Yes

(Source: EMBA Analysis data, 2025)

E. coli bacterial contamination test was also conducted because the presence of these bacteria is an indicator of fecal contamination and food hygiene. In this study, the media used was Eosin Methylene Blue Agar (EMBA) where this media has a function to confirm the presence of *E. coli* bacteria. The presence of *E. coli* bacteria in food can indicate the presence of pathogenic bacteria in food and the risk of the presence of bacteria originating from feces, because *E. coli* is classified as coliform bacteria that live in the human digestive tract. Based on SNI 7388:2009, the safe limit for *E. coli* contamination is not detected at 25 grams/sample (Badan Standarisasi Nasional, 2009). In this study, 85,7% of elementary school children's snacks were not contaminated with *E. coli*.

According to study of an elementary school in Nganjuk, the *E. coli* contamination was linked to some variables. The variables were the food handler's hygiene ($p = 0.015$), sanitation from the equipment ($p = 0.028$), serving process ($p = 0.010$), and peddler facilities ($p = 0.045$) (Arum Sari et al., 2024).

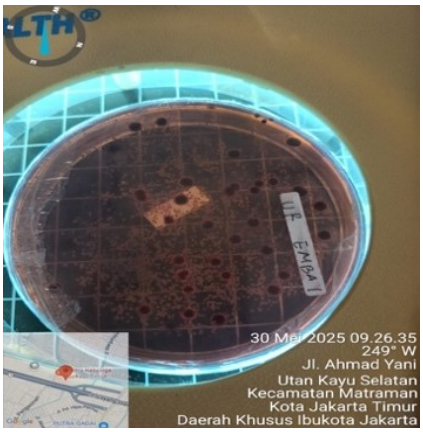

Figure 1. *Udang rambutan* analysis with EMBA.

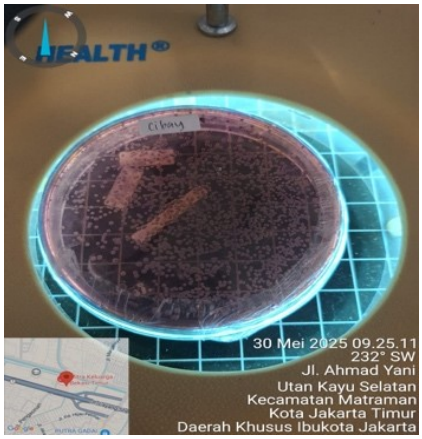

Figure 2. *Cibay* analysis with EMBA.

School snacks are generally sold on the roadside, and are processed at the point of sale. Based on observations, food handlers generally do not use plastic gloves during the preparation process and do not wash their hands when preparing food and serving customers. Then the food sold is left at room temperature without a cover. This can cause contamination from bacteria, mold, and yeast that come from the air and dust. Snacks should be stored in closed containers because if food is left at room temperature for 4 hours or more, the food will be at risk of microbial growth (Aryanti E. et al., 2023). Although most snack foods are processed by heating or frying, it does not rule out the possibility of cross-contamination from equipment, food handlers, or containers for serving food (Inriani et al., 2024). Food handlers' behavior in maintaining cleanliness is very important to prevent

cross-contamination that can cause snack products to be unsafe for consumption.

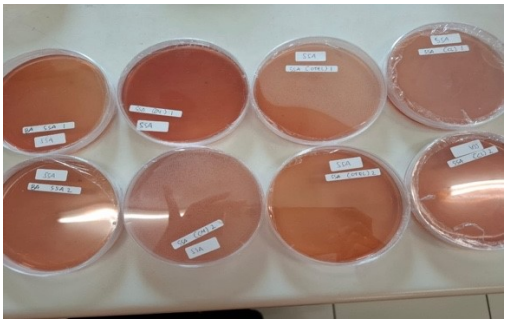

Figure 3. SSA test.

Other analysis conducted was the SSA test. The SSA test, also known as the Salmonella Shigella Agar, is a test performed to detect the presence of Salmonella and Shigella. The following are the results of the SSA test on 14 school snacks.

Table 3. The result of Salmonella analysis.

No	Sample	SSA test
1	*Onigiri*	-
2	*Udang Rambutan*	-
3	*Bakso Bakar*	-
4	*Spagheti*	-
5	*Chicken Mini*	-
6	*Takoyaki*	-
7	*Cibay*	-
8	*Otak-otak telur*	-
9	*Cireng Isi*	-
10	*Papeda*	-
11	*Martabak Telur*	-
12	*Cilor*	-
13	*Bakso Tusuk*	-
14	*Batagor*	-

Salmonella and Shigella generally originate from animal products. These bacteria are enteric pathogens that can cause serious infections if ingested by humans (Virdianita et al., 2023). Based on the SSA test on children's snacks at three elementary schools, it was found that the school snacks did not contain Salmonella or Shigella. This is because the products are generally processed by heating and use only a small amount of animal ingredients. The animal ingredient used in the snacks is mostly eggs. According to SNI 7388:2009, Salmonella and Shigella are strictly prohibited in ready-to-eat foods such as elementary school snacks (Badan Standarisasi Nasional, 2009)

Discussion

This study collected data on snack foods sold in public elementary schools located in Bekasi. The selection of these sites was based on the observation that in most public elementary schools in Bekasi, a wide variety of street foods is sold within or around the school environment. Additionally, the majority of students frequently purchase these snacks during school hours.These conditions raise important concerns regarding the safety and hygiene of foods consumed by children, who are particularly vulnerable to foodborne hazards. The high accessibility of snack vendors, combined with limited awareness among young students about choosing safe foods, reinforces the need for systematic evaluation of food safety within school environments.Therefore, this research aimed to assess the safety of school snack foods and to provide evidence that may support schools, parents, and policymakers in improving food safety practices and creating a safer school food environment.

CONCLUSIONS

The TPC results for school children's snack showed that more than 71,4% were classified as unsafe, with only 4 types of food classified as safe, namely onigiri, papeda, cilor and meatball skewers. There are 2 foods that grow in EMBA media, namely udang rambutan and cibay, both foods may be contaminated with *E. coli.* Based on the SSA test, no food samples were found containing Salmonella.

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Authors' Contributions: **Afrinia Ekasari:** Conceptualization; Methodology; Experimental Design; Investigation; Laboratory Analysis.**Maulin Inggraini:** Investigation; Laboratory Assistance.**Arindah Nur Sartika:** Writing – Original Draft Preparation.**Reza Anindita:** Resources; Sample Collection.

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