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Assessment of *Escherichia Coli* Contamination in Ready-to-Eat Foods from Food Stalls near Universitas Indonesia Station

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ABSTRACT

Background: Processed food refers to food products that have undergone preparation, with or without additional ingredients. Various types of ready-to-eat processed foods are sold at food stalls around Universitas Indonesia Station and are widely consumed by the public. Escherichia coli, a common gastrointestinal bacterium, serves as an indicator of microbial contamination according to the Regulation of the Minister of Health of the Republic of Indonesia No. 2 of 2023.
Methods: A Total Plate Count (TPC) was conducted using selective MacConkey Agar. Five popular ready-to-eat processed food samples were collected from three different food stalls: capcay and omelette from Food Stall A, soy sauce–seasoned chicken and Mustofa potatoes from Food Stall B, and stir-fried water spinach from Food Stall C.
Results: TPC analysis revealed no E. coli growth in any of the tested samples. Specifically, capcay and omelette from Food Stall A, soy sauce–seasoned chicken and Mustofa potatoes from Food Stall B, and stir-fried water spinach from Food Stall C showed no microbial contamination.
Conclusion: All examined ready-to-eat processed food samples met the microbiological standards specified by the Indonesian Ministry of Health

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INTRODUCTION

Food is a product derived from plantations, agriculture, animal husbandry, fisheries, aquaculture, and forestry that is consumed by humans in the form of food or beverages, either processed or unprocessed. Food that has undergone processing, with or without additional ingredients, is referred to as processed food. Contamination in processed food can be caused by various contaminants, including chemical, biological, and other substances that can harm consumers.[1] Biological contaminants in food may include bacteria, viruses, and parasites. These substances are also known as foodborne pathogens, which can cause foodborne illnesses in consumers (Madigan et.al 2022).

Foodborne diseases are a global issue, particularly in low- and middle-income countries.[3] According to WHO data in 2019, it is estimated that each year 1 in 10 people worldwide falls ill due to foodborne diseases, resulting in the loss of 33 million healthy life years. This situation is worse in children under 5 years of age, with 420,000 deaths annually, representing one-third of the total mortality from foodborne diseases.Every year, more than 150 million people in Southeast Asia fall ill due to foodborne diseases, and over 175,000 of them die. Among these, 60 million sick individuals and 50,000 deaths occur in children under 5 years of age. Additionally, Southeast Asia accounts for half of the global cases of typhoid fever and hepatitis A infections and deaths, which are also foodborne diseases.

Food poisoning is one form of foodborne illness that occurs when a person ingests food containing toxins, leading to various symptoms such as nausea, vomiting, diarrhea, fever, sore throat, and even paralysis. According to the study by Arisanti R, et al. (2018), there were 1,167 outbreaks of food poisoning in Indonesia during 2000–2015, with the highest number of cases in Central Java, amounting to 61,119 incidents causing 291 fatalities. The most common type of food contamination is bacterial contamination, primarily caused by improper food processing and storage. The frequent occurrence of food poisoning outbreaks in Indonesia is also supported by data on microbial contamination in processed foods based on research by Tjampakasari C, et al. (2021), which showed that 19.11% of tested processed food samples did not meet the maximum microbial contamination standards set by the Indonesian Food and Drug Supervisory Agency (BPOM) Regulation No. 13 of 2019 (Tjampakasari et al, 2021).

Contamination in ready-to-eat processed foods refers to the presence of unwanted or unintended substances in the food. Such contaminants may be biological, chemical, or physical and can interfere with, harm, or endanger consumer health. Contamination in processed foods can originate from the surrounding environment or occur during various stages along the food chain. The most frequently found biological contaminant is E. coli, which can cause a variety of gastrointestinal disorders, ranging from mild to severe diarrhea, including bloody diarrhea, abdominal cramps, nausea, vomiting, and fever (Lorenzo et al, 2017; Cappucino et al, 2019).

Due to the high incidence of food contamination in Indonesia, it is necessary to conduct food safety assessments according to the Regulation of the

Minister of Health of the Republic of Indonesia Number 2 of 2023, in the vicinity of Universitas Indonesia (UI) Station. This assessment is conducted using the Total Plate Count (TPC) method with selective MacConkey agar media on ready-to-eat processed foods sold at several food stalls around UI Station to determine the safety and compliance of the foods offered (CDC, 2022; CDC, 2023).

THEORETICAL REVIEW

Previous studies have reported that ready-to-eat foods sold by street vendors are vulnerable to microbial contamination due to inadequate sanitation, improper food handling, and environmental exposure. Research conducted by Tambekar et al. (2011) found that several street-vended foods were contaminated with Escherichia coli, indicating poor hygiene practices during food preparation. Similarly, studies in Southeast Asia have shown that ready-to-eat foods sold in public areas such as transportation hubs and campuses often contain microbial contaminants, particularly coliform bacteria that originate from fecal contamination.

In Indonesia, several studies have also reported the presence of E. coli in street foods and ready-to-eat meals sold in traditional markets and roadside stalls. These findings suggest that contamination can occur during processing, storage, or serving stages, especially when food handlers do not follow proper sanitation procedures. Therefore, monitoring microbial contamination in ready-to-eat foods is essential to ensure food safety and protect public health.

Based on these previous findings, assessing the presence of E. coli in ready-to-eat foods sold near busy public locations such as university stations becomes important. Such studies can provide scientific evidence regarding the microbiological safety of foods consumed daily by students and the surrounding community.

METHODOLOGY

Microbiological Testing

The microbiological analysis employed was a quantitative method, specifically the Total Plate Count (TPC) using selective MacConkey Agar media. The sampling technique used was convenience sampling, selecting five popular types of processed foods: capcay, omelette, soy sauce–seasoned chicken, Mustofa potatoes, and stir-fried water spinach from three different food stalls. Capcay and omelette were obtained from Food Stall A, soy sauce–seasoned chicken and Mustofa potatoes from Food Stall B, and stir-fried water spinach from Food Stall C, all located around Universitas Indonesia Station. This study has received ethical approval from the Faculty of Medicine, Universitas Indonesia, with the approval letter number KET-1275/UN2.F1/ETIK/PPM.00.02/2020.

Total Plate Count (TPC) Procedure

For each food sample, 25 g was weighed and homogenized in 225 mL of Buffered Peptone Water (BPW) (Oxoid) using a blender (Iso Lab) at 12,000–14,000 rpm for 1–2 minutes. The homogenate was then subjected to serial tenfold dilutions using Tryptic Soy Broth (TSB) (Oxoid) as the diluent. From each dilution, 1 mL was plated onto sterile Petri dishes in duplicate. Subsequently, 20

mL of molten MacConkey Agar (Oxoid) was poured into each Petri dish and homogenized by gently swirling the dishes left and right. After solidification, the plates were incubated at 37°C for 24 hours. The resulting colonies were then counted using a colony counter. (Nelson et al, 2019).

RESEARCH RESULTS AND DISCUSSION

The TPC analysis using MacConkey agar showed that no bacterial growth was observed in all dilutions, ranging from 10^{-1} to 10^{-10}, in duplicate, as presented in Table 1.

Table 1. TPC Results of Ready-to-Eat Processed Food Samples

Dilution factor	Number of Colony				
	Capcay	Omelette	Soy sauce–seasoned chicken	Mustofa potatoes	Stir-fried water spinach
10^{-1}	0	0	0	0	0
	0	0	0	0	0
10^{-2}	0	0	0	0	0
	0	0	0	0	0
10^{-3}	0	0	0	0	0
	0	0	0	0	0
10^{-4}	0	0	0	0	0
	0	0	0	0	0
10^{-5}	0	0	0	0	0
	0	0	0	0	0
10^{-6}	0	0	0	0	0
	0	0	0	0	0
10^{-7}	0	0	0	0	0
	0	0	0	0	0
10^{-8}	0	0	0	0	0
	0	0	0	0	0
10^{-9}	0	0	0	0	0
	0	0	0	0	0
10^{-10}	0	0	0	0	0
	0	0	0	0	0

The comparison of TPC results with the standards outlined in Minister of Health Regulation No. 2 of 2023 regarding biological parameters in the Environmental Health Quality Standards for Ready-to-Eat Processed Food can be seen in Table 2. In this regulation, E. coli contamination is established as the standard.

Table 2. Comparison of TPC Results with Minister of Health Regulation No. 2 of 2023 Standards

Food Sample	TPC (CFU/gram)	Acceptable Limit of *E. coli* (CFU/gram)
Capcay	0	< 1,1
Omelette	0	< 1,1
Soy sauce–seasoned chicken	0	< 1,1
Mustofa potatoes	0	< 1,1
Stir-fried water spinach	0	< 1,1

TPC is a test used to determine the number of microorganisms based on the colonies that grow on the media. In this study, MacConkey agar was used to observe the growth of E. coli colonies according to the criteria of Minister of Health Regulation No. 2 of 2023. (Pegues et al, 2019).

MacConkey agar is a selective and differential medium. Certain types of microorganisms will form colonies with characteristic appearances when grown on this medium. The main components of this medium are lactose, bile salts, and neutral red as a color indicator. The medium inhibits the growth of Gram-positive bacteria due to bile salts, which interact with crystal violet. Gram-negative bacteria that grow can be differentiated based on their ability to ferment lactose. Bacteria that ferment lactose produce red colonies, often surrounded by bile salt precipitation. This precipitation results from the breakdown of lactose into acids, which react with the bile salts. (Permenkes RI, 2023).

Bacteria that do not ferment lactose are generally pathogenic. These bacteria do not cause any change in the medium, meaning that the colony color is the same as that of the medium. The colony color can be observed in isolated colonies. The growth of E. coli on MacConkey agar appears as red colonies surrounded by a turbid zone (Chauhan, 2020).

In general, TPC is not directly related to food safety hazards; however, this test can indicate the quality, shelf life, contamination, and hygienic status of the tested processed food. The maximum permissible limit of E. coli contamination in ready-to-eat processed foods is < 1.1 CFU/g. All tested food samples showed no bacterial growth from dilutions 10^{-1} to 10^{-10} on both media in duplicate.

The key parameter tested in all processed food samples was E. coli. This bacterium can originate from human and animal feces, which, if present in water, can contaminate food or beverages prepared using that water. The absence of E. coli in all tested samples indicates that the water sources used by the food stall

vendors were free from E. coli contamination. These results are highly favorable compared to the study by Yulistiani et al. (2023) at a culinary center in Surabaya, where 8 out of 12 food samples tested positive for E. coli exceeding the maximum allowable limit (Maturin et al, 2021).

These findings indicate that the tested processed food samples have good quality, shelf life, and hygienic status, categorizing them as safe for consumption.

From the perspective of microbiological contamination factors, potential sources of contamination can include soil and/or water adhering to raw ingredients that are not thoroughly washed, unclean utensils used during preparation and serving, cross-contamination from spoons used for multiple dishes, and vendors not maintaining proper personal hygiene, such as handwashing. According to Anggreni et al. (2023), unwashed processed ingredients have higher TPC values than washed ones. The study also found that the best method for washing ingredients is using running water.

These results can also be influenced by the hygienic practices of the food stalls where the processed foods are prepared, handled, and sold. According to the Regulation of the Minister of Health of the Republic of Indonesia No. 1096 of 2011 concerning Food Service Hygiene, food stalls are categorized as A1 or A2: A1 refers to food service using household kitchens managed by families, while A2 refers to those employing staff to prepare meals for the public (Permenkes RI, 2011).

In this study, Food Stalls A and C fall under the A1 category, whereas Food Stall B falls under the A2 category. Key points related to biological food contamination that vendors must pay attention to include: sanitation facilities, selection of ingredients, storage of raw materials, food preparation, storage of cooked foods, food transportation, and food serving practices.

CONCLUSIONS AND RECOMMENDATION

All tested ready-to-eat processed food samples, including capcay, omelette, soy sauce–seasoned chicken, Mustofa potatoes, and stir-fried water spinach, obtained from three different food stalls around Universitas Indonesia Station, met the established standards and are therefore deemed safe for consumption.

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