

Outbreak Investigation of Scombroid Fish Poisoning in Pandak Sub-district, Bantul Regency, 2024

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Abstract

On May 29th, 2024, Bantul District Health Office received information about a suspected food poisoning in Pandak Sub-district after consuming mackerel fish. The report stated that the patients experienced headache, chest palpitations, vomiting, rash or skin redness, flushing, diarrhea and dizziness. This investigation aims to confirm the outbreak, evaluate the risk factors, and recommend preventive measures. We conducted an active case finding to find additional cases. Cases were defined as persons who consumed mackerel fish sourced from a distributor in Piring Hamlet on May 27-28th, 2024 and have one or more symptoms of headache, nausea, chest palpitations, vomiting, burning sensation around mouth or head, rash or skin redness, flushing, diarrhea and dizziness. Data was collected by interview using a structured questionnaire and environmental observation. We also carried out a laboratory test of raw and fried mackerel. Data were analyzed descriptively. There were 48 people who were interviewed and found 11 cases with 2 of them being hospitalized. The main symptoms were dizziness (81.8%), headache (72.2%) and chest palpitations (63.6%). Incubation period was 5-120 minutes with average at 47 minutes. The highest attack rate was found in males (26.09%), those aged 19-64 years (27.78%), and those living in Kauman and Triharjo Village (50%). According to the laboratory test result, histamine was the cause of this outbreak with results of 3633.87mg/kg found in fried mackerel and 163.27 mg/kg in raw mackerel. Improper food storage during the distribution from distributor to community level reseller was the risk factor that caused histamine poisoning. There was a scombroid poisoning outbreak in Pandak Sub-district on May 29th, 2024 caused by contaminated mackerel fish that produce histamine. Improper food storage during distribution of fish was the main risk factor. We recommend DHO to give health promotion to ensure proper handling, storage, distribution and processing the mackerel.

Keywords: Outbreak; Investigation; Poisoning

Introduction

Billions of people around the world face the risk of unsafe food, millions get sick and hundreds of thousands die every year due to unsafe food (Fung et al., 2018). Without food safety, we cannot have food security and achieve sustainable development goals (King et al., 2017).

Food poisoning occurs when an individual develops symptoms of illness or toxicity after consuming food contaminated with biological or chemical agents (Permenkes RI No. 2 Tahun 2013). A food poisoning

outbreak, classified as a Public Health Emergency, is defined as an incident in which two or more individuals exhibit symptoms of poisoning or illness following the consumption of a common contaminated food source, as determined by epidemiological analysis (Permenkes RI No. 86 Tahun 2019).

One of the causes of food poisoning that often occurs is histamine poisoning. Improper processing when consuming fish causes histamine or scombroid poisoning (Hungerford, 2021). Scombroid poisoning is an acute histamine intoxication resulting from the intestinal absorption of large amounts of histamine, typically beginning 1-2 hours after the consumption of contaminated fish. It mimics an allergic reaction, characterized by an erythematous urticarial rash that primarily affects the face and upper body, causing redness (Zapata et al., 2021). Actually, histamine is present in the human body but when consuming fish stored with improper refrigeration, poisoning can occur in the body (Feng et al., 2016; Smolinska et al., 2014).

On Tuesday, May 28, 2024, Pandak 1 Public Health Center received reports of a suspected food poisoning incident involving four patients, two of them required hospitalization. The symptoms included dizziness, headache, chest palpitations, vomiting, a burning sensation in the head, and redness of the hands and face. The initial suspicion was that the outbreak was linked to the consumption of rice and tuna. The suspected food poisoning occurred in Kadekrowo Hamlet RT 02, Gilangharjo, Pandak Subdistrict, Bantul Regency. According to affected residents, the mackerel was sourced from a reseller who obtained the fish from a seafood distributor in Dusun Piring RT 1, Sanden Subdistrict, Bantul.

The Rapid Response Team (RRT) of Pandak 1 Public Health Center confirmed the outbreak on May 28, 2024, collected initial data, and secured samples of raw and fried tuna suspected to be the source of the food poisoning for laboratory analysis. On May 29, 2024, Pandak 1 Public Health Center reported the suspected food poisoning case to the Bantul Health Office. Following this report, the TGC of Pandak 1 Public Health Center, in collaboration with Sanden Public Health Center and the FETP UGM team, conducted an Epidemiological Investigation from May 30 to June 1, 2024. This investigation included interviews with respondents from at-risk populations, as well as with distributors and some resellers.

The epidemiological investigation provided data on symptoms, the food menu, and the incubation period, leading to a preliminary conclusion that the food poisoning was likely due to histamine. The outbreak investigation aimed to confirm the outbreak, assess risk factors, and recommend preventive measures in Bantul District, Yogyakarta, Indonesia.

Methods

This study was conducted a descriptive research design. Cases were defined as people who consumed mackerel fish sourced from a distributor in Piring Hamlet on May 27-28th, 2024 and have one or more symptoms of headache, nausea, chest palpitations, vomiting, burning sensation around mouth or head, rash or skin redness, diarrhea and dizziness. Active case detection was conducted to find additional cases. Those who fulfilled the case definition were interviewed using structured questionnaires.

Environmental assessments were also conducted by visiting the food preparation sites and interviewing the food handlers. Laboratory analysis was performed on the remaining food samples, including fried and raw mackerel to test for histamine level, which were sent to Saraswanti Laboratory in Bogor on Thursday, May 30, 2024.

The data collected in this investigation included demographic information, the symptoms experienced, incubation periods, the types of food consumed, methods of processing mackerel, and the distribution chain of mackerel from the producer to the consumer.

All data collected was analyzed using Microsoft Excel. A descriptive analysis was conducted using table, frequency and graph to assess the distribution of cases by person, place, and time. The analysis also included the distribution of symptoms and the timing of onset, which were visualized using histograms at 2-hour intervals. Additionally, the attack rate ratio (ARR) was calculated to quantify the increased risk of illness in the exposed group compared to the unexposed group.

Results

Epidemiologic Investigation

On Tuesday, May 28, 2024, Pandak Public Health Center reported a suspected food poisoning with 4 patients having similar symptoms and two of them were hospitalized. The suspected food poisoning chronology was as follows:

1. On Sunday, May 26, 2024, a fish distributor (Mrs. F) in Piring 2 Hamlet, Sanden, Bantul Regency bought 60 kilograms of mackerel from fishermen in Wonosari, Gunung Kidul. The fish was delivered using a pick-up truck and stored in a styrofoam box. At 23.00, the mackerel arrived at the distributor's location and immediately moved into her styrofoam box.
2. On Monday, May 27 2024, Mrs. F promoted the mackerel through WhatsApp and Facebook. In addition, fish sales were also made through several resellers. The mackerel delivered to the resellers and individual buyers started at 05.30. There were 3 resellers who bought the mackerel >10 kilograms, they were Mrs. M, Mrs. K and Mrs. T. They bought the mackerel from the distributor on a different day with the following descriptions:
 - a. Mrs. M bought 15kg of mackerel on Monday at 05.30 and distributed it to a restaurant.
 - b. Mrs. K bought 10kg of mackerel on Monday at 05.30 and sold it door-to-door.
 - c. Mrs. T bought 14 kg of mackerel on Tuesday at 20.45 (after work) and distributed it to residents of Kadekrowo Hamlet RT 02, Pandak Sub-district and her colleagues.
 - d. Meanwhile, the others were individual buyers and the last purchase was on Wednesday, May 28 2024.
3. On Tuesday, May 28, 2024, Mrs. T distributed the mackerel right after work to Kadekrowo Hamlet, Pandak Sub-district RT 02 at 21.00. There was one resident who cooked the fish on the same day at 23.00

and then at 23.45 experienced a stomachache. On Wednesday, May 29, 2024, one resident distributed cleaned raw mackerel to several relatives (2 families, 5 people). Each family cooked the mackerel by frying it and about 30 minutes-one hour after eating the mackerel, they experienced symptoms such as headache, chest palpitations, nausea, vomiting, burning sensation around mouth or head, hands and face flushing, and dizziness.

The distribution of mackerel from distributors to consumers is depicted in the chart below:



Figure 1. The Distribution of Mackerel from Distributor to Consumers

4. On May, 29 – June 1, 2024 Pandak 1 Public Health Center, in collaboration with Sanden Public Health Center and the FETP UGM team, conducted an Epidemiological Investigation with the results of a total of 9 people were outpatients, and 2 people were hospitalized (1 person with comorbid chronic kidney disease). The cases of headache, chest palpitations, nausea, vomiting, a burning sensation around the mouth or head, rash or skin redness, and dizziness occurred among several residents in Kadekrowo Hamlet RT 02, Gilangharjo, Pandak Sub-district, Bantul Regency on May 28-29, 2024, indicating an outbreak of food poisoning. Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2013 concerning Outbreaks of Food Poisoning, this incident meets the criteria for

an outbreak because more than 2 people experienced the similar symptoms after consuming the same food.

Descriptive Result

Table 1. Distribution of Cases by Sex and Age Group

Variable	Population at Risk	Ill	Not Ill	Attack Rate (%)
Sex				
Male	23	6	17	26.09
Female	25	5	20	20.00
Age Group				
0-19	13	1	12	7.69
20-39	12	4	8	33.33
40-59	17	5	12	29.41
>60	6	1	5	16.67

Based on Table 1, the highest attack rate for food poisoning cases in Pandak Hamlet was observed among males, with 6 cases (26.09%). The highest attack rate based on age was found in the 20-39 years age group with 4 cases (27.78%).

The distribution of clinical symptoms felt by food poisoning cases is described as follows:

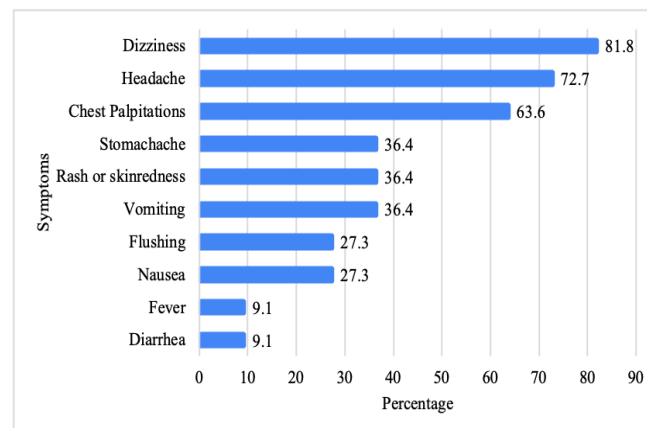


Figure 2. Distribution of Cases by Symptoms

From the Figure 2 above, it was found that the most common clinical symptoms reported were dizziness (81.8%), headache (72.7%), and chest palpitations (63.6%).

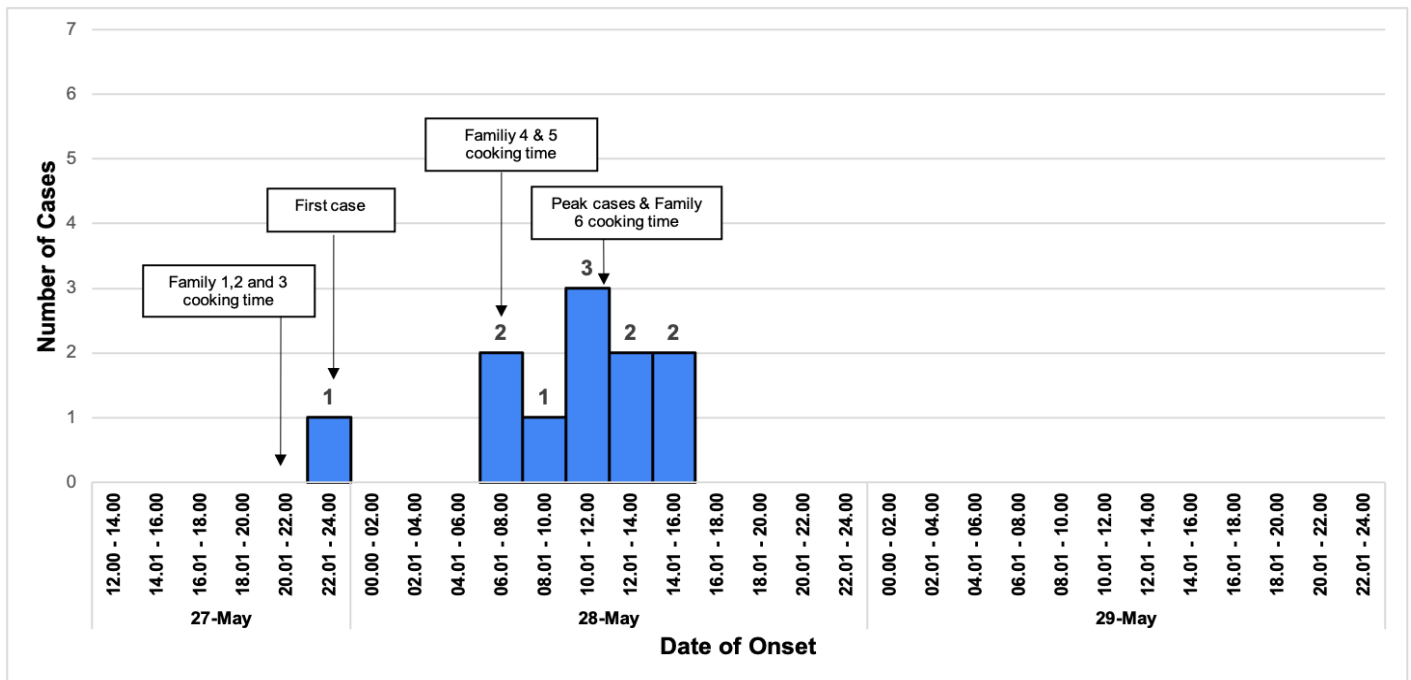


Figure 3. The Epidemic Curve of Scombroid Food Poisoning in Pandak Sub-district, Bantul Regency, 2024

The epidemic curve indicates a common source outbreak, suggesting that the transmission of the disease likely come from a single source, specifically the mackerel. On Monday, May 27, 2024, around 21:00-22:00 WIB, families 1, 2, and 3 received the mackerel and prepared it for cooking. At approximately 23:00, one family consumed the mackerel and one member began experiencing symptoms within minutes of consumption. On Tuesday, May 28, 2024, families 4 and 5 started cooking around 07:30-08:00 WIB, meanwhile family 6 began cooking at around 11:45 WIB. The timing of mackerel consumption varied among families, occurring between 06:00–07:00, 08:00–10:00, and 11:00–13:00. However, symptoms manifested within 5 to 120 minutes after consumption, with an average incubation period of 47 minutes.

Table 2. Distribution of Cases by Place

Address	Population at Risk	Ill	Attack Rate (%)
Bebekan Kaderowo RT 1	4	0	0
Bebekan Kaderowo RT 2	20	7	35
Gejayan	1	0	0
Karanganyar	6	0	0
Ndebekan RT 2	1	0	0
Pajangan RT 3, Pringgading	2	0	0
Piring 2 RT 1, Sanden	6	0	0
Tambalan RT 1, Kauman	2	1	50
Ciren RT 2 Triharjo, Pandak	6	3	50

A food poisoning outbreak occurred in Kadekrowo Hamlet, Gilangharjo, Pandak Subdistrict, Bantul Regency, following the consumption of a meal containing mackerel. The highest attack rates (AR) were recorded in Tambalan RT 1 and Ciren RT 2 Triharjo, each at 50%, and Bebekan Dusun Kadekrowo RT 2 at 35%.

Table 3. Attack Rate Ratio (ARR) of Scombroid Food Poisoning in Pandak Sub-district, Bantul Regency, 2024

Food	Ate				Did not Eat				Attack Rate Ratio (ARR)
	Ill	Did not ill	Total	AR (%)	Ill	Did not ill	Total	AR (%)	
Rice	9	29	38	23,7	2	8	10	20	1,19
Mackerel	11	25	36	30,6	0	12	12	0	#DIV/0!
Sambal	0	3	3	0	11	34	45	24,5	0
Coconut milk vegetables	1	1	2	50	10	36	46	21,7	2,85
Fried tempe	0	1	1	0	11	36	47	23,4	0
Bacem tofu	0	2	2	0	11	35	46	23,9	0
Fried chicken	0	1	1	0	11	36	47	23,4	0
Urap	0	1	1	0	8	36	47	23,4	0
Fried noodles	0	1	1	0	8	36	47	23,4	0

Based on the epidemiological investigation, no individuals who abstained from eating mackerel developed illness, making it impossible to calculate the ARR. To address this, 1 was added to each cell, yielding the following results:

Table 4. Attack Rate Ratio (ARR) of Scombroid Food Poisoning in Pandak Sub-district, Bantul Regency, 2024

Food	Ate				Did not Eat				Attack Rate Ratio (ARR)
	Ill	Did not ill	Total	AR (%)	Ill	Did not ill	Total	AR (%)	
Rice	10	30	40	25	3	9	12	25	1
Mackerel	12	26	38	31,6	1	13	14	7,1	4,5
Sambal	1	4	5	20	12	35	47	25,5	0,8
Coconut milk vegetables	2	2	4	50	11	37	48	23	2,2
Fried tempe	1	2	3	33,3	12	37	49	24,5	1,4
Bacem tofu	1	3	4	25	12	36	48	25	1
Fried chicken	1	2	3	33,3	12	37	49	24,4	1,4
Urap	1	2	3	33,3	9	37	46	19,6	1,7
Fried noodles	1	2	3	33,3	9	37	46	19,6	1,7

Table 4 shows that the highest attack rate ratio (ARR) is associated with mackerel consumption, followed by coconut milk vegetables. This indicates that individuals who consumed mackerel have a 4.5 times higher risk of illness compared to those who did not consume mackerel. Similarly, those who consumed coconut milk vegetables have a 2.2 times greater risk of becoming ill compared to those who did not consume these vegetables.

Environmental findings

The results of field observations and interviews with handlers were as follows:

a. Food Preparation Methods

The methods of cooking mackerel varied among families. Some families boiled the fish for approximately 15 minutes with bay leaves and salt, while others fried the mackerel directly after seasoning it. Similarly, the cleaning techniques differed; some families only removed the internal organs, while others removed both the head and tail

b. Condition of the Fish

Food handlers procured mackerel from a reseller, who obtained the fish from a distributor located in Piring 2 Hamlet RT 1, Sanden, Bantul Regency. Several food handlers who developed illness reported that the mackerel exhibited suboptimal quality, characterized by a lack of firmness, a tendency to crumble, and a taste deviating from that of fresh fish. Conversely, food handlers who remained asymptomatic described the fish as appearing very fresh, with firm and chewy meat. The distribution of the fish from the distributor to resellers Mrs. T was conducted using plastic bags, with the fish maintained at ambient temperature instead of being refrigerated.

c. Cooking Process

Each food handler processes fish using different methods, as outlined in Table 5 below:

Table 5. The Cooking Process of Mackerel in Food Handlers

Family	Cooking Time	Types of Dishes and Seasonings
Family 1 (2 family members)	21:30 (May, 28)	Deep-fried (garlics, coriander, salt)
Family 2 (6 family members)	21.30 (May, 28)	Deep-fried (garlics, salt, MSG, chili)
Family 3 (4 family members)	21.30 (May, 28)	Kuah pindang (onions, garlics, turmeric, shrimp paste, candlenuts, tomatoes, basil, bay leaves, galangal, sugar, salt, flavoring)
Family 4 (2 family members)	08:00 (May, 29)	Deep-fried (garlics, coriander, salt)
Family 5 (3 family members)	08:00 (May, 29)	Deep-fried (garlics, coriander, turmeric, salt)
Family 6 (3 family members)	11.45	Deep-fried (garlics, coriander, salt)

d. Fish Distribution and Storage

Fish distributors source their seafood directly from boats at Sadeng Beach, Gunung Kidul, including shrimp, mackerel, skipjack, cuttlefish, and ribbonfish. Prior to the food poisoning incident, the mackerel were delivered by fishermen on May 26, 2024, at 22:00 and arrived at the distributor's location at approximately 23:00. The fish were transported in an open pick-up truck and stored in styrofoam containers filled with ice.



Figure 4. Method for Storing Mackerel

Mackerel was stored for a maximum of 3 days by placing it in styrofoam containers with ice cubes. The ice was replaced twice daily—once in the evening around 07:00 and in the morning around 21:00. If any mackerel remains that was unsuitable for sale, indicated by the meat becoming easily crushed and losing its chewiness, the fish was discarded and given to cats. During the food poisoning incident at Kadekrowo Hamlet RT 02, Gilangharjo, Pandak Subdistrict, Bantul Regency, the mackerel supply was depleted on Wednesday, May 29, 2024.

Laboratory investigation

The specimens, including raw and fried tuna samples, were sent to the Saraswanti Laboratory in Bogor on May 30, 2024. The examination results are presented in the following table:

Table 6. Result of Laboratory Test

Specimen	Parameter	Unit	Result	Method
Fried Mackerel	Histamine	mg/kg	3633.87	SNI ISO 19343-2017 (HPLC-PDA)
Raw Mackerel	Histamine	mg/kg	163.27	SNI ISO 19343-2017 (HPLC-PDA)

Laboratory analysis revealed that the histamine content in fried tuna was 3,633.87 mg/kg, while in raw mackerel was 163.27 mg/kg.

Discussion

Descriptive results

Scombroid poisoning affected 11 individuals in Pandak Sub-district, presenting symptoms such as headache, chest palpitations, vomiting, rash or skin redness, flushing, diarrhea and dizziness. Scombroid poisoning is linked to the consumption of histamine-producing fish, including tuna, mackerel, mahi-mahi, and others. The diagnosis of scombroid poisoning was based on the incubation period and the symptoms observed. The investigation revealed an incubation period ranging from as short as 5 minutes to as long as 120 minutes. According to the FDA, symptoms of histamine poisoning can include a drop in blood pressure, headache, dizziness, skin itching, nausea, vomiting, diarrhea, asthmatic-like airway constriction, heart palpitations, and respiratory distress. These symptoms may manifest within minutes to hours after consuming histamine-producing fish (FDA, 2024).

In this outbreak, the predominant symptoms were dizziness, headache, and chest palpitations, with headache being the most common symptom. This finding is consistent with studies conducted by Velut in France (Velut et al., 2019) and Zapeta in Chile (Zapata et al., 2021). Furthermore, the investigation supports the diagnosis of histamine poisoning, as the attack rate ratio (ARR) for mackerel was the highest, with an ARR of 4.5. This indicates that individuals who consumed mackerel had a 4.5 times greater risk of illness compared to those who did not.

The highest attack rate of scombroid poisoning in Pandak Sub-district, Bantul Regency, based on gender, was observed in males at 26.09%, meaning that 26.09% of all males who consumed mackerel experienced illness. In terms of age, the 20-39 age group had the highest attack rate at 33.33%, indicating that 33.33% of individuals in this age group who consumed mackerel experienced illness.

Environmental findings

Certain bacteria are capable of producing the enzyme histidine decarboxylase. Fish proteins contain various amino acids, including histidine. Histidine decarboxylase catalyzes the conversion of histidine into scombrotoxin (histamine). The growth of these bacteria can be controlled by storing fish at temperatures below 4.4°C, with freezing effectively halting histamine formation (FDA, 2024). Histamine-producing bacteria can thrive and generate histamine across a wide temperature range, but histamine production accelerates significantly at higher temperatures, such as 70°F (21.1°C) or above, compared to 45°F (7.2°C). Histamine production becomes particularly rapid when temperatures approach 90°F (32.2°C) (FDA, 2024).

Histamine accumulation in fish belonging to the Scombridae family can occur during production, processing, or distribution stages (Santoso et al., 2020). An environmental study revealed that fish were collected from fishermen on May 26, 2024, using Styrofoam boxes filled with ice cubes, without any temperature monitoring. The fish were then transferred to the distributor's Styrofoam boxes, also containing ice cubes. Effective histamine control during the distribution process cannot be guaranteed if the storage temperature exceeds 4.4°C at any point during transit, due to the lack of temperature monitoring and recording (Santoso et al., 2020). Although ice cubes were replaced twice daily, this does not ensure that the temperature remained below 4.4°C, as the Styrofoam boxes were kept at room temperature. In deceased fish, bacterial growth within the visceral muscle cannot be completely halted, but it can be managed through proper cooling. If the cooling process is inadequate, it can accelerate the spread of histamine from the visceral cavity to the fish flesh (FDA, 2024).

In this outbreak, the poisoning incident was confined to the customers of reseller Mrs. T, with no reported cases among other resellers. This may be attributed to the possibility that the fish already had a high histamine content since the production process. Furthermore, before the mackerel was delivered to reseller Mrs. T at 21:00, it was removed from the Styrofoam box and repackaged into plastic bags in 1 or 2-kilogram portions, as the reseller's request. This repackaging process began around 19:00, and after completion, the mackerel was returned to the Styrofoam box, but without ice cubes. Under these conditions, it is likely that

the temperature exceeded 4.4°C, or even reached room temperature, further promoting histamine formation. The initial handling of mackerel during raw material processing on the ship is critical; tuna that has just been brought aboard typically has a temperature of around 30°C, and if not promptly cooled, this can lead to an increase in histamine (Santoso et al., 2020).

The methods of cleaning the mackerel varied among food handlers. Some only removed the stomach, while others also removed the head and tail, as these parts are known to harbor spoilage bacteria (Sandria et al., 2023). Histamine naturally occurs in the gills, outer surface, and intestines of living marine fish. While evisceration can reduce histamine levels, it does not eliminate them entirely (FDA, 2024). In the households that received mackerel from reseller Mrs. T, most of the fish was cooked by frying, with only one family opting to boil the fish. In a study conducted by Chung et al., it was found that heat processing methods such as grilling and frying of fishery products can increase histamine levels. However, boiling does not significantly affect histamine levels, although a slight increase was observed (Chung et al., 2017). Both the histidine decarboxylase enzyme and bacteria responsible for histamine production can be inactivated by cooking. However, if histamine has already formed before cooking, it cannot be removed by either heating or freezing (FDA, 2024).

Laboratory investigation

The histamine found in fried mackerel was 3,633.87 mg/kg, while in raw mackerel was 163.27 mg/kg. The maximum allowable limit for histamine, as specified by the Indonesian National Standard (SNI 2729:2013), is 100 mg/kg (National Standardization Agency, 2013). The histamine levels found were 1 to 36 times higher than the permitted standard, and this excessive histamine concentration was identified as the cause of the food poisoning outbreak in Kadekrowo Hamlet RT 02, Gilangharjo, Pandak Sub-district, Bantul Regency, on May 27-28, 2024. The study mentioned the average concentration of histamine in poisoning samples was 1107.21 mg/kg (Colombo et al., 2018). Consumption of foods containing histamine beyond the limit can cause symptoms of poisoning. Symptoms that appear when histamine poisoning include facial flushing, abdominal pain, diarrhea, headache, and palpitations (Feng et al., 2016).

Conclusion

An outbreak of scombroid poisoning occurred in Kadekrowo Hamlet, RT 02, Gilangharjo, Pandak Subdistrict, Bantul regency, on May 27-28, 2024. The highest number of cases was reported in Kadekrowo RT 2, with 7 cases. The most common symptoms included dizziness (81.8%), headache (72.7%), and chest palpitations (63.6%). The source of exposure was mackerel, with an attack risk ratio (ARR) of 4.5. Contributing risk factors included non-standardized storage and distribution of the fish, which resulted in suboptimal conditions and leading the bacteria to form histamine. The Bantul District Health Office needs to regularly monitor and supervise the quality and safety of food sold or served within the Bantul District Health Office area. Additionally, the DHO should actively provide public information on the potential dangers of

scombroid poisoning, the symptoms, and disseminate information on histamine toxicity and prevention measures, such as safe fish storage and preparation.

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Author Contribution and Competing Interest

The authors report no competing interest.

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