Makara J. Health Res., 2015, 19(1): 1-7
doi: 10.7454/msk.v19i1.4603

The Correlation between Eating Utensils and Place of Sales in the Contamination of *Escherichia coli* in Food Sold at Campus Food Stalls

Dewi Susanna[1*],Tris Eryando[2], Aria Kusuma[3], Dian Pratiwi[4]

1. Department of Environmetal Health, Faculty of Public Health, Universitas Indonesia, Depok 16424, Indonesia
2. Department of Biostatistic, Faculty of Public Health, Universitas Indonesia, Depok 16424, Indonesia
3. Center of Public Health Intervention Technology, National Institute of Health Research and Development, Ministry of Health, Jakarta 10560, Indonesia
4. The Center of Health Informatic and Biostatistics Studies, Faculty of Public Health, Universitas Indonesia, Depok 16424, Indonesia

[*]*e-mail: dsusanna@ui.ac.id*

Abstract

Up to now, in general, the safety of food that is sold at any canteens in the campuses, the eating utensils are handled and the food stalls are managed are still uncertain. This research was aimed to understand the correlation between the eating utensils handling and the contamination of *Escherichia coli* (*E. coli*) in the food sold by the food vendors in the campus. The cross-sectional design research applied on the food stalls in the university campus in Depok with a total number of 173 consumers as respondents. The variables observed as independent variables were the sanitation of the eating utensils and the sanitation of the dining place. The examination method of the Most Probable Number (MPN) for *E. coli* was conducted to assess the food's hygiene. The data analyzed using the chi-square test and followed by the logistic regression. The result showed that more than half of the food samples (59.54%) were contaminated by *E. coli*. The storage place of the eating utensils was most significantly correlated with the *E. coli* contamination of the served food with an OR=0.45 (0.21-0.87). Therefore, it is necessary to promote the awareness of this risk and reinforce supervision by the Health Authorities and by the management of the place of sales to provide guidance to the food vendors and to the consumers as well. Further research is recommended to observe the *E. coli* contamination through clean water, eating utensils, the hands of the consumers and the napkins used to wipe dry the eating utensils.

Abstrak

Hubungan Pengelolaan Peralatan Makan dan Tempat Penjualan terhadap Kontaminasi *Escherichia coli* pada Penyajian Makanan Jajanan. Selama ini belum diketahui kondisi keamanan makanan jajanan, pengelolaan peralatan makan dan tempat penjualan makanan di lingkungan Kampus. Penelitian ini betujuan untuk mengetahui hubungan antara pengelolaan peralatan makan dan tempat penjualan terhadap kontaminasi *Escherichia coli* (*E. coli*) pada penyajian makanan jajanan. Penelitian ini menggunakan disain potonglintang. Pengamatan dilakukan terhadap seluruh tempat penjual makanan di lingkungan Kampus UI Depok dengan responden sebanyak 173 penjamah makanan. Pemeriksaan Most Probable Number (MPN) *E. coli* dilakukan untuk mengetahui keamanan makanan. Lebih dari separuh 59,54% sampel makanan jajanan terkontaminasi *E. coli*. Tempat penyimpanan peralatan makan paling berhubungan dengan kontaminasi *E. coli* pada penyajian makanan jajanan. Faktor ini protektif terhadap kontaminasi *E. coli* pada penyajian makanan jajanan. Hal ini diduga disebabkan adanya faktor-faktor lain yang berkontribusi terhadap kontaminasi tersebut tetapi tidak diamati dalam penelitian ini seperti, kontaminasi *E. coli* pada air bersih, peralatan makan, tangan penjamah makanan dan lap yang digunakan untuk mengeringkan peralatan makan. Perlu ditingkatkan sosialisasi dan pengawasan oleh dinas kesehatan dan pengelola tempat penjual makanan jajanan kepada penjual makanan dan penjamah makanan. Perlu dilakukan penelitian lanjutan dengan mengamati kontaminasi *E. coli* pada air bersih, peralatan makan, tangan penjamah makanan dan lap yang digunakan untuk mengeringkan perlatan makan.

Keywords: contamination, E. coli, utensils, food stalls, food serving, canteen

Introduction

The *Escherichia coli* (*E. coli*) bacteria is used as one of the indicators for the existence of contamination from fecal-oral transmission or due to poor sanitation of the food processing.[1] *E. coli* strives normally in the digestive system of humans or mammals.[2-3] If bacteria are found in food, then it can be suspected that the contamination

was transmitted from human or animal excretions. The contamination could be transmitted through various media among others from the eating utensils and the management of service.[3] Poor hygiene and improper sanitation in handling the eating utensils and managing the place of service may cause the food to be contaminated[4] as food can carry more than two hundred diseases.[5]

The steps in managing food begins from the selection of the raw ingredients, storage, preparation, cooking, storing cooked food and serving the food.[6] Each stage in handling food is critical in exposing the risk of *E. coli* contamination, if not managed properly. Contaminated or unclean utensils are one of the causes for food contamination.[7] The eating utensil is part of the critical path in serving the food. If the eating utensils are contaminated by *E. coli*, then the food would also pose a risk of being contaminated. Poor sanitation in the place of food processing also contributes to the risk of food contamination.[4]

One of the government's policy to ensure that hygiene food are served at food stalls is by issuing the Guidelines on the Required Hygiene and Sanitation for Food Stalls as stipulated in the Decree of the Ministry of Health (Kepmenkes) Number 942/MENKES/SK/VII/ 2003.[8] However, based on a research conducted at the Faculty of Public Health, University of Indonesia (FKM-UI), the results showed that the food served with *sambal (*ground red chili*)* is one of the high risk food contaminated by *E. coli*.[9] Therefore, this research is aimed to examine the hygiene condition of the food served at the canteens located in the campus of the University of Indonesia, Depok by applying a bacteriological study approach. The contamination of *E. coli* in the food served at the food stalls is one indicator of the sanitation quality of the eating utensils that are used for serving the food and in managing the sanitation of the food stall. The reference applied for this research is the standard hygiene requirement as stipulated in the Kepmenkes No. 942/MENKES/SK/VII/2003 particulary in handling the eating utensils and managing the place for processing the food.

Methods

The research design applied in this study was the cross-sectional design. The observation on the eating utensils was conducted only at the time of the data collection. Likewise, the sanitation of the place of sales was only observed during the data collection. The contamination of *E. coli* in serving the food was the dependent variable while the eating and drinking utensils and the sanitation of the place of sales were independent variables. The utensil variable that was observed included the availability of the utensils, how the utensils were stored, the washing facilities for the utensils, the condition of the washing facilities, the method of washing the utensils, dish soap and clean water, disinfectant, the method of drying the utensils, the condition of the drying cloth and clean water source. The sanitation variable of the place of sales that was observed included the physical quality of the clean water, the availability of clean water, the drinking water source, the water source for cooking, the treatment of drinking water, the waste water management, the water flow in the sewage gutter, the availability of toilets, the presence of flies, cockroaches, cats and mice in the kitchen, the presence of flies, cockroaches, cats and mice in the dining place, whether there are efforts to prevent the infestation of flies, roaches, cats and mice in the kitchen, the availability of a garbage container, the condition of the garbage container, the capacity of the container, the availability of a public trash container, the system for garbage disposal, usage of clean drying napkin for consumers, the utensils to prepare the food and the cutting utensils.

The data was collected by the enumerator that consisted of students and graduates of the Faculty of Public Health University of Indonesia (FKM-UI) who had been trained to conduct the survey using the questionnaires and take sampling of the food and drinks. The method of the survey is through interview, observation and sampling of food and drinks. The interview used a structured questionnaire that consisted of questions and an observation sheet. The research objects are the food vendors or the canteens located in the faculty facilities, student dormitory and food kiosks the Depok Campus. One hundred seventy three respondents were interviewed and 173 food and drink samples were taken.

Identification of *E. coli* was done using the *membrane filter* method. The food samples were examined in two stages: firstly the food samples were prepared and then continued with the filtration stage, using the *membrane filter*.

In the preparation stage, the samples were diluted to reach 10^{-1}, 10^{-2}, and 10^{-3} concentration by following these steps: a) Using sterilized 10mL pippettes. 250 mL Erlenmeyer. MI agar media and steril physiological saline. Each sample uses these three sets of equipment; b) Before scaling the food sample, ten grams of the food sample was put into a steril *plastic bag* using an aseptic technique; c) The food samples in the plastic bag were crushed using a mortar; d) The crushed food sample was inserted into the 250 mL Erlenmeyer and diluted using 100mL physiological saline to reach a 10^{-1} dilution; e) Using a pippette. 10mL of 10^{-1} diluted samples were inserted into another 250 mL Erlenmeyer; f). The samples were further diluted using physiological saline up to 100 mL to reach a 10^{-2} concentration; g) Ten mL of the 10^{-2} diluted samples were inserted into another 250 mL Erlenmeyer to be diluted upto 100 mL to reach a 10^{-3} concentration.

The filtration stage using the *membrane filter* follows these steps: a) Prepare steril petri dish, membrane filter, funnel and the respective food samples diluted to 10^{-1}, 10^{-2} and 10^{-3} concentration; b) The agar MI media wss poured and evenly spread into the petri dish; c) The membrane filter was taken out from the steril package using an aspetic technique and placed into the funnel; d) Applying an aseptic technique, the diluted samples were poured into the funnel; e) The samples were sucked using a vacuum suction until all samples go through the *membrane filter*; f) The *membrane filter* was rinsed with steril phyisological saline, and the saline also sucked using the vacuum suction; g) Using an aseptic technique, the *membrane filter* was taken out from the funnel, and placed in the petri dish also applying an aspetic technique; h) Place the samples in an incubator under a temperature of 36-37 °C for 24-48 hours; i) The number of *E.coli* blue colony was then counted.

The results grouped into data categories. A univariate analysis is administered to examine the percentage of the independent variables and the dependent variables. A bivariate analysis was also administered to examine the correlation between the respective independent variables and the dependent variables (*E. coli* contamination in the food sold at the food kiosks using the *chi-square* test with a level significance of 0.05 (α=0.05). A multivariate analysis was administered to identify the most correlated independent variable associated to the *E. coli* contamination in the food samples by applying a logistic regression test.

This research is part of a research entitled "*Health Certification Assessment on Food and Beverages sold by Street Vendors*" funded by the Competence Cluster Grant, Directorate of Research and Community Services of the Universitas Indonesia in 2010, under contract Number 3429/H2.R12/23 PPM/2010.

Results and Discussions

This research concluded that more than half (59.54%) of the food and drink samples were contaminated by *E. coli* and 40.46% of the samples were not contaminated by *E. coli.* The statistical bivariate analysis resulted in a significant correlation of (p<0.05) (OR= 0.43; CI95%: 0.21-0.87) between the utensil storage variable with the *E. coli* contamination in the food served.

The samples were further analyzed applying the multivariate logistic regression. by first selecting the candidate variable, namely the independent variable that has a value of $p<0.25$.

The statistical multivariate analysis shows that there is a significant correlation between the methods of storing the eating utensils toward the *E. coli* contamination (Table 2). The way the eating utensils is stored poses a high risk of contamination and it is the most correlated factor in spreading *E. coli* in the food sold at the food kiosks.

The storage of the eating utensils that pose a high risk should be improved to prevent *E. coli* contamination when serving food in the campus facilities (Table 3).

Proper food handling is one effort to prevent food contamination and ensure food safety. The *E. coli* contamination in food sold at the campus food stalls shows that the food is not safe in terms of bacteriology, due to the poor hygiene in handling the food. Micro-organisms particularly bacteria could be airborne or found in the water or ground. Micro-organism could grow where other organisms grow, such as on the surface of plants and animals and in the mouth, nose and intestines of animals and also in humans. In fact, they could grow in a higher temperature environment such as hot water springs that contain sulphur.[10]

The *E. coli* cateria could be found in human intestines and warm blooded animals. Most of these bacteria are harmless. However, *Enterohaemorrhagic Escherichia Coli* (EHEC) is one of the dangerous types of bacteria that can be transmitted through food. This type of bacteria have caused outbreaks in the United States in 1982.[11] The bacteria strive in a temperature between 7-46 °C. The optimum temperature to grow is 37 °C.[12-13] The bacteria contamination indicates that there is fecal transmission from human or mamalian excretion.

There are several factors that contribute to the *E coli* contamination in food namely: a) environment, b) contamination from the environment due to improper sanitation in the agriculture or fishery chain process c) water, d) animals, e) consumers, f) utensils, and kitchen activity.[10] The place of sales is the environment in which the food is prepared and served.

However, the statistical analysis shows no significant correlation between the place of sales and the *E. coli* contamination in the food served at the stalls.

The most relevant factor that is correlated to *E. coli* contamination in this research is the method of storage of the eating and drinking utensils. The storage place should be contamination-free.[8] The storage place for the utensils should be dry, covered and separated from any source of contamination.[14-15]

In addition, the storage place is recommended to be covered and not be used as a changing room, nor should it be near a toilet, or a garbage container, a mechanic room, located under a sewage pipe that poses a risk of leakage, near a water canal, including near a fire hydrant of a building, under an open staircase or near a source of contamination.[16-17] This is to prevent contami-

Table 1. Correlation between the Factors in Handling Eating Utensils and Place of Sales towards Contamination of *Escherichia coli* in Food Sold at the Food Stalls

Variable	*E. coli* Contamination			*p*	OR	CI 95%
	Yes	No	Number			
	n (%)	n (%)	n (%)			
Sanitation of Utensils						
Availability of Utensils						
Not provide utensils	1(50.0)	1(50.0)	2(100)	0.647	0.68	0.04-10.99
Provide Utensils	102(59.6)	69(40.4)	171(100)			
Storage of utensils						
No storage place/open storage	65(53.7)	56(46.3)	121(100)	**0.027**	0.43	0.21-0.87
Closed storage	38 (73.1)	14 (26.9)	52(100)			
Washing facilities						
Not available	1(50.0)	1(50.0)	2(100)	0.647	0.68	0.04-10.99
Available	102(59.6)	69(40.4)	171(100)			
Condition of washing facilities						
Not clean	34(65.4)	18(34.6)	52(100)	0.391	1.42	0.73-2.80
Clean	69(57)	52(43)	121(100)			
Washing Technique						
With running water	28(68.3)	13(31.7)	41(100)	0.260	1.64	0.78-3.44
No running water	75(56.8)	57(43.2)	132(100)			
Use of washing soap						
With soap	2 (40)	3(60)	5(100)	0.323	0.44	0.07-2.72
No soap	101 (61.5)	67 (39.9)	168(100)			
Use hot water						
No	100(59.2)	69(40.8)	169(100)	0.466	0.48	0.05-4.74
Yes	3(75)	1(25)	4(100)			
Drying utensils after washing						
Not dried with cloth	88(60.3)	58(39.7)	146(100)	0.806	1.21	0.53-2.78
Wiped dry with cloth	15(55.6)	12(44.4)	27(100)			
Cleanliness of drying cloth						
High risk	39(61.9)	24(38.1)	63(100)	0.750	1.17	0.62-2.20
Low risk	64(58.2)	46(41.8)	110(100)			
Water Source						
Not PDAM/not ground water	9(78.6)	10(21.4)	19(100)	0.369	0.57	0.22-1.45
PDAM/ground water	94(59.1)	60(40.9)	154(100)			
Sanitation of Venue						
Physical Condition of clean water						
Tainted/odorous/unclear	1 (50)	1(50)	2(100)	0.647	0.68	0.04-10.998
Clear. clean /no odor	102 (59.6)	69(40.4)	171(100)			
Availability of clean water						
Not all year round	6 (60)	4(40)	10(100)	0.624	1.02	0.28-3.76
All year round	97 (59.5)	66(40.5)	163(100)			
Drinking water source						
PDAM/ground water well/refilled water source /bottled water	39 (58.2)	28(41)	67(100)	0.901	0.91	0.49-1.70
NOT from PDAM/ground water well /refilled water source /bottled water	64 (60.4)	42(39.6)	106(100)			
Water source for cooking						
PDAM/ground water well /refilled water source /bottled water	4 (80)	1(20)	5(100)	0.326	2.79	0.31-25.48
NOT from PDAM/ground water well /refilled water source /bottled water	99 (58.9)	69(41.1)	168(100)			

Continue of Table 1

Variable	*E. coli* Contamination			*p*	OR	CI 95%
	Yes n (%)	No n (%)	Number n (%)			
Treatment of drinking water						
High risk	39 (58.2)	28(41.8)	67(100)	0.901	0.91	0.49-1.70
Low risk	64 (60.4)	42(39.6)	106(100)			
Waste water used after washing						
Not boiled	6 (40)	9(60)	15(100)	0.181	0.41	0.14-1.24
Boiled	97 (61.4)	61(38.6)	158(100)			
Waste water flow						
Into the gutter	9 (60)	6(40)	15(100)	1.000	1.02	0.35-3.01
No gutter	94 (59.5)	64(40.5)	158(100)			
Availability of toilets						
Not clean	62 (59)	43(41)	105(100)	0.996	0.95	0.51-1.77
Clean	41 (60.3)	27(39.7)	68(100)			
Cleanliness of toilets						
Not clean	66 (59.5)	45(40.5)	111(100)	1.000	0.99	0.52-1.87
Clean	37 (59.7)	25(40.3)	62(100)			
Presence of flies						
Present	87 (58.4)	62(41.6)	149 (100)	0.587	0.70	0.28-1.74
None	16 (66.7)	8(33.3)	24(100)			
Presence of cockroaches						
Present	73 (59.3)	50(40.7)	123 (100)	1.000	0.97	0.50-1.90
None	30 (60)	20(40)	50(100)			
Presence of cats						
Present	62 (61.4)	39(38.6)	101 (100)	0.667	1.20	0.65-2.22
None	41 (56.9)	31(43.1)	72(100)			
Presence of mice						
Present	70 (60.3)	46(39.7)	116 (100)	0.886	1.11	0.58-2.11
None	33 (57.9)	24(42.1)	57(100)			
Presence of insects and mice						
Present	31 (67.4)	15(32.6)	46 (100)	0.275	1.58	0.78-3.21
None	72 (56.7)	55(43.3)	127(100)			
Trash bin cover						
Present	69 (58)	50(42)	119(100)	0.652	0.81	0.42-1.57
None	34 (63)	20(37)	54(100)			
Condition of garbage container						
Not clean	13 (44.8)	16(55.2)	29(100)	0.118	0.49	0.22-1.09
Clean	90 (62.5)	54(37.5)	144(100)			
Capasity of garbage container						
Full/insufficient	5 (44.8)	2(55.2)	7(100)	0.407	1.74	0.33-9.20
Not full/sufficient	98 (62.5)	68(37.5)	166(100)			
Public trash bin						
None	1 (25)	3(75)	4(100)	0.182	0.22	0.02-2.15
Available	102 (60.4)	67(39.6)	169(100)			
Napkin for consumers						
Not individually for each serving	25 (62.5)	15(37.5)	40(100)	0.801	1.18	0.57-2.43
Individual napkin for each serving	78 (58.6)	55(41.4)	133(100)			
Kitchen Utensils						
None / not easy to clean	46 (58.2)	33(41.8)	79(100)	0.868	0.91	0.49-1.66
Easy to clean	57 (60.6)	37(39.4)	94(100)			
Cutting tools						
Not stainless steel/not clean	12 (63.2)	7(36.8)	19(100)	0.926	1.18	0.44-3.18
Stainless steel/clean	91(59.1)	63(40.9)	154(100)			

Remarks: n = Number of observations. OR= odds ratio; PDAM=*Perusahaan Daerah Air Minum* or the local drinking water company

Table 2. The Multivariate Variable candidate Analysis on the Management of Eating Utensils and Place of Sales towards Contamination of *Escherichia coli* in Food Sold at Food Stalls

Variable	ß	p value	*OR*	*95%* confidence interval
Eating Utensils Sanitation:				
Storage of utensils	-1.369	0.002	0.25	0.02-38.51
Condition of washing stand for handwashing	0.860	0.045	2.36	1.02-5.48
Technique od washing utensils	0.612	0.160	1.84	0.79-4.33
Sanitation of Place of Sales:				
Water sewage	-1.239	0.055	0.29	0.08-1.03
Condition of garbage container	-1.088	0.078	0.34	0.10-1.13
Presence of flies	0.676	0.130	1.97	0.82-4.72
Presence of mice	-0.883	0.054	0.41	0.17-1.02
Condition of garbage container	-0.671	0.090	0.51	0.24-1.11
Cover of garbage container	1.505	0.163	4.51	0.54-37.37
Capacity of garbage container	-1.634	0.188	0.20	0.02-2.22
Public Trash container	0.909	0.141	2.48	0.74-8.34
Constant	0.232	0.898	1.26	

Remarks: n= number of observations. OR= Odds ratio

Table 3. The Results from Multivariate Variable Analyisis on the Management of the eating Utensils and the Place of Sales Showed the most Significant Correlation in the Contamination of *Escherichia coli*

Variable	ß	p value	OR	95% CI
Method of storing the utensils	-0.849	0.019	0.43	0.21-0.87
Constant	-0.149	0.414	0.86	

Remarks: OR= odd ratio

nation of the eating utensils when in storage. If the utensils are contaminated during storage, then the contaminant may also infect the food if using the affected utensils to serve the food.

This research found that the eating utensils were stored in an open place without using a special covered container, therefore, posing the risk of contamination on the utensils. The path of the *E. coli* contamination from human or animal excretion may have passed through the utensils from the storage place. There are several possible paths of contamination on the utensils that are not covered properly, namely: (i) direct contamination from domestic animal excretion, as the storage place is not covered, (ii) contact with domestic animals or insects that have been exposed to the excretion,[18] (iii) contact with a surface that is contaminated by *E. coli.* The surface in this case is the surface of the storage place of the eating utensils.[19]

Improper hygiene and sanitation handling of the utensils may contribute to the contamination of the eating utensils and subsequently the food in contact with the utensils may also be affected.[14] The results from this research in the handling of eating utensils of the canteens in the campus show that it is necessary to improve the condition of these canteens. In the campus there are still many food vendors that store their utensils in uncovered storage places (60.7%), in fact some vendors do not use any special container for the utensils (9.8%). This attributes to the risk of contamination of the utensils in the storage place.

From the observation on the presence of disease vectors in the kitchen, the majority of the kitchens had flies and roaches visible in the area: 86.1% and 71.1% respectively. More than half of the kitchens showed the presence of mice and cats: 58.4% and 67.1% respectively. Meanwhile, the storage of the utensils is usually near or in the kitchen. Therefore, utensils stored in uncovered containers or not stored in any container bear the risk of contamination by insects or animals.

This research does not focus on the quality of the bacteria on the eating utensils, so the quality of the bacteria on the utensils is unknown. It is presumed that this is the reason for more protective measures in storing the utensils, since the *E. coli* contamination is not only from the food served with utensils that are stored at high risk (uncovered container or without any container), but also from food served with utensils that are stored properly (low risk or covered container). According to the five key guidelines to ensure the safety of the food, the first key is related to the serving utensils

that must be kept hygiene, prevent from insects, domestic pets and other animals entering the kitchen and wash hands properly.[5,17]

The decree of the Ministry of Health (Kepmenkes) No 942/MENKES/SK/VII/2003, states that it is mandatory for the vendors to store the utensils in a clean place that is free from contamination.[8] The utensils would be safe from contamination particularly protected from vectors and animals. However, the storage place of the utensils in the canteens of the campus of UI is still not secured from the contact of vectors or animals, as the utensils are stored in unvcovered containers or without any containers.

Conclusions

The most relevant factor in *E. coli* contamination in the food served at the food stalls at the campus of UI Depok is the storage of the eating and drinking utensils. Uncovered containers to store the utensils or storage without containers pose 0.4 times risk to *E. coli* contamination in food served in the campus of UI Depok.

The City Health Authorities should promote the campaign on hygiene and safe storage of eating utensils to the management of the food stalls (the Faculty management), to the vendors and to the consumers as well. The management of the food stalls (the Faculty management) plays an important role in facilitating a clean storage place for the utensils and in supervising the practice of the vendors in storing the utensils properly. The vendors are also expected to maintain a clean and contamination–free storage place for their utensils. In addition to that, it is recommended to conduct further research to observe the microbiological quality of the utensils and the micobiological quality of the cloth used to wipe dry the utensils. Regular supervision on the microbiological quality of the food served at the canteens is needed to monitor the effectiveness of the policy in ensuring food safety in the campus of UI.

Acknowledgments

We would like to acknowledge the Directorate of Research and Community Services of the Universitas Indonesia that has provided the oppportunity to conduct and publish this research under the Competence Cluster Grant with contract Number 3429/H2.R12/23 PPM/2010.

References

1. Feng P, Weagant SD, Grant MA, Burkhardt W. BAM: Enumeration of Escherichia coli and the Coliform Bacteria. Bacteriological Analytical Manual Chapter 4 Enumeration of *Escherichia coli* and the Coliform Bacteria In: Administration U.S. FDA., 2013.
2. Redman NE. Food Safety A Reference Handbook. 2nd ed. California: ABC-CLIO, Inc; 2007.
3. Clive de W, Blackburn, Mc. Clure PJ. Foodborne pathogens Hazards, risk analysis and control. England: Woodhead Publishing Ltd and CRC Press LLC, Abington Cambridge; 2001.
4. Arvanitoyannis IS. HACCP and ISO 22000 Application to Foods of Animal Origin. Willey Blackwell Publishing Ltd; 2009.
5. World Health Organization. Five Keys to Safer Food Manual: Department of Food Safety, Zoonoses and Foodborne Diseases; 2006. (internet) [cited 2013 August 13]. Available from: http://www.who.int/foodsafety/publications/consumer/manual_keys.pdf.
6. Swane DM, Rue N, Linton R. Essential of Food Safety and Sanitation. 2nd ed. New Jersey: Pearson Education, Inc upper saddler River; 2003.
7. Mariot NG, Gravani RB. Principles of Food Sanitation. 5th ed. New York: Springer Science+Business Media, Inc; 2006.
8. Department of Health Republic Indonesia. Decree of the Minister of Health of the Republic of Indonesia Number 942/MENKES/SK/VII/2003 on Guidelines for Hygiene and Sanitation Standard for Food sold at Food Stalls. Indonesia: Ministry of Health, 2003.
9. Susanna D, Eryando T, Indrawani YM. (2009). The relation between the knowledge and practice of foodhandler and Escherchia coli Contamination in foods. Med J Indones. 2011;20(1):66-70.
10. Adams M, Motarjemi Y. Basic Food Safety for Health Workers Geneve: World Health Organization, 1999.
11. World Health Organization. Enterohaemorrhagic Escherichia coli (EHEC). 2011. (internet). [cited 2014 August 19]. Available from: http://www.who.int/mediacentre/factsheets/fs125/en/.
12. World Health Organization dan Food and Agriculture Organization. Microbiological Risk Assessmentseries Enterohaemorrhagic *Escherichia Coli* in Raw Beef and Beef Products: Approaches For The Provision of Scientific Advice: World Health Organization, Food and Agriculture Organization of The United Nations, 2011.
13. Robert L, Buchanan, Doyle MP. Foodborne Disease Significance of Escherichia coli O157:H7 and Other *Enterohemorrhagic E. coli.* Food Technol. 1997;51(10): 69-76.
14. U. S. Food and Drugs Administration. Food code: Food and Drug Administration; 2013.
15. CSIRO Food dan Nutritional Sciences. Make It Safe A Guide to Food Safety. Collingwood: CSIRO Publishing, 2010.
17. U. S. Food and Drugs Administration. Food Code U.S. Public Health Service 1997. College Park: Food and Drug Administration; 1997.
18. Motarjemi Y. Research Priorities on Safety of Complementary Feeding. Pediatrics Official J. Am. Acad. Pediatr. 2000;106:1304.
19. Kibret M, Tadesse M. The Bacteriological Safety and Antimicrobial Susceptibility of Bacteria Isolated From Street-Vended White Lupin (Lupinus Albus) in Bahir Dar, Ethiopia.Ethiop. J. Health Sci. 2013;23(1):19-26.