

THE ASSOCIATION BETWEEN FOOD HYGIENE AND THE ESCHERICHIA COLI CONTAMINATION ON SCHOOL SNACK AT ELEMENTARY SCHOOL IN CAKUNG SUBDISTRICT, EAST JAKARTA

Hanifatun Nisa Ath Thoriqoh¹⁾, Budi Haryanto²⁾, Ela Laelasari³⁾

¹⁾Public Health Postgraduate Study Program,
Faculty of Public Health, Universitas Indonesia

²⁾Department of Environmental Health,
Faculty of Public Health, Universitas Indonesia

³⁾Department of Environmental Health, Faculty of Health Sciences,
UIN Syarif Hidayatullah Jakarta

ABSTRACT

Background: Unsafe food hygiene poses threats for becoming disease transmission. The most common of foodborne pathogenic bacteria is *Escherichia coli*. The purpose of this study was to examine the association between food hygiene and the contamination of *Escherichia coli* bacteria on school snack.

Subejts and Method: A cross-sectional study was conducted in Cakung, East Jakarta from December 2016 to January 2017. A sample of 60 food handlers from a total of 147 foods handlers' population was selected by cluster sampling. The dependent variable was *E. coli* bacteria. The independent variables were proper hand washing, food serving aids, proper equipment washing, types of selling facilities, sanitation facilities, the placement of cooked food, and food preparation. The data were collected by laboratory test result and questionnaire. The data were analyzed by multiple logistic regressions.

Results: As many as 45% of the positive snacks were contaminated with *E. coli* bacteria. *E. coli* bacterial contamination on food was related to the practice of using food serving aids (OR= 5.00; 95% CI= 1.19 to 20.92; p= 0.044), a place to store cooked food (OR= 6.11; 95% CI = 1.73 to 21.59; p = 0.007) and method of presentation (OR = 7.14; 95% CI = 1.43 to 35.57; p = 0.002).

Conclusion: The incidence of *Escherichia coli* contamination on food is related to the practice of using food serving aids, the placement of cooked food and food serving.

Keywords: *Escherichia coli*, school snack

Corresponden:

Hanifatun Nisa Ath Thoriqoh. Public Health Postgraduate Study Program, Faculty of Public Health, University of Indonesia, Depok, West Java. Email: hanifatunnisa10@gmail.com. Mobile: 081808157745.

BACKGROUND

Food safety is one of the things that affect human health. Food can be a medium of transmission of diseases for humans if contaminated by pathogens that can cause *foodborne illness*, where the most common case is diarrhea (Ruchiyat, 2007). According to the WHO, as many as 70% of developing countries' diarrhea events are caused by food contaminated with pathogens. Types of

contaminants found in food are bacteria, viruses, parasites, chemicals, and toxins produced by the food itself (WHO, 2015).

Contamination in food is most caused by bacterial contamination of 74.9%. In comparison, other causes are the use of excess BTP in food coloring 15.7% and the use of hazardous materials by 9% (Ministry of Health, 2015). One of the most common diarrhea-causing bacteria is contamination

from *Escherichia coli* in food or water sources used in processing food (Setyorini, 2013). *E.coli* bacteria are pathogenic microorganisms often found in children who have acute diarrhea in developing countries with a percentage of 10-20%, while other bacteria are *Vibrio cholera* by 5-10% *Salmonella* by 1-5% (WHO, 2015).

The prevalence of diarrhea incidence in Indonesia in the age group of 5-14 years is 9% in 2007 (Ministry of Health RI, 2011). In DKI Jakarta Province in 2014, the prevalence of diarrhea incidence in the age group 5-9 years was 2.57%. The region with the highest diarrhea pain rate is East Jakarta, with the number of diarrhea events reaching 5,972 cases in 2014 in the age group 5-9 years. Cakung subdistrict is the location in East Jakarta, with the highest diarrhea incidence in the age group 5-9 years from January to June 2016 with 373 cases (Dki Jakarta Provincial Health Office, 2016).

Schoolchildren are at high risk of contracting the disease through food, where the food consumed is purchased in the school cafeteria or street vendors (WHO, 2006). Based on the type of Food Management Place (TPM), *E.coli* contamination in food was most found in street vendors as much as 40.7%, while other places include food services 38.2%, hotels 33.3%, warungs 32.9%, restaurants 31.3%, and the food industry 21.3% (Djaja, 2008). Based on the results of pjas survey conducted by BBTKLPP Jakarta, it is known that *E.coli* positively contaminates 87% of snack food sold in elementary schools in Cakung subdistrict.

Some studies have shown that the high rate of diarrhea pain is caused by not washing your hands after defecating, not washing your hands before cooking, and buying snacks sold by street vendors (Muhonja and Kimathi, 2014). According to

the Food and Agricultural Organization (FAO), as many as 2.5 million people eat snacks every day, food processing practices by food vendors play an essential role in the safety of snack food itself (Gadi, Bala, and Kumar, 2013). The incidence of foodborne diseases can occur due to poor personal hygiene practices of traders who sell snack food in schools (Odonkor et al., 2011).

Food eaters are careers or can be a medium of transmission of pathogenic enteric bacteria (Muhonja and Kimathi, 2014). Poor personal hygiene can facilitate the contamination of pathogenic bacteria from the environment into the human body through edible food (Bhaskar et al., 2004). Poor personal hygiene and environmental hygiene practices, improper storage, preparation, and processing of food and beverages, as well as unanitized cooking utensils can lead to foodborne disease (Odonkor et al., 2011).

Contamination of *E.coli* bacteria in food can cause diarrhea for humans, resulting from poor hygiene sanitation of food vendors, food processing equipment, conditions of vendor facilities, and the way food is served. Food sold in school canteens and street vendors around elementary schools can lead to foodborne illnesses caused by *E.coli* contamination due to poor food sanitation, hygiene behavior, and conditions. School children are vulnerable to disease, so if the state of food consumed is not good, it will affect the child's growth and development process. This study aimed to find out the relationship of food sanitation hygiene with *E.coli* contamination in snack foods in elementary schools in Cakung subdistrict.

SUBJECTS AND METHOD

1. Study Design

This research is a type of quantitative analysis using a cross-sectional design. This research was conducted in December 2016-January 2017 in elementary school Cakung Subdistrict, East Jakarta.

2. Population and sample

This study's population was 147 food vendors who sold around the elementary school cakung subdistrict and recorded in the report of the District Health Center Cakung. The study sampled 60 food eaters taken with cluster sampling.

3. Study Variables

Independent variables in this study are the practice of washing hands using soap, the course of using food serving aids, how to wash equipment, types of selling facilities, sanitation facilities, where to store cooked food, and food storage. The dependent variable is E.coli contamination in snack foods.

4. Test Method *E.coli*

The dependent variable of this study is E.coli contamination in snack foods. Snack food samples were examined by laboratory tests using the Presence-Absence (P/A) method using LMX fluorocult broth as a media of Kovacs inoculation and reagents to see the discoloration that occurred in the sample. If a red ring is formed in the model after being dripped by Kovac reagents, the positive sample is contaminated by E.coli.

Independent variables of this study, such as the practice of washing hands using soap, the course of using tools in serving food, washing equipment, vendor types, sanitation facilities, where to store cooked food, and food serving, were obtained through structured interviews using questionnaires.

5. Data analysis

All variables will be analyzed univariately, bivariate with chi-square and multivariate with logistic regression.

RESULTS

Laboratory test results showed that 45% of snack food sold in elementary school in Cakung subdistrict was positively contaminated with E.coli bacteria. Most food eaters (70%) do not practice handwashing with soap when processing food. However, most food eaters (80%) use tools when serving food.

How to wash cookware carried out by food campers is not eligible (66.7%). A total of 51.7% of food vendors sell using canteen building advice or kiosks. Sanitation facilities owned by food campers are still not eligible (60%). Cooked food storage is still not suitable (65%), and the way hawker food is served is not yet qualified (76.7%). The distribution of respondents based on E.coli contamination and sanitary hygiene aspects can be seen in table 1.

Based on table 2, it is known that in 95% of CI, there is a relationship between the use of food serving aids ($p=0.044$), so that the risk of E.coli contamination in food is 5 times greater in foods sold by food eaters who do not use food serving aids. Cooked food storage is also associated with E.coli contamination of snack foods ($p=0.007$), where cooked food stored in unqualified places is at 6 times greater risk of E.coli contamination.

The way of serving is related to E.coli contamination in snack foods ($p=0.02$), where the way unqualified foods are served is 7 times greater risk of causing E.coli contamination in snack foods. However, in the variable practice of washing hands with soap ($p=1.00$), how to clean equipment ($p=0.783$), types of means of selling ($p=0.775$),

and sanitation facilities ($p = 1.00$) are known not to be related to contamination of *E. coli* in snack food.

The results of the multivariate analysis carried out by logistic regression in Table 3 show that the factor that most influenced *E. coli* contamination of street food was the way of serving it after being controlled by the

variable where cooked food was stored. The modeling is: $\text{Logit} (E. coli \text{ contamination of street food}) = -4,316 + 1,878 (\text{serving method}) + 1,741 (\text{storage of cooked food}) + e$.

Table 3. Multivariate analysis of hygiene sanitation aspects and *E. coli* contamination on street food in elementary schools in Cakung District.

Table 1. Respondent Distribution based on *E. coli* Contamination and Sanitary Hygiene Aspects

Variable	Frequency (n=60)	Percentage (%)
E.coli contamination		
Positive	27	45
Negative	33	55
Practice of washing hands with soap		
Not	42	70
Yes	18	30
Practice of using food serving aids		
Not	12	20
Yes	48	80
How to wash equipment		
Ineligible	40	66.7
Qualify	20	33.3
Types of means of selling		
Cart	29	48.3
Kiosk/canteen	31	51.7
Sanitation facilities		
Ineligible	36	60
Qualify	24	40
Cooked food storage		
Ineligible	39	65
Qualify	21	35
How it is presented		
Ineligible	46	76.7
Qualify	14	23.3

Tabel 2. Analysis Bivariat

Variable	E.coli contamination				Total		OR	95% CI	P
	Positive		Negative		N	%			
	N	%	N	%					
Contamination of E. coli									
Positive	19	45.2	23	54.8	42	100	1.03	0.34-3.14	1.00
Negative	18	44.4	10	55.6	18	100			
Practice washing your hands with soap									
No	9	75	3	25	12	100	5.00	1.19-20.92	0.044
Yes	18	37.5	30	62.5	48	100			
Practice using food serving aids									
No	19	47.5	21	52.5	40	100	1.36	0.46-4.03	0.783
Yes	8	40	12	60	20	100			
How to wash equipment									
Not eligible	12	41.4	17	58.6	29	100	0.75	0.27-2.09	0.775
Eligible	15	48.4	16	51.6	31	100			
Types of means of selling									
Cart	16	44.4	20	55.6	36	100	0.95	0.34-2.67	1.00
Canteen	11	45.8	13	54.2	24	100			
Sanitation facilities									
Ineligible	23	59	16	41	39	100	6.11	1.73-21.59	0.007
Qualify	4	19	17	81	21	100			
Cooked food storage									
Ineligible	25	54.3	21	45.7	46	100	7.14	1.43-35.57	0.02
Qualify	2	14.3	12	85.7	14	100			
Presented									
Ineligible	25	54.3	21	45.7	46	100	7.14	1.43-35.57	0.02
Qualify	2	14.3	12	85.7	14	100			

Table 3. Analysis Multivariate

Variables	B	OR (Exp. B)	95% CI	P
Cooked food storage	1.741	5.705	1.53 – 21.26	0.009
Presented	1.878	6.543	1.23 – 34.93	0.028
Constant	-4.316	0.013		0.001

DISCUSSION

In this study, it is known that *E. coli* contaminates only 45% of street food. This is because most of the food sold is hot or freshly cooked when served to consumers. The temperature factor can affect the growth of bacteria in food. *E. coli* bacteria have an optimum growth temperature of 37 °C (Baylis et al., 2011). These bacteria can survive for 15 minutes at 60 °C. Therefore, if food ingredients contaminated with *E. coli* are not cooked at more than this temperature, the bacteria will remain (Puspita, Palandeng, and Sinolungan, 2014).

From the research results, it is known that most food handlers (70%) have not yet practiced washing hands with soap. Some food handlers only wash with water without using soap, and some do not use running water to wash their hands. The statistical test results showed no significant relationship between the practice of washing hands with soap and contamination of *E. coli* bacteria in street food. This is since most food handlers (80%) have used food serving aids in the form of tongs, spoons, forks, and pricks, so that there is no direct contact between the hands and the food being sold. Hands are the most common medium for transferring bacteria from one place to another. Correct and effective handwashing practices can help prevent the spread of harmful bacteria from hands to food, food processing tables, and equipment (Food Standards Agency, 2016). This research is in line with research conducted in the traditional markets of Klaten City, where there is no significant relationship between the practice of washing hands with soap and *E. coli* contamination ($p = 0.52$) (Anggorowati, 2014). However, this study was not in line with research conducted at the UNS canteen, where

there was a significant relationship between the practice of washing hands with soap and *E. coli* contamination in food ($p = 0.008$) (Pratiwi, 2014).

To avoid transferring microorganisms on the hands into the food, tools are needed to take food. Assistive devices are used to bring cooked food or carry out food packaging to contact food handlers' hands directly. From the results of the bivariate analysis in this study, it is known that there is a significant relationship between using food serving aids and contamination of *E. coli* bacteria in street food with a P-value of 0.044. Food traders who do not use food serving aids have a 5.00 times greater risk of causing *E. coli* bacterial contamination than traders who use cooked food serving aids. Besides, assistive devices such as tongs can avoid direct food contact with hands (EATS, 2016). The results of this study are consistent with research in Atlanta, which showed a significant relationship between the use of a food serving aids and *E. coli* contamination in food ($p < 0.001$) (Green et al., 2007). However, this study was not in line with research in the UNS canteen, which showed no significant relationship between using food serving aids and *E. coli* contamination in food ($p = 1.00$) (Pratiwi, 2014).

The improper way of washing equipment will cause bacteria contained on the equipment to transfer to the food to be processed. Based on the research that has been done, it is known that 66.7% of the methods of washing equipment carried out by food handlers do not meet the requirements, which only use buckets and do not use running water. There was no statistically significant relationship between washing equipment and contamination of *E. coli* bacteria in street food with a value of

0.783. This can be caused by the frequency of changing the water in the bucket 3 to 6 times by the food handler. Water used repeatedly can potentially cause bacterial contamination into food when processed when using equipment that is washed using water often (Badrie, Joseph and Chen, 2003). This research is in line with research conducted on street vendors in Temanggung, which showed no significant relationship between washing equipment and *E. coli* contamination ($p = 0.431$) (Atmiati, 2012). However, this study is not in line with research in Denpasar, which shows a significant relationship between how to wash equipment and *E. coli* contamination ($p = 0.004$) (Aristin, Mahayan, and Aryasih, 2014).

Based on the research results, it is known that as much as 51.7% of the food handlers used the means of selling in the form of a canteen and a kiosk. The statistical test results showed no significant relationship between the type of means of selling and the contamination of *E. coli* bacteria in street food with a value of 0.775. This is because the food handlers sell canteens and kiosks, which already have adequate sanitation facilities. The means of selling street food plays an essential role in preventing *E. coli* contamination of street food. The means of selling street food is essential in determining the success of processing safe and healthy snacks (Riyanto and Abdillah, 2012). This study is consistent with research in South Jakarta, which states that there is no significant relationship between the types of selling facilities and *E. coli* contamination ($p = 0.08$) (Djaja, 2008). However, this study was not by research in Uganda, which stated that there were significant differences in food handlers selling in canteens and outside buildings with *E.*

coli contamination ($p < 0.05$) (Baluka, Miller and Kaneene, 2015).

Sanitation facilities are the facilities and equipment that must be available to maintain and control environmental factors that can cause food contamination. The research results show that 60% of the sanitation facilities owned by food handlers do not meet the requirements, where the sanitation facilities only use buckets filled with water and are not equipped with running water and soap. Based on statistical tests, it is known that there is no relationship between the existence of sanitation facilities and *E. coli* bacterial contamination in street food with a value of 1.00. This can be since although the sanitation facilities that are owned only use buckets filled with water, food handlers separate the buckets for washing hands from those for washing utensils so that the possibility of bacterial contamination is reduced.

Sanitation facilities that meet the requirements can support the improvement of acceptable personal hygiene practices. Food handlers who have sanitation facilities that meet the needs of 1.89 times have better private hygiene practices than food handlers with sanitation facilities that do not meet the requirements. This is because food handlers with adequate sanitation facilities will maintain personal hygiene and practice good food handling (Tessema, Gelaye, and Chercos, 2014). This study is in line with research in Bangkinang District, which showed no significant relationship between sanitation facilities and *E. coli* bacterial contamination ($p = 0.053$) (Kurniadi, Saam, and Afandi, 2013). However, this study was not in line with the study in Nakawa, Uganda, which showed a significant relationship between

sanitation facilities and *E. coli* bacterial contamination ($p = 0.001$) (Mugampoza et al., 2013).

Cooked food needs to be stored in a secure place and protected from dust, disease vectors, and other contaminated sources that can potentially cause food contamination. The results showed that 65% of the storage places for cooked food owned by food handlers did not meet the requirements, namely not closed and free from dust, flies, and other disease vectors. Based on the statistical test, it is known that there is a significant relationship between the storage area for cooked food and the contamination of the snack food *E. coli* bacteria with a value of 0.007. Unqualified cooked food stores have a 6 times greater risk of causing *E. coli* contamination of food.

The storefront conditions where food is stored must be clean and closed. Peddling food in an open state can increase the risk of food contamination by the environment, either through the air, dust, vehicle fumes, or insects (Triandini and Handajani, 2015). Food that is not kept closed can invite animals/insects that can contaminate the food. Animals/insects, such as flies, usually carry disease pathogens. Flies have a habit of living in dirty places and are attracted to foul odors such as garbage so that pathogenic germs will be carried on the feet and mouths of flies, which will cause food contamination (Atmiati, 2012). This study is in line with research in Manado City, which states a relationship between the storage of cooked food and *E. coli* contamination in food ($p = 0.006$) (Yunus, Umboh, and Pinontoan, 2015).

Serving food open can increase the risk of food contamination. This study indicates that 76.7% of serving street food does not meet the requirements, where

the food is served in an open state, and some foods are served using newspaper and styrofoam. Based on the statistical test, it is known that there is a relationship between the presentation method and *E. coli* bacterial contamination in street food with a value of 0.02. Ways of serving that do not meet the requirements can be at 7 times greater risk of bacterial contamination than methods of serving that meet the criteria. The multivariate analysis results showed that serving food was the most influencing factor on *E. coli* contamination of street food ($p = 0.028$).

Most of the snack foods in this study are served to consumers in an open state because they are included in the ready-to-eat fare. The use of wrappers such as paper to serve food can be a contamination source if the form is not clean. Also, food wrappers that are not stored properly or are placed on the table can be exposed to dust or raw food materials that can contaminate the food served (Ademi and Rinanda, 2011). This research is in line with research in elementary schools in Bangkinang District, which shows a significant relationship between the way food is served and contamination with *E. coli* bacteria ($p = 0.002$) (Kurniadi, Saam, and Afandi, 2013). However, this study is not in line with research in elementary schools in Denpasar District, where it shows that there is no significant relationship between the way food is served and *E. coli* contamination in food ($p > 0.05$) (Nuryani, Adiputra, and Sudana, 2016).

Some of this study's limitations include not testing the rectal swabs, equipment swabs, and clean water used by food handlers. This causes it is not clear the source of *E. coli* contamination in street food is evident. This study shows

that the risk of *E. coli* contamination in snack foods increases in food handlers who do not use food serving aids, places to store cooked food, and how to help them. The school and the Cakung District Health Center can provide guidance and empowerment for food handlers selling around the school by offering stimulants, such as providing sanitation facilities and trash cans. Besides, food vendors are advised to maintain personal and environmental hygiene around food processing areas to avoid contamination of bacteria or other infectious agents that can enter the food.

REFERENCE

- Ademi BF, Rinanda T (2011). Deteksi cemaran *Escherichia coli* pada daging burger penjual kaki lima di Desa Kopelma Darussalam dan restoran cepat saji di Banda Aceh. *Jurnal Kedokteran Syiah Kuala*, 11(3): 134–142.
- Anggorowati W (2014). Hubungan Higien Sanitasi dan Perilaku Penjamah Makanan dengan Kontaminasi *Escherichia coli* pada Jajanan Tradisional Sekitar Pusat Kota Klaten. Universitas Diponegoro.
- Aristin NPI, Mahayan IMB, Aryasih IGAM (2014). Hubungan Penyimpanan Bahan Makanan dan Pencucian Alat Makan dengan Kualitas Bakteriologis Lalapan di Wilayah Kerja Puskesmas III Denpasar Selatan. *Jurnal Kesehatan Lingkungan*. 4(1): 40–44.
- Atmiati WD (2012). Faktor-faktor yang berhubungan dengan keberadaan bakteri *Escherichia coli* pada jajanan es buah yang dijual di sekitar pusat Kota Temanggung. *Jurnal Kesehatan Masyarakat*. 1(2): 1047–1053.
- Badrie N, Joseph A, Chen A (2003). An observational study of food safety practices by street vendors and microbiological quality of street-purchased hamburger beef patties in Trinidad, West Indies. *Internet Journal of Food Safety*. 3(7): 25–31.
- Baluka, S. A., Miller, R., Kaneene, J. B. (2015). Hygiene practices and food contamination in managed food service facilities in Uganda. *African Journal of Food Science*, 9(1): 31–42.
- Baylis, C. et al. (2011). The Enterobacteriaceae and Their Significance to the Food Industry. Brussels: International Life Sciences Institute.
- Bhaskar, J. et al. (2004). Bacteriological Profile of Street Foods in Mangalore. *Indian J Med Microbiol*, 22: 191–197.
- DKI Jakarta District Health Office (2016). Surveilans dinas kesehatan DKI Jakarta.
- Djaja, I. M. (2008). Kontaminasi *E.coli* pada makanan dari tiga jenis tempat pengelolaan makanan (TPM) di Jakarta Selatan. *Makara Kesehatan*, 12(1): 36–41.
- EATS (2016). Sanitation, Safety & Loss Prevention for Food Service Personnel. New Jersey: Food, Beverage & Games Division of Morey's Piers.
- Food Standards Agency (2016). *E. coli* O157 Control of Cross-contamination: Guidance for food business operators and local authorities. Scotland.

- Gadi, C., Bala, K. L., Kumar, A. (2013). Study on hygienic practices of street food vendors in Allahabad city and determination of critical control points for safe street foods. *The Allahabad Farmer*, 6(52): 1–10.
- Green, L. R. et al. (2007). Factors related to food worker hand hygiene practices. *Journal of Food Protection*, 70(3): 661–666.
- Kurniadi, Y., Saam, Z., Afandi, D. (2013). Faktor kontaminasi bakteri *E. coli* pada makanan jajanan di lingkungan kantin sekolah dasar wilayah Kecamatan Bangkinang. *Jurnal Ilmu Lingkungan*, 7(1): 28–37.
- Ministry of Health (2011). Situasi diare di Indonesia. *Buletin Jendela Data & Informasi Kesehatan*, 1–44.
- Ministry of Health (2015). Situasi pangan jajanan anak sekolah. Jakarta.
- Mugampoza, D. et al. (2013). Occurrence of *Escherichia coli* and *Salmonella* spp. in street-vended foods and general hygienic and trading practices in Nakawa Division, Uganda. *American journal of food and nutrition*, 3(3): 167–175.
- Muhonja, F., Kimathi, G. K. (2014). Assessment of hygienic and food handling practices among street food vendors in Nakuru Town in Kenya. *Science Journal of Public Health*, 2(6): 554–559.
- Nuryani, D., Adiputra, N., Sudana, I. B. (2016). Kontaminasi *Escherichia Coli* Pada Makanan Jajanan Di Kantin Sekolah Dasar Negeri Wilayah Denpasar Selatan. *Jurnal Ilmu Lingkungan*, 10(1): 28–32.
- Odonkor, S. T. et al. (2011). Evaluation of hygiene practices among street food vendors in Accra metropolis, Ghana. *Elixir Food Science*, 41: 5807–5811.
- Pratiwi, L. R. (2014). Hubungan Antara Personal Hygiene Dan Sanitasi Makanan Dengan Kandungan *E. Coli* Pada Sambal Yang Disediakan Kantin Universitas Negeri Semarang Tahun 2012. *Unnes Journal of Public Health*, 3(4): 17–26.
- Puspita, I., Palandeng, H., Sinolungan, J. (2014). Hubungan Praktik Higiene Sanitasi Penjamah Makanan Terhadap Cemaran *Escherichia coli* pada Makanan Gado-gado di Sepanjang Jalan Kota Manado. Universitas Sam Ratulangi.
- Riyanto, A. and Abdillah, A. D. (2012). Faktor yang Memengaruhi Kandungan *E. coli* Makanan Jajanan SD di Wilayah Cimahi Selatan. *Majalah Kedokteran Bandung*, 44(2): 77–82.
- Ruchiyat, A. (2007). Hubungan antara higiene perorangan, frekuensi konsumsi dan sumber makanan jajanan dengan kejadian diare. Universitas Gadjah Mada.
- Setyorini, E. (2013). Hubungan Praktek Higiene Pedagang Dengan Keberadaan *Escherichia Coli* Pada Rujak Yang Di Jual Di Sekitar Kampus Universitas Negeri Semarang. *Unnes Journal of Public Health*, 2(3): 1–8.
- Tessema, A. G., Gelaye, K. A., Chercos, D. H. (2014). Factors affecting food handling Practices among food handlers of Dangila town food and drink establishments, North West Ethiopia. *BMC Public Health*, 14(1): 1–5.
- Triandini, F. A. and Handajani, S. (2015). Pengetahuan, Sikap Penjamah Makanan Dan Kondisi Higiene

- Sanitasi Produksi Otak-Otak Bandeng Di Kabupaten Gresik. E-Journal Boga, 04(2): 27–36.
- WHO (2006). Five Keys to Safer Food Manual. Geneva: WHO Press.
- WHO (2015). Key foodborne diseases and hazards. Available at: <https://apps.who.int/iris/bitstream/handle/10665/327499/WHO-FOS-15.4-eng.pdf?sequence=1&isAllowed=y> (Accessed: 22 June 2016).
- Yunus, S. P., Umboh, J. M., Pinontoan, O. (2015). Hubungan personal higiene dan fasilitas sanitasi dengan kontaminasi *Escherichia coli* pada makanan di rumah makan padang Kota Manado dan Kota Bitung. JIKMU, 5(2): 210–220.