

SANITARY HYGIENE PRACTICES AND ESCHERICHIA COLI CONTAMINATION IN SNACK FOOD AT ELEMENTARY SCHOOL CANTEENS IN NGANJUK DISTRICT

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ABSTRACT

Sanitary Hygiene Practices and Escherichia coli Contamination in Snack Food at Elementary School Canteens in Nganjuk District. Snacks served at schools that are contaminated with *Escherichia coli* germs run the risk of harming students' health. The World Health Organization states that around 70% of diarrheal disease cases are caused by food contaminated with *Escherichia coli*. *Escherichia coli* contamination in school snacks can be influenced by a lack of hygiene and sanitation aspects. This investigation aimed to establish a connection between good cleanliness habits and an *E. coli* infection in the cafeteria food at Nganjuk District's primary schools. This kind of study has an observational design and a cross-sectional study plan. The research sample consisted of 12 canteens selected through purposive sampling. Data collection methods included observation, interviews, and laboratory tests, followed by univariate analysis with descriptive statistics and bivariate analysis with Fisher's exact test. Laboratory test results explained that of the 12 samples, there were 5 (41.7%) foods contaminated with *Escherichia coli*. The outcomes demonstrated a link between the handler's hygiene ($p = 0.015$), sanitation of equipment ($p = 0.028$), serving process ($p = 0.010$), peddler facilities ($p = 0.045$), and *Escherichia coli* contamination. While the quality of food ingredients ($p = 0.222$) and TPM sanitation ($p = 1.000$) do not correlate with *Escherichia coli* contamination, It can be concluded that personal hygiene of the handler, sanitation of tools, serving process, and poor peddling facilities can increase the contamination of hawker food by *Escherichia coli* bacteria.

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INTRODUCTION

Snacks for elementary school children need special attention because, at that age, children's knowledge regarding food safety is still not adequate. Moreover, snacks are liked and often given to children, so the supervision of hygiene and sanitation of snack foods needs to be intensified. ⁽²⁾ Hygiene and sanitation in snacks in school canteens have been regulated in the Republic of Indonesia Minister of Health Decree No. 942 of 2003 regarding Guidelines for Sanitary Hygiene Requirements for Snack Foods, which consist of requirements for food handlers, utensils, water, food ingredients, food additives, presentation, vending facilities, and trading centers. ⁽¹⁾ On the other hand, in the Republic of Indonesia, Minister of Health Regulation No. 1098 of 2003 states that food must not contain *Escherichia coli* because it can

cause health problems such as diarrhea, poisoning, and worm infections if it enters the digestive tract. ⁽²⁾

According to data from the Nganjuk District Health Service, cases of food poisoning in educational institutions, especially elementary schools, occurred in Nganjuk District, Nganjuk Regency, in 2018. This case occurred in 12 students at SDN Ganung Kidul 1 due to expired bread. ⁽³⁾ In 2019, another case of poisoning occurred in six students of Madrasah Ibtidaiyah NgLuyu, Nganjuk Regency, which was caused by consuming expired intestine satay and its unhygienic processing. ⁽⁴⁾ Apart from that, the Nganjuk District Health Service noted that from 2020 to 2022, the highest cases of worm infections were in Nganjuk District, namely 16 sufferers in 2020, 3 sufferers in 2021, and 1 sufferer in 2022. ⁽⁵⁾ Meanwhile, cases of diarrhea in the District of Nganjuk declined, with 845 in 2020, 671 in 2021, and 44 in 2022. ⁽⁶⁾

On the other hand, the results of monitoring by the Nganjuk Community Health Center regarding sanitary hygiene practices show that in 2021, in Nganjuk District Elementary Schools, there will be 10 out of 25 canteens that do not meet health requirements. In 2022, there will be 9 out of 19 canteens that do not meet health requirements. A preliminary study conducted by researchers on sanitation hygiene practices in elementary school canteen snacks supports this issue. The preliminary study conducted in the Nganjuk Subdistrict area reveals that food handlers scratch their limbs when serving food, do not wash their hands before handling food, and leave food handlers open without a cover, resulting in the contamination of one snack with the bacteria *Escherichia coli*, also known as *E. coli*.

In Nganjuk District, Nganjuk Regency, elementary school canteen snacks still adhere to relatively minimal sanitation hygiene standards. Many traders sell food but do not practice sanitary hygiene. On the other hand, there are indications that there are still canteens that sell snacks containing *Escherichia coli*, so it is necessary to conduct a study on the relationship between sanitary hygiene practices and *Escherichia coli* contamination in elementary school canteen snacks in Nganjuk District.

MATERIALS AND RESEARCH METHODS

This research includes both quantitative research and analytical observational research. The study design used is a cross-sectional study, in which data collection for each variable is only carried out once at the same time. The research population consisted of 39 schools in Nganjuk District with 23 canteens, a sample of 12 respondents, and a sample of 12 snacks. The sample was chosen using a purposive sampling method after considering the inclusion criteria.

This research investigates variables such as personal hygiene of handlers, sanitation of equipment, quality of food ingredients, serving process, vending facilities, sanitation of food management places (TPM), and *E. coli* contamination. Observations and interviews were used along with a checklist sheet based on Minister of Health Decree No. 942 of 2003 to gather information. *E. coli* content tests were done at the Regional Health Laboratory of Kediri Regency.

Giving coding to each variable, which includes personal hygiene of handlers, sanitation of tools, quality of food ingredients, serving process, vending facilities, and TPM sanitation, is given the number 0 as a no answer and 1 as a yes answer. Meanwhile, the *E. coli* contamination variable is given the number 0 if it contains *E. coli* and the number 1 if it does not contain *E. coli*. Scores for each variable are given in two categories based on the standards of Minister of Health Decree No. 942 of 2003, including a poor category if the score is <65% of the total score and a good category if the score is ≥65% of the total score. In data analysis, univariate analysis was used to identify the frequency distribution of each variable, while bivariate analysis was used to test the relationship between the independent variables and the dependent variable. The statistical test used is a Fisher's exact test with a p-value of 0.05.

RESEARCH RESULTS AND DISCUSSION

Table 1. Distribution of laboratory results examining Escherichia coli bacteria in snack foods

E. coli contamination	f (Canteen)	Percentage (%)
Positive	5	41.7
Negative	7	58.3
Total	12	100

Table 1 illustrates that out of the 12 snack food samples collected from 12 elementary school canteens in Nganjuk District, 5 (41.7%) contained E. coli bacteria in their snack food, while 7 (58.3%) did not. The presence of snacks in the canteen that contain E. coli explains that the quality of elementary school canteen snacks in Nganjuk District is not guaranteed. Apart from that, food that contains E. coli bacteria is not suitable for consumption. ⁽⁸⁾

The local health department is expected to regularly check the E. coli bacteria content of snacks regularly in the Nganjuk District Elementary School canteen. This program can be combined with a canteen supervision and monitoring program, which is carried out at least once a year. The goal is for traders to be aware that there is a high possibility that there will be E. coli bacteria in the snacks they sell. Due to a lack of funds or budgets, the local health service has not implemented this program.

Table 2. Results of Bivariate Analysis between Sanitation Hygiene Practices and Escherichia coli Contamination

Variable	E. coli Bacterial Contamination				p value
	Positive		Negative		
	f	%	f	%	
Handler Personal Hygiene					
Not good	5	83.3	1	16.7	0.015
Good	0	0.0	6	100	
Tool Sanitization					
Not good	5	71.4	2	28.6	0.028
Good	0	0.0	5	100	
Quality of Food Ingredients					
Not good	3	75	1	25	0.222
Good	2	25	6	75	
Presentation Process					
Not good	4	100	0	0	0.010
Good	1	12.5	7	87.5	
Vendor Facilities					
Not good	3	100	0	0	0.045
Good	2	22.2	7	77.8	
TPM Sanitization					
Not good	4	40	6	60	1,000
Good	1	50	1	50	

Table 2 shows that the majority of school canteens have poor personal hygiene practices among handlers. This is demonstrated by all food handlers not wearing aprons (100%), and not wearing head coverings (100%). All food handlers, both women and men, do not wear aprons or head coverings because they are uncomfortable and disturbed. In addition, almost all handlers did not wash their hands (91.7%). Food handlers do not wash their hands every time they handle food or after carrying out activities such as receiving or handling money, after leaving the toilet, etc.

Observation results show that the majority of school canteens have sanitation equipment in the poor category. 91.7% of canteens use equipment storage areas that are not free from contamination, which contributes to poor equipment sanitation. Traders are accustomed to storing clean cutlery and cooking utensils in unclean, open areas, which can give the impression of being less neat. There are also places where equipment can be stored near

pollution sources, such as rubbish bins. Furthermore, some canteens fail to wash equipment with clean water and soap (41.7%). During observations, it was found that several food traders used murky and smelly water to wash food utensils. This happens because the water used for washing and rinsing equipment is stored in buckets and has been used many times. Observation results show that almost the majority of food quality is in the good category, which includes the condition of 75% of food ingredients. The eggs used as raw materials for martabak and maklor are in good condition, as evidenced by their unbroken or cracked shells and the absence of stains or dirt. The condition of chicken meat as raw material for skewered pentol and dumplings is also classified as good and healthy, as seen from the bright yellowish-white color of the meat, no strong or rotten odor, and the meat feeling moist when touched. Apart from that, the packaging of processed food ingredients is appropriate (66.7%). Vermicelli, as a processed food ingredient, comes in packaging that is not damaged, bears a brand and label, has not expired based on the expiration date, and has been registered with the Ministry of Health. Food ingredients and ready-to-eat food are stored separately (66.7%). Some traders store food ingredients in the kitchen cupboard, while ready-made food is placed in the refrigerator. Traders who still store food ingredients and ready-to-eat food together in one place already use different containers for food ingredients and ready-to-eat food.

Observation results show that most of the serving processes are in the good category, which includes most of the wrappers and covers that are clean and do not contaminate the food (66.7%). The types of food packaging used by canteens are clear plastic, rice paper, plates, plastic cups, and mica plastic. Meanwhile, food covers are made of clean plastic, paper, and cloth that do not contaminate the food. In addition, most traders no longer blow wrappers (66.7%). Based on observations, food vendors in the canteen do not practice blowing on the wrappers that will be used to wrap snacks when serving customers.

Observation results show that most of the vending facilities are in the good category, which includes components that are easy to clean (83.3%). Snack food vendors are generally made from wooden tables covered with plastic tablecloths, so they are easier to clean. In addition, almost all canteens have equipment storage (91.7%). On average, the equipment storage used is in the form of open shelves, either made of plastic or wood. Almost all canteens also have rubbish bins (91.7%), but there are still canteens that provide uncovered rubbish bins. Observation results show that almost all TPM sanitation is classified as poor. Several factors contribute to the poor quality of TPM sanitation, including the door's inability to open outwards, its self-closing mechanism, and the presence of anti-insect equipment in 75% of cases. During observations, it was found that most of the TPM doors and windows opened inward, and it was rare to find doors and windows that had anti-insect equipment. In addition, 58.3% of TPM locations are close to sources of pollution, such as bathrooms and toilets. Observation results also show that some TPM walls have uneven surfaces because they are cracked and porous, making them difficult to clean. The TPM walls are also still dark-colored.

The study focuses on the relationship between Handler's Personal Hygiene and *Escherichia coli* contamination in snack foods.

According to statistical tests, there was a significant relationship between the personal hygiene of food handlers and *E. coli* contamination in elementary school canteen snacks in Nganjuk District, Nganjuk Regency, with a p-value of 0.015. This demonstrates that poor personal hygiene by handlers can increase snack contamination by *E. coli* bacteria.

The results of the assessment of research respondents showed that all food handlers (100%) did not smoke when processing and serving food, thereby minimizing the possibility of food being contaminated due to cigarette residue or dust from cigarette butts. However, there are still a few components of food handling practices that were carried out the least frequently by respondents, namely not wearing an apron (100%), not wearing a head covering (100%),

and not washing hands before handling food (91.7%). Food handlers should use PPE, such as aprons and head coverings, to protect against food contamination. Aprons are also used to prevent direct contact with food, while head coverings function to absorb sweat and prevent hair from falling into food. ⁽⁹⁾ In addition, it's crucial to regularly wash your hands to prevent the transfer of bacteria and germs from dirty hands to food. This process can transfer bacteria and germs from various sources to food. Hands can be washed with soap to remove microbes. Therefore, washing hands has proven to be quite effective in preventing food contamination. ⁽¹⁰⁾

The findings of this study are supported by Diana's research in 2019, which showed a relationship between handler hygiene and E. coli contamination in snack foods around SMPN 2 Sukoharjo. In this study, handler hygiene was poor at 56.7%. According to Diana's observations, as many as 80% of handlers do not wash their hands when cooking and serving food, and 60% do not wear aprons when selling. This research shares the same conditions as Diana's observations. ⁽¹¹⁾

The findings of this study were strengthened by Yuniatun's research in 2017, which showed a significant relationship between handler hygiene and the presence of E. coli in food. The handlers in the study had poor personal hygiene. Observation results show that handlers do not wash their hands before touching food during processing or serving and do not use aprons and head coverings because they are less comfortable to use when processing the food. ⁽¹²⁾

It is hoped that the role of the government, namely the local health service, will be to provide supervision through inspections and stickers to each elementary school canteen. Supervision is carried out at least once a year using a checklist sheet for monitoring sanitary hygiene practices, which refers to Minister of Health Decree No. 942 of 2003. Stickers will be installed in canteens that meet the requirements and regulations. The purpose of the supervision is to enhance sanitation hygiene practices, particularly the use of aprons and head coverings. While some sellers are already aware of these practices, their implementation has been hindered by a lack of warnings from the Health Service. This program was implemented by the Health Service, but it has not been implemented regularly and comprehensively in school canteens.

The study examines the relationship between Equipment Sanitation and Escherichia coli contamination in snack foods.

According to statistical tests, there was a significant relationship between equipment sanitation and E. coli contamination in elementary school canteen snacks in Nganjuk District, Nganjuk Regency, with a p-value of 0.028. This proves that poor equipment sanitation can increase the contamination of snack foods by E. coli bacteria.

The assessment results show that almost all traders (83.3%) who dry their equipment comply with the provisions. Food handlers have implemented drying of cutlery using special cloths and hygienic towels to prevent re-contamination and germs sticking to cutlery. However, several aspects of equipment sanitation remain inadequate, including the failure to wash equipment with clean water and soap (41.7%) and the failure to store washed equipment in a pollution-free environment (91.7%). During observations, it was found that several food sellers were using water that was cloudy and smelly because it had been used many times to wash and rinse equipment. The use of unclean water leads to E. coli contamination due to the delayed removal of stains from the utensils, which then has the potential to re-enter the food. ⁽⁸⁾ In addition, many sellers store cutlery on uncovered plate racks, even leaving them in place. Open storage exposes eating utensils to contamination from dust, mice, insects, and other vectors. ⁽¹³⁾

The results of this research are similar to Riyanto's (2013) research, which stated that food equipment had a significant relationship with the presence of E. coli in snack foods at South Cimahi Elementary Schools. In this research, street food vendors repeatedly used water in buckets, which were rarely replaced. In addition, the canteen does not have equipment

storage, and equipment is left in the open. This increases the chance of contamination by dirt, insects, and even particles on food equipment. ⁽¹⁴⁾

This research is also in accordance with Kurniasih's research in 2019, which explained that there was a significant relationship between the quality of service sanitation and the presence of *E. coli* in food at food stalls around the Borobudur Magelang Terminal. This is evident in the low quality of equipment sanitation, which stands at 48.4%. According to Kurniasih's observations, as many as 51.6% of traders did not wash their equipment with clean water. However, the majority of traders use water to wash tools repeatedly, rarely replacing them. Unclean water may contain *E. coli* bacteria, so if it is used to wash equipment, it is likely that *E. coli* bacteria can be transferred to food equipment. Aside from that, food equipment is stored in a location that is not 100% free of pollution sources. Equipment is placed on an open plate rack, increasing the risk of *E. coli* contamination. ⁽⁸⁾

We hope that food traders can provide a closed storage space for equipment, protecting it from dust and contaminants, as only 8.3% of equipment storage components meet the required standards. The findings of Rahmadiani's 2015 research, which demonstrated a correlation between the location of cutlery storage and germ counts, suggest that poorly stored cutlery is susceptible to 143,500 times more germs than well-stored cutlery.

The study examines the relationship between food ingredient quality and *Escherichia coli* contamination in snack foods.

The results of statistical tests explain that there is no significant relationship between the quality of food ingredients and *E. coli* contamination in elementary school canteen snacks in Nganjuk District, Nganjuk Regency, with a p-value of 0.222. This research is supported by Kurniasih's research in 2015, which showed that there was no significant relationship between the quality of food ingredients and the presence of *E. coli* in food at food stalls around Borobudur Terminal, Magelang. In this study, the majority of food ingredients' sanitation quality complies with regulations. The observation results align with this research in that they do not use raw materials that are 100% fresh or free of mold. Using rotten food ingredients has an impact on the quality of cooked food because the ingredients may contain pathogenic bacteria. 90.32% of people store food ingredients separately from cooked food. This is important because storing cooked food ingredients in the same place as food ingredients allows the transfer of bacteria from food ingredients to cooked food. ⁽⁸⁾

The assessment results show that the school canteen has good food conditions (75%). Ingredients cooked into snacks must be of good quality, fresh, and undamaged, as evidenced by physical characteristics such as shape, color, freshness, and aroma. This is because contamination in food is often caused by the quality of the raw materials used. Especially if the processed food ingredients include components that are easily contaminated by *E. coli*. Other components, such as the condition of processed food ingredients, are also classified as good (66.7%), and food storage areas are dirt-free, watertight, closed, and not mixed with cooked food to avoid cross-contamination (66.7%). Food handlers have chosen processed food ingredients that have labels and brands, are registered with the Ministry of Health, and the packaging is not damaged, has not expired, and is not stale or moldy. The selection of processed food ingredients without labels or brands, without registration with the Ministry of Health, and with damaged packaging can lead to food contamination due to product contact with air and dust, as well as a lack of information about the food's contents. ⁽¹⁵⁾ In addition, the storage of ingredients is crucial. It is important to eat food in a closed room because it is possible that meals will quickly spoil and wilt and can be contaminated by microbes if it is only placed in an open space. ⁽¹⁵⁾

The results of this research are different from Nuryani's research in 2016, which explained that food ingredients were related to the presence of *E. coli* in snack foods. In this research, more food ingredients were rated as poor, namely 71%, and as many as 29% were rated as good. The results of his observations were that the majority of food ingredients were not

fresh or wilted, the processed ingredients used did not have brands and labels, and the food storage areas were still open. ⁽¹⁶⁾

In this study, the quality of food ingredients had no relationship with *E. coli* contamination in snack foods. This is due to other influencing factors, such as the characteristics of street food vendors and the quality of the water used. The study examined the characteristics of street food traders based on their male gender, with a total of two respondents. Men are less careful in choosing raw materials to cook for buyers, in contrast to women. ⁽¹⁷⁾ When it comes to water quality, up to 3 individuals (25%) fail to meet the physical requirements due to cloudiness. The availability of water that meets standards has a significant impact on the food processing stage, as water plays a crucial role in the entire food processing process, including the cleaning of raw materials. If the water quality does not meet health standards, there is a potential for contamination of food raw materials. ⁽¹⁶⁾

The study examines the relationship between the serving process and Escherichia coli contamination in snack foods.

The results of statistical tests explain that there is a significant relationship between the serving process and *E. coli* contamination in elementary school canteen snacks in Nganjuk District, Nganjuk Regency, with a p-value of 0.010. This demonstrates that poor serving processes can increase *E. coli* contamination of snack foods.

The results of the assessment of the canteen showed that the majority (66.7%) of the wrappers or covers did not contaminate the food, and the handlers did not blow on the food containers. The use of food wrappers and covers made from old newspapers and other inappropriate materials results in improper food coverage, leading to the contamination of snack foods. The practice of blowing on food wrappers has been designated as a prohibited unhygienic practice for traders because it can contaminate food. However, there are still canteens (58.3%) that do not cover and wrap the snacks served. Observations carried out revealed that a number of snack foods, such as fried foods and cakes, were served without a cover, whereas during the observation, we could see flies flying around and even landing on snack foods. Food vendors should serve food in closed conditions so that the risk of food contamination can be minimized as much as possible. ⁽¹⁸⁾

The findings of this study are consistent with Kurniadi's 2013 research, which revealed that food presentation had a significant relationship with the presence of *E. coli* in snack foods in the Bangkinang District Elementary School canteen environment. In this study, the majority of traders did not use clean packaging; some snacks were served without a cover; and they used newspaper and plastic as food covers. ⁽¹⁹⁾

This research is also strengthened by Thoriqoh's research in 2016, which stated that the way food is served is related to *E. coli* bacterial contamination in PJAS at Cakung District Elementary Schools. According to Thoriqoh's observations, most snack foods are served to consumers uncovered, and the packaging or cover used does not cause food contamination. ⁽²⁰⁾

While only 41.7% of canteens implement this, it is hoped that food traders will pay attention to the use of covers and wrappers when serving food to reduce contamination of *E. coli* bacteria in snacks, thereby minimising foodborne illnesses. The results of a 2019 study by Yunaenah, which demonstrated a correlation between the sanitary quality of food serving and the presence of *E. coli* in food, support the idea that poor food presentation increases the risk of *E. coli* contamination in snack food by 6.118 times compared to good food serving.

This study examines the relationship between vendor facilities and Escherichia coli contamination in snack foods.

The results of statistical tests explain that there is a significant relationship between vending facilities and *E. coli* contamination in elementary school canteen snacks in Nganjuk District,

Nganjuk Regency, with a p-value of 0.045. This proves that poor hawker facilities can increase the contamination of snack foods by *E. coli* bacteria.

The assessment of the canteens revealed that almost all (91.7%) had equipment storage and rubbish bins. Canteen traders already have equipment storage areas, so that washed equipment can be protected from contamination and insects. This is important because the location where equipment is stored can be the starting point for dust and germ contamination. There are also many trash bins available in school canteens, although many are still not closed. Trash cans that are not closed pose a risk of attracting insects. However, the majority (75%) of canteens do not have a place to store ready-made food. Based on observations, it is known that food is generally only placed on the sales table without a special place for storing the finished food. Sellers should have ready-made food storage facilities in the form of special cupboards or food display cases, refrigerators, or other places to store ready-made food so that the safety and suitability of the food are guaranteed. ⁽²¹⁾

The findings of this study are supported by Syafriyani's 2020 research, which explained that there was a significant relationship between the condition of vending facilities and the presence of *E. coli* in snack foods at Medan Satria and Jati Asih District Elementary Schools. The condition of the vending facilities, which is 59% in compliance with the provisions, reflects this. This research has similar conditions, namely that vending facilities are available in the form of rubbish bins, but they are not covered, and there is a lack of sanitation facilities, especially places for storing ready-made food. ⁽²²⁾

The results of this study are also similar to Astuti's research in 2019, which explained that there was a relationship between the availability of vending facilities and *E. coli* contamination in snack foods in the elementary school environment in Genuk District, Semarang City. This is evident from the fact that the majority of hawker facilities fall into the category of good quality. According to Astuti, not a single canteen has complete sanitation facilities; only 57.6% of schools have equipment storage areas, 45.5% have trash cans, and 51.5% have ready-made food storage areas. ⁽²³⁾

In this way, it is hoped that schools can facilitate vending facilities in canteens around elementary schools so that the snacks sold are more clean and safe. There are several vending facilities available in the elementary school canteen, but they are not yet complete and optimal. These facilities, such as shelves for storing equipment and rubbish bins, are still open.

The study focuses on the relationship between TPM Sanitation and *Escherichia coli* contamination in snack foods.

The results of statistical tests explain that there is no significant relationship between TPM sanitation and *E. coli* contamination in elementary school canteen snacks in Nganjuk District, Nganjuk Regency, with a p-value of 1,000. The findings of this study are supported by Kurniadi's 2013 research, which explained that building construction had no relationship with the presence of *E. coli*. In this research, the TPM building was close to a source of pollution; the TPM roof had leaks; the walls were uneven; and the floors were not waterproof, uneven, and difficult to clean. ⁽¹⁹⁾

The results of the TPM assessment revealed that the majority (83.3%) of TPMs had building lighting and ventilation according to the provisions. The lighting in the TPM must be bright enough to ensure smooth food preparation, serving, and storage. Adequate lighting is also useful to ensure that all equipment used is clean and not contaminated by dust or insects. The building is also equipped with ventilation to remove steam and odors while avoiding condensation, which triggers bacterial growth.

Some components of TPM sanitation that are classified as poor include doors that are unable to open to the outside and close on their own, equipped with anti-insect equipment (75%), located near a source of pollution (58.3%), and walls with a flat surface that is not damp, light colored, and easy to clean (58.3%). During observation, it was discovered that most of the TPM doors and windows could not be opened outside. In fact, to prevent him from entering,

the door should open outward. When the doors and windows are open, the blowing wind will push the door away from inside the room. It is feared that if flies previously land on dirt and then enter the TPM and land on food, there is a high possibility that the food could be contaminated. Doors and windows should also be equipped with anti-insect devices in an effort to protect food hygiene because insects are carriers of germs that have the potential to contaminate cooked food. The observation results also indicate that the TPM location is in close proximity to bathrooms and toilets. When the TPM is located near a source of pollution, there is a high risk of exposure to dangerous substances that come from the surrounding environment and affect the quality of the food produced. In addition, the surface condition of the TPM walls appears cracked, porous, lacks a flat surface, and has a dark color. Small particles from the porous walls may become loose and fall onto food. In addition, if the wall surface is difficult to clean because the surface is uneven, bacteria and other pathogens can also breed in that area and become a source of contamination for food. ⁽²⁰⁾

This study differs from Yunus' 2015 research, which stated that TPM sanitation was related to the presence of *E. coli* in food. In this research, 64.6% of TPM sanitation received a good rating, while 35.4% received a poor rating. Most TPMs are constructed in areas that are shielded from unpleasant odors, smoke, and dust particles, and are situated far from waste disposal locations. The majority of building walls feature flat surfaces, are not damp, have a light color, and are easy to clean. This contrasts with the findings of this study, which indicated that 16.7% of TPM sanitation was deemed good, while 83.3% was deemed poor. The observations reveal that several TPMs are situated near various sources of pollution, and the building walls exhibit cracks, porous surfaces, a non-flat surface, and a dark color. ⁽²⁵⁾

CONCLUSIONS AND RECOMMENDATIONS

The study's findings revealed a significant relationship between personal hygiene of handlers, sanitation of tools, serving processes, and vending facilities, as well as *E. coli* bacterial contamination in snack foods. As many as 41.7% of school canteen snacks in Nganjuk District contain *E. coli* bacteria.

It is recommended that the Health Service provide supervision regarding proper sanitary hygiene practices through environmental health inspections and checking the *E. coli* content in snack foods at least once a year in school canteens in Nganjuk District. Future researchers are expected to carry out confirmation with microbiological laboratory tests to ensure the content of *E. coli* in water sources, food raw materials, and equipment, which influences the *E. coli* content in snack foods.

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