



Food and Water Safety Surveillance at Galala Port in Ambon, Indonesia: An Investigation Study

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ABSTRACT

The port is a place for ships as sea transportation to dock. The port, as a place of entry and exit for goods or passengers from various regions, places, and environments, encourages the potential for disease transmission to a new environment. Pathogens present in the environment can directly contact the human body through air, touch, and transmission through food around areas with high mobilization. Therefore, this study aims to look at the results of hygiene observations and laboratory testing related to food, drinking water, and air samples at Galala Port, Ambon City. This study used descriptive research with a cross-sectional research design. From all parameter examination results, several examination results do not meet the standards such as food microbiology examination results (*E. coli* bacteria > 3.6MPN/gr), sanitation (walls and floors are not watertight), the presence of mosquito larvae (seven *Aedes albopictus* mosquito larvae), drinking water microbiology (total Coliforms 64 CFU.100 mL⁻¹), and clean water microbiology (*E. coli* > 250 CFU. 100 mL⁻¹ and total Coliforms 8 CFU.100 mL⁻¹). Therefore, it can be concluded that the inspection of restaurants carried out at Galala port, Ambon City, is not appropriate and does not meet the standards according to the Minister of Health Decree number 942 of 2003.

INTRODUCTION

Food is a basic human need that contains nutrients and essential substances that are good for the growth, repair, and maintenance of body tissues and play a role in regulating vital body processes (Munteanu & Schwartz 2022). Although the body needs food to fulfill the body's nutrients, excessive food consumption or a poor diet is a problem (Gao et al. 2021). Poor food hygiene is a current public health concern (Food and Agriculture Organization of the United Nations 2019).

Globally, there are 420,000 deaths and 600 million cases of foodborne illness each year. Children under the age of five account for 30% of foodborne deaths (World Health Organization, 2024). Meanwhile, excess foodborne disease is contributed by the world's number one disease, cardiovascular disease, with 17.9 million deaths annually, with 85% caused by heart attacks and strokes (World Health Organization 2021). In the Asia-Pacific region, more than 275 million cases of food poisoning are reported per year (Nations 2019). Cardiovascular cases in Asia cause 10.8 million deaths, or about 35% of total deaths in Asia (Zhao 2021).

In 2020, The Indonesian Food and Drug Authority reported there were 45 outbreaks with 3,276 people exposed, so 1,528 of them were sick, and 6 people were declared dead. In Indonesia, cardiovascular disease is dominated by 34.1% hypertension, 10.9 per mile incidence of stroke, 1.5% coronary heart disease, and 0.38% chronic kidney failure (Ministry of Health 2021).

Public transportation is an environment that people visit daily, which affects the level of density and contact between passengers, which can affect the increase and transmission of disease or health problems (Goscé & Johansson 2018). Over the years, there has been an increase in the number of international travelers, more international refugees and migrants, shipping capacity by sea, and a greater volume of international air travel passengers (Findlater & Bogoch 2018). Mobility and length of stay at the destination, as well as spatially controlled mobility of individuals, affect the dynamics of an epidemic (Espinoza et al. 2020).

Load distribution and increased tissue density contribute to the spread of epidemics. Increased global mobility of people, non-human animals, plants, and products drives the introduction of infectious diseases to new locations. Many factors contribute to the global spread of infectious diseases, including the increased speed and range of human mobility, increased volumes of trade and tourism, and changes in the geographic distribution of disease vectors (Yang et al. 2017). Therefore, this study aims to look at the results of hygiene observations and laboratory testing related to food, drinking water, and air samples at Galala Port, Ambon City, Indonesia.

MATERIALS AND METHODS

This study uses descriptive research which aims to the

results of laboratory examination of food samples, drinking water samples, and clean water samples at Galala Port. The research design uses a longitudinal design using primary and secondary data sources. Data collection using the *grab sampling* technique was conducted in 2024 at the entrance of Galala Ambon Port, Maluku Province, Indonesia. This study took 50 human samples and food samples taken at eating places around the port entrance. Food and water samples were tested with the identification of physical, chemical, and biological parameters conducted by the Technical Center for Environmental Health and Disease Control (BTKLPP) of Ambon City. Data analysis was done descriptively to describe the test results.

RESULTS AND DISCUSSION

Table 1 shows the chemical test results of food samples at X restaurant were not found to contain harmful additives with negative results, so it was declared safe according to the National Food and Drug Testing Development Center of the Republic of Indonesia, number 07/MM/2000. The use, restriction, and prohibition of Food Additives (BTP) have been regulated in Minister of Health Regulation No. 033 of 2012 and No. 239/Menkes/Per/V/1985 regarding food additives and prohibition of hazardous BTP (Pandey & Upadhyay 2012).

The ban on the use of Borax, Formalin, Rhodamin B, and Methail Yellow in food is due to the effects of the substances themselves on the body. Borax, Formalin, Rhodamin B, and Methail Yellow have toxic properties that cause body disorders such as throat burning, irritation, headaches and nausea, decreased immunity, hormonal imbalances, premature birth, concentration or cognitive impairment, psychological disorders, while long-term effects (chronic/

Table 1: Results of chemical examination of food samples of the restaurant X at Galala Harbor in Ambon City, Year 2024.

Food Name	Test Sample No.	Unit	Inspection Result				Description
			Borax	Formalin	Rhodamine B	Methai l Yellow	
Restaurant X							
1). Yellow Noodles	K.237	/25mg	Negative	Negative	Negative	Negative	Eligible
2). White Rice	K.238	/25mg	Negative	Negative	Negative	Negative	Eligible
3). Meatball frontman	K.239	/25mg	Negative	Negative	Negative	Negative	Eligible

Table 2: Results of microbiological examination of food samples restaurant X at Galala Port Ambon City, Year 2024.

No.	Food Name	Test Sample No.	Unit	Restaurant "X"		Description
				Total Coliform	<i>E. coli</i> / Limit Condition <3.6MPN.g ⁻¹	
1	Yellow Noodles	B.211	MPN.g ⁻¹	Negative	14	<i>E.coli</i> not eligible
2	White Rice	B.212	MPN.g ⁻¹	Negative	350	<i>E.coli</i> not eligible
3	Meatball frontman	B.213	MPN.g ⁻¹	Negative	<1.3	not eligible

accumulative) are caused such as respiratory system disorders, kidney and liver disorders, reproductive system disorders, nervous system disorders, other chronic diseases, cancer, and death (Sujarwo et al. 2020, Hadrup et al. 2021, Agency for Toxic Substances and Disease Registry 2014, Ghosh et al. 2017, Ridha et al. 2023).

From the results of the samples that were subjected to microbiological examination, only the meatball sample met the criteria for food that is safe for consumption according to Minister of Health Regulation RI No. 2 of 2023 concerning Regulations for the Implementation of Government Regulation No. 66 of 2014 concerning Environmental Health (Hukum Online 2023). Meanwhile, the samples of yellow noodles and white rice did not meet the requirements because they were found to contain *E. coli*.

The discovery of *E. coli* in food at Restaurant “X” that exceeds the threshold limit can increase the *E. coli* pathogenic

strains in the body. These pathogens are associated with intestinal problems that cause generalized diarrhea to bloody diarrhea (*Hemorrhagic Colitis*), urinary tract infections due to contamination of other organs, and death. Despite treatment with antibiotics, *E. coli* leaves behind a higher toxin load when the bacteria die. (National 2017, Daneman et al. 2023, Mueller & Tainter 2024). The two samples containing *E. coli* in Table 2 are considered unfit for consumption, so there needs to be attention from Restaurant owners and vigilance from the community towards food hygiene. This is important to do to avoid the onset of disease for port visitors, especially people who want to use ship transportation.

The results of the sanitation inspection at “X” restaurant (Table 3) found that the restaurant service did not wear work clothes, and the walls of the dining room and the floor were not watertight, so it was stated that “X” restaurant did not meet the requirements of Hygiene Sanitation of Eateries and Restaurants as stated in KepMenKes No.942 of 2003

Table 3: Sanitation inspection results of Restaurant X in Galala Port Ambon Year 2024.

Variable	Inspection Result Sanitation	Description
1	2	3
Food Service		
Personal Hygiene	Eligible	
Health Of The Handler In The Last 1 Month	Healthy	
Wear Work Clothes While Working	No	Not Workwear
Finished Food Storage		
Clean	Yes	
Food Containers Used	Eligible	
Enclosed/Protected From Dust/Insects/Other Disturbances	Yes	The Storage Area Does Not Allow Food To Be Polluted/Contaminated
Cutlery/Drinking Utensil Requirements		
Glass/Spoon/Fork Cleanliness	Eligible	
Storage Method	Eligible	
Dining Table Is Always Clean	Yes	
Dining Room Sanitation		
Waterproof Floor	No	
Waterproof Wall	No	Still Using The Board
Cleanliness Of The Skies	Not Eligible	
Adequate Room Ventilation	Not Eligible	
Porcelain Handwashing Station	Not Eligible	
Lighting Is Sufficient	Eligible	
Always Maintain General Hygiene	Eligible	
Storage Requirements		
Food Ingredients		
Between One Type Of Foodstuff Stored Separately	Yes	
Made Of Strong And Clean Materials	Yes	
Clean Water Needs Are Sufficient	Yes	

Table 4: Results of *Aedes albopictus* mosquito inspection in broken speedboats at Galala Harbor in Ambon City 2024.

No.	Container Type	Flick Check		Total
		Positive	Negative	
1	In Broken Speed	7	0	7

(Kementerian Kesehatan Republik Indonesia 2021).

The use of clean work clothes only on duty is one of the protocols for food handlers as well as controlling food-borne diseases so that there is no contamination from the outside environment when guests travel from their place of residence to the work environment (Hasriani & Zulfan 2022). Watertight wall criteria are needed to withstand wind and rainwater and protect the area inside the restaurant and the processed food inside from being damaged by direct sun exposure and dust from the outside environment. Impermeable floors are associated with moisture, when floors become damp, there is potential for bacterial growth in a building (Keman 2007).

Table 4 shows positive results with the presence of 7 *Aedes albopictus* mosquito larvae in the Broken *Speedboat*. Just like *A. aegypti*, *A. albopictus* can transmit all four serotypes of dengue virus, yellow fever virus, chikungunya virus, and Zika virus and is suspected to have the potential for *Venezuelan Equine Encephalitis virus* (Lwande et al. 2020)

Females *Aedes* lay eggs in domestic or natural water reservoirs and disperse their eggs in two or more places. The breeding and distribution of *Aedes* larvae is influenced by the size of the container, the use of the container or the water in the container, the water temperature, the water source (especially the pH of the water), and the location of the container (Waewwab et al. 2019, Firmansyah et al. 2024). The use of an environment also influences the distribution of *Aedes* mosquitoes across different landscapes, including urban, suburban, rural, forest, and agricultural areas (Rahman et al. 2021, Vannavong et al. 2017). The port is one of the

places where the import of goods or the entry and exit of people between districts, provinces, and even countries. The spread of *A. albopictus* is a more frequent spread on local transportation departures compared to *A. aegypti* (Irayanti et al. 2022). This local outbreak usually occurs within 5-15 years after the infestation of *A. albopictus* (Kraemer et al. 2019).

To prevent introductions, countries should strengthen entomological surveillance, particularly around high-risk introduction routes such as ports and highways, and develop rapid response protocols for vector control to prevent introduced mosquitoes from establishing permanent populations (European Centre for Disease Prevention and Control 2017, Ridha et al. 2023, McGregor & Connelly 2021, Cahyanti et al. 2024).

Examination of physical and chemical parameters of drinking water taken in kettles Restaurant "X" (Table 5) obtained that the restaurant has met the requirements of drinking water quality standards attached in Minister of Health Regulation number 492/MENKES/PER/IV/2010 regarding standardization of drinking water quality (Permenkes 2010) with the highest lab result on *Total Dissolved Solid* (TDS) 45.4 mg.L⁻¹. TDS can come from the place where drinking water sources are taken, exposure from the environment, and places used to store water (Wang 2021). Drinking water should be tasteless and should not contain ions such as calcium, magnesium, potassium, sodium, and other ions. The nitrite parameter showed a result of 0.8018 with a maximum level of 20 mg.L⁻¹. High nitrite in drinking water can cause health problems due to heavy metal consumption and poisoning (Moreno et al. 2020, Nowicki et al. 2020).

Drinking water that goes through the heating process in kettles and pipes triggers the formation of calcium, magnesium, and nitrate ions. These substances have the potential to form N-nitroso compounds (NOCs) that pose a non-carcinogenic threat. Indirect contamination of drinking water can continue to occur if the host is unable to provide the necessary components

Table 5: Results of examination of physical and chemical parameters of drinking water from kettles at restaurant X Port Galala Ambon City, Year 2024.

No.	Parameters	Unit	Max Allowable Level	Laboratory Test Results	Description
				K.241	
A.	PHYSICAL				
1	Color	NTU	10	Not Detected	Eligible
1	Turbidity	NTU	5	0,48	Eligible
2	Smell	-	Odorless	Odorless	Eligible
4	Temperature	°C	-	30,4	Eligible
5	TDS	mg.L ⁻¹	500	45,4	Eligible
B.	CHEMICAL				
1	Nitrite (as NO ₂)	mg.L ⁻¹	20	0,8018	Eligible

Table 6: Results of biological parameter examination of drinking water taken in kettles at RM. “X” Port Galala, Year 2024.

No.	Microbiological Parameters	Unit	Limit Terms	Laboratory Test Results	Description
				B.0214	
1	<i>E.coli</i>	CFU.100 mL ⁻¹	0	0	Eligible
2	Total <i>Coliforms</i>	CFU.100 mL ⁻¹	0	64	Not Eligible

for water treatment and measures to prevent it (Muryanto et al. 2014, Shoukat et al. 2020, Ward et al. 2018, Dippong et al. 2019).

Examination of the biological parameters of drinking water taken from kettles (Table 6) obtained unqualified results with Total Coliform 64 CFU.100 mL⁻¹. The excess microbiological standards of drinking water are in accordance with those stipulated in Minister of Health Regulation number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitary Hygiene Purposes, Swimming Pools, Solus perAgua and Public Baths (Permenkes 2017).

Coliform bacteria are bacteria found in the human environment and feces of warm-blooded animals that should not be found in food (Hammad et al. 2022). The presence of coliforms in drinking water indicates the presence of disease-causing organisms (pathogens) in the water system. Coliforms in the water supply may indicate the ineffectiveness of the water treatment system as well as contamination included in the water supply distribution

system and corresponding quality reports (Martin et al. 2016). The presence of coliforms, expressed in concentration, is an indicator to determine the contamination of drinking water (Bahagian 2019). Typically, health symptoms associated with contaminated drinking water range from no ill effects to diarrhea (indigestion) (Martin et al. 2016).

Clean water in “X” restaurants (Table 7) is declared not to meet the criteria for clean water quality standards by the Sanitation Minister of Health Regulation number 32 of 2017 (Permenkes 2017), as evidenced by the results of TDS 511.6 mg. L⁻¹.

TDS, which is total solids, refers to the residual material left in storage. Increasing TDS concentrations in clean water cause scaling and corrosion of cooling water and boilers, thereby limiting water functions for drinking, power generation, industrial cooling, supporting biodiversity, ecosystem services, recreation, transportation routes, waste disposal, agricultural production, irrigation, energy production, regional planning, and fish farming, resulting in significant economic losses (Dey & Vijay 2021, Dörnhöfer &

Table 7: Results of examination of physical and chemical parameters of clean water taken in containment (bucket) at RM. “X” Port Galala, Year 2024.

No.	Parameters	Unit	Max. Allowable Level	Laboratory Test Results	Description
				K.240	
A. PHYSICAL					
1	Color	TCU	10	Not Detected	Eligible
2	Turbidity	NTU	5	0.43	Eligible
3	Smell	-	Odorless	Odorless	Eligible
4	Temperature	°C	-	30.4	Eligible
5	TDS	mg.L ⁻¹	300	511>6	Eligible
B. CHEMICAL					
1	Nitrite (as NO ₂)	mg.L ⁻¹	20	17.0902	Eligible

Table 8: Results of examination of physical and chemical parameters of drinking water taken in containment (bucket) at RM. “X” Port Galala, Year 2024.

No.	Parameters	Unit	Max Allowable Level	Laboratory Test Results	Description
				K.240	
B. CHEMICAL					
1	Dissolved Iron (Fe)	mg.L ⁻¹	0.2	< 0,0322	Eligible
2	Nitrite (as NO ₂)	mg.L ⁻¹	0,2	0,0017	Eligible
3	pH	-	6,5-8,5	7,12	Eligible
4	Dissolved Manganese (Mn)	mg.L ⁻¹	0,1	< 0,0325	Eligible

Table 9: Results of microbiological parameter examination of clean water taken in containment (bucket) at restaurant X, Port Galala, Year 2024.

No.	Microbiological Parameters	Unit	Limit Terms	Laboratory Test Results	Description
				B.0215	
1	<i>E. coli</i>	CFU.100 mL ⁻¹	0	>250	Not Eligible
2	Total Coliform	CFU.100 mL ⁻¹	0	8	Not Eligible

Oppelt 2016, Cheng et al. 2022, Dube et al. 2015, Giao et al. 2021, Ismail et al. 2019). Swimming and boating in impaired waters can also lead to respiratory and gastrointestinal illnesses (Adjovu et al. 2023).

The results of the examination of physical and chemical parameters of drinking water in “X” Restaurant taken from buckets (Table 8) have met the drinking water safety requirements in accordance with Minister of Health Regulation number 492/MENKES/PER/IV/ of 2010 concerning Drinking Water Quality requirements (Permenkes 2010).

All parameters of the microbiological examination of clean water taken from the Restaurant “X” (Table 9) bucket did not meet the requirements of the clean water criteria listed in Minister of Health Regulation number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitary Hygiene Purposes, Swimming Pools, Solus per Aqua and Public Baths. (Permenkes 2017) with *E. coli* >250 CFU.100 mL⁻¹ and Total Coliform 8 CFU.100 mL⁻¹.

Clean water has a variety of uses in food production, for cleaning, sanitation, and manufacturing purposes. Clean water is used for various activities in the food industry, such as for growing, unloading, fluming, washing, salting, ice making, and in sanitation and hygiene programs (Mahaza et al. 2025). Poor water quality has a detrimental impact on processed food through the pathogenic growth of bacteria, viruses, and microorganisms that produce toxic substances and contaminate water that can cause harm to consumers (Bhagwat 2019, Senami 2021, World Health Organization 2019).

Clean water contaminates food through water-borne microorganisms (Golic et al. 2023). Microorganisms then colonize and multiply on food or equipment used in the processing process, especially during washing. Microorganisms can survive for years to adapt to environmental conditions and leave toxic substances after cleaning (Badan Standarisasi Nasional 2017).

CONCLUSIONS

Hygiene observations and laboratory testing of food, drinking water, and air samples at Galala Harbour, Ambon City. Observations showed that chemical examination of food samples of the Restaurant. Microbiological Examination

of Food Samples found that only the meatball pentolan sample met the criteria for safe food consumption according to Minister of Health Regulation Republic of Indonesia number 2 of 2023, while the other 2 samples found *E.coli* that exceeded the threshold, which could increase the pathogenic strain of *E.coli* in the body. Examination of the biological parameters of drinking water taken from the kettle gave unqualified results with Total *Coliform* 64 CFU.100 mL⁻¹. The results of the examination of the physical and chemical parameters of clean water taken in the shelter (bucket) are stated to have not met the criteria for clean water quality standards as sanitation Minister of Health Regulation number 32 of 2017 as evidenced by the TDS result of 511.6 mg.L⁻¹. TDS, which is total solids, refers to the remaining material left in the storage area. Drinking water samples were taken from the reservoir in the restaurant kettle. Drinking water passing through the heating process in the kettle and pipes can trigger the formation of calcium, magnesium, and nitrate ions.

Hygiene observations were also made at the site, and 7 *Aedes albopictus* mosquito larvae were found in the Broken Speedboat. Females *Aedes* lay eggs in domestic or natural water reservoirs and spread their eggs in two or even more places. *Albopictus* was found more in local transport departures than *Ae.* This study also highlighted the disease found from Galala Port activities in Ambon City, with many risk factors that can occur.

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