Original Research Report

IDENTIFICATION OF PATHOGENIC BACTERIA IN FOOD SAMPLES FROM CAFETERIAS OF A UNIVERSITY IN DENPASAR, INDONESIA

Anak Agung Ayu Lila Paramasatiari, Putu Indah Budiapsari, Putu Arya Suryanditha, Ni Wayan Widhidewi

Department of Microbiology and Parasitology, Faculty of Medicine and Health Sciences, Universitas Warmadewa, Denpasar, Bali, Indonesia

ABSTRACT

Foodborne diseases still remain a problem especially in public areas. This study aimed to identify pathogenic bacteria in foods sold at the cafeterias of Universitas Warmadewa, Denpasar, Indonesia. The presence of pathogenic bacteria in the food samples was identified using the brain heart infusion (BHI) agar for the growth of Escherichia coli *and* Streptococcus aureus*, selenite for* Shigella *and* Salmonella*, and alkaline peptone for* Vibrio cholerae*, then bacterial culture was conducted to identify the species. The results showed that* Escherichia coli *were found in two food samples, kangkong and jinggo rice, with the colony counts of 50-118.* Escherichia coli *was the most commonly found contaminant in food samples from the Warmadewa Cafeterias. Further suggestions must be offered to increase hygiene in the food processing by advising the stalls' owners to serve good foods and conducting regular inspections to assess the food quality.*

Keywords: *Pathogen; bacteria; food; consumption; public health*

Correspondence: Putu Indah Budiapsari, Department of Microbiology and Parasitology, Faculty of Medicine and Health Sciences, Universitas Warmadewa, Denpasar, Bali, Indonesia. Email: putuindah51@yahoo.com

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Highlights:

1. Eschericia colli was the most contaminant bacteria among food samples from Warmadewa Cafeterias.
2. Further suggestions to increase the hygiene in food processing must be offered.

INTRODUCTION

Foodborne diseases are commonly found diseases around the world, which produce health problems through the distribution of infectious bacteria from food handlers (Adesiyun et al. 2020). As the name implies, foodborne diseases transmit through food (Akilan et al. 2020, Abolghait et al. 2020). Foodborne diseases can be caused by various types of microbes, such as coliforms and bacteria that most commonly cause food contaminations (i.e. *Escherichia coli* and *Salmonella* sp.) (Dallal et al. 2020). If *Escherichia coli* is present in water and food, then it indicates a contamination of the food and water (Ahmed & Shimamoto 2014, Adimasu et al. 2016). Bacteria often contaminate meat because of the high water and protein content that can foster bacterial growth (Ghoneim et al. 2020). As one of the most common public health problems, foodborne diseases commonly show clinical manifestation, such as nausea, vomiting, abdominal cramp, diarrhea, and fever (Jang et al. 2021).

Pathogenic bacteria have possibilities of contamination in any step of food processing (Sari et al. 2013). Therefore, food quality and sterile process as the important concepts of food handling must be implemented when selecting ingredients, storing and processing food, also serving and storing cooked food (Li et al. 2020). Hygiene and sanitation are efforts to avoid diseases. They are needed to protect food from contamination and disease-transmitting microorganisms (Atun 2016). They are also efforts to control the settings of kitchen, equipments used, food handlers, and ingredients that can prevent contaminated food from spreading diseases (Valero et al. 2016).

In developing countries, it is estimated that 70% of diarrhea cases are associated with the consumption of contaminated food (Aruna & Rajan 2017, El-Sharkawy

et al. 2017). Outbreaks of foodborne disease due to the contamination transmitted from food handlers are estimated at 30% (Sofiana 2012). In a research conducted at a school cafeteria in Central Jakarta area, 56.92% food samples and 52.89% beverage samples were positively contaminated by *E. coli* (Sofiana 2012). A previous research conducted in Java, Indonesia, showed that 25% of the food samples were contaminated with bacteria (Sunarno et al. 2010).

Food handlers and people managing places (especially public places) that sell foods and beverages should be given attention, so that they serve healthy and safe foods (Zhao et al. 2016). Schools and universities, such as Universitas Warmadewa, Denpasar, Indonesia, are public places that provide street foods. All cafeterias located in Universitas Warmadewa sell types of food that contain high water and protein content. Universitas Warmadewa has seven cafeterias that sell various types of foods and beverages. Data on knowledge and attitudes regarding hygiene and sanitation of the food handlers, who were actively selling foods, and the microbiological quality of foods in Universitas Warmadewa were not yet known. Based on the description above, it was necessary to conduct a research on the hygiene, sanitation, and microbiological quality of foods in Universitas Warmadewa.

MATERIALS AND METHODS

This study used a descriptive method with a cross-sectional approach. This research was conducted at all of the cafeterias of Universitas Warmadewa in July-December 2017. All of the food sellers acted as the respondents in this study. The samples used were all food handlers who played an active role in the cafeterias of Universitas Warmadewa and the foods sold at the cafeterias. The microbiological quality was assessed by identifying the presence of pathogenic bacteria in food samples obtained from the cafeterias of Universitas Warmadewa. The ethical compliance assessment result was obtained from the Research and Development Unit of Universitas Udayana, Denpasar, Indonesia, with the letter number 909/UN14.2.2/III/14LT/2018.

Following the methods of microbial detection and identification by (Ferone et al. 2020), the food samples were brought to the laboratory, then ground and wrapped in sterile containers. According to a study on evaluation of antimicrobial activity by (Grace et al. 2020), each of the samples should be weighed approximately five grams for foods and 10 mL for beverages, then taken directly using a dropper and put into the agar media to be incubated for 1x24 hours. The media used in this study were similar to what were used in a study by Happy et al. (2018). Brain heart infusion (BHI) agar was used for growing *Escherichia coli* and *Streptococcus aureus*, selenite medium for *Shigella* sp. and *Salmonella sp.*, and alkaline peptone for *Vibrio cholerae*. Food samples should be infused with the media, then preserved at 37^{o}C for 24 hours (Hussein et al. 2018, Yu et al. 2021). After a day, a dose of the enrichment media should be taken and then planted on the selective media, i.e. blood agar media for growing *Staphylococcus aureus*, MacConkey agar for growing *Escherichia coli*, *Salmonella-Shigella* (SS) agar for growing *Salmonella sp.* and *Shigella sp.*, and thiosulfate-citrate-bile-sucrose (TCBS) agar for growing *Vibrio cholerae* (Omara et al. 2017, Pei et al. 2020).

The next process after planting in the medium is carrying out the Gram staining and the indole, methyl red (MR), Voges-Proskauer (VP), and citrate (IMViC) (Tabashsum et al. 2013, Tarabees et al. 2017). In this research, the samples were taken to the Health Laboratory Unit (*Balai Laboratorium Kesehatan*), Bali Province, Indonesia, to check the bacteriological quality using bacterial culture. The bacteriological quality checks were carried out to determine the pathogenic bacteria contained in the foods and beverages sold at the cafeterias of Universitas Warmadewa. In a descriptive study, the researcher collects data and analyzes the data descriptively (Zhao et al. 2016). The data from this research were also collected and then analyzed in the same manner.

RESULTS

Two to three food and beverage samples were taken from seven cafeterias of Universitas Warmadewa. The samples studied were 22 samples, with 15 food specimens and 7 beverage specimens. The sampling was carried out in the morning before the foods were sold out. *Escherichia coli* is an indicator of food sanitation and food processing quality. Two foods were found to be contaminated by *Escherichia coli*, i.e. kangkong and jinggo rice. The colony counts of *Escherichia coli* in the kangkong and jinggo rice were 50 and 118 respectively. However, the regulation of the Indonesian Ministry of Health number 1096/Menkes/Per/VI/2011 concerning the requirements for sanitation and hygiene of catering services accredited to ISO/IEC 17025:2005 states that the presence of *Escherichia coli* bacteria in foods and beverages should be 0 gr/mL. Test result of >0 indicate that the food is not allowed to be consumed. It also indicates that the food is not processed well by the food handler.

The only pathogenic microbes found in the foods sold at the cafeterias of Universitas Warmadewa were *Escherichia coli*, while the identification of the other bacteria came out as negative as listed in Table 1.

Table 1. Identification of pathogenic bacteria in foods and beverages from the cafeterias of Universitas Warmadewa

No	Food sample	Colony count				
		E. coli	*Staphylococcus aureus*	*Salmonella*	*Shigella*	*Vibrio cholerae*
1	Kangkong	50 (+)	(-)	(-)	(-)	(-)
2	Fried chicken and lalapan	0	(-)	(-)	(-)	(-)
3	Tempe and lalapan	0	(-)	(-)	(-)	(-)
4	Saltwater fish	0	(-)	(-)	(-)	(-)
5	Betutu chicken	0	(-)	(-)	(-)	(-)
6	Jinggo rice	118 (+)	(-)	(-)	(-)	(-)
7	Tipat tahu	0	(-)	(-)	(-)	(-)
8	Stir fried tempe and tomato	0	(-)	(-)	(-)	(-)
9	Sayur jepang	0	(-)	(-)	(-)	(-)
10	Fried rice	0	(-)	(-)	(-)	(-)
11	Beef rendang	0	(-)	(-)	(-)	(-)
12	Sayur urap	0	(-)	(-)	(-)	(-)
13	Chicken soto	0	(-)	(-)	(-)	(-)
14	Tipat cantok	0	(-)	(-)	(-)	(-)
15	Rujak	0	(-)	(-)	(-)	(-)
16	Mango juice	0	(-)	(-)	(-)	(-)
17	Iced tea 1	0	(-)	(-)	(-)	(-)
18	Iced orange squash 1	0	(-)	(-)	(-)	(-)
19	Iced tea 2	0	(-)	(-)	(-)	(-)
20	Iced tea 3	0	(-)	(-)	(-)	(-)
21	Iced sugar water	0	(-)	(-)	(-)	(-)
22	Iced orange squash 2	0	(-)	(-)	(-)	(-)

DISCUSSION

According to the literature review, *Escherichia coli* passes on to humans from feces. When a person performs defecation activities, they might not wash their hands thoroughly with enough soap and tap water. It contributes to the findings of *Escherichia coli* that can transfer to human hands (Zhao et al. 2016). The presence of *Escherichia coli* in foods or beverages correlate with the spreading of pathogens that can cause gastrointestinal problems, such as diarrhea and toxication or poisoning (Ghoneim et al. 2020).

The results of the observations showed that only one cafeteria in Universitas Warmadewa where the food handlers used utensils when taking foods in the serving and storing processes. Whereas, the food handlers in the other cafeterias used bare hands without gloves and utensils. They only occasionally washed their hands before and after taking foods. There were only five food handlers at the cafeterias of Universitas Warmadewa who used aprons, while none used head coverings when processing and serving foods. Based on the results of the questionnaires distributed before sampling, 100% respondents answered correctly regarding knowledge of food hygiene and sanitation. The attitude of the food handlers mostly agreed with the requirements of food hygiene and sanitation.

Strength and limitation

It was necessary to conduct a research on the hygiene, sanitation, and microbiological quality of foods.

CONCLUSION

Eschericia coli is the most commonly found contaminant bacteria in food samples from the cafeterias of Universitas Warmadewa. Futher suggestions must be offered to increase the hygiene in food processing by guiding the stalls' owners to serve good foods and conducting regular inspections to assess the food quality.

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Conflict of interest

None declared.

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Author Contribution

The list of author contribution is as follows. AAA LP collected and provided the samples, then transferred them to the Health Laboratory Unit (*Balai Laboratorium Kesehatan*), Bali Province, Indonesia. PIB wrote the manuscript and analyzed the data. PAS performed the culture of the samples, then tabulated the results. NWW supported us by gathering the food handlers who allowed us to take their foods as the research samples.

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