ORIGINAL ARTICLE

SCOMBROID POISONING AMONG PRISONERS OF A PRISON IN JOHOR, MALAYSIA

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ABSTRACT

Scombroid poisoning is a food poisoning caused by ingesting contaminated fish from the Scombridae family, which presented as an allergic reaction due to over-histamine release. On 15th of April 2019, Kluang District Health Office received notification of a suspected food poisoning outbreak among prisoners in Johor, Malaysia following several of them experiencing allergic reactions after consumption of fish during dinner. Thus, this study aimed to describe the epidemiological characteristics of the outbreak, determine the extent and causative agent and make recommendations on the control and preventive measures. In this study, a case is delineated as a prisoner confined at Kluang Prison A displaying symptoms of scombroid poisoning—urticaria, respiratory distress, headache, eye redness, fever, or diarrhoea—after consuming fried ikan tongkol and mackerel during dinner on April 15, 2019, from 16:30 to 22:00 hours. Data on demographic characteristics, the onset of food poisoning and allergic symptoms, critical control point assessment of raw fish, food intake history and food preparation method were obtained. Of 3156 prisoners 30 (0.95% attack rate) were infected during this outbreak. Five prisoners were referred to the hospital and 3 of them were required admission. Predominant clinical features were urticaria (96.7%), shortness of breath (66.7%), eye redness (56.7%), fever (46.7%) and diarrhoea (36.7%). Moreover, the study revealed that fried mackerel fish has a high histamine level (430.3 mg/kg). The poisoning occurs due to a breach in critical control point during fish preparation. The outbreak was declared free on 16 April 2019. The scombroid poisoning outbreak in Kluang Prison A was conclusively attributed to spoiled mackerel fish. The investigation revealed significant lapses in food cleanliness within the prison, with a notable contribution to cross-contamination by food handlers. The findings underscore the importance of collaborative efforts among the prison administration, prisoners, and health officers to prevent future incidents of food poisoning.

***Keywords**: scombroid, poisoning, prisoners*

INTRODUCTION

Scombroid poisoning, or histamine fish poisoning is a pseudo allergic poisoning caused by ingestion of contaminated fish from Scombridae family[1]. The common examples of Scombridae family are tuna, mackerel, bonito and sardines[2]. Scombroid poisoning is common in Europe & countries that consume the fish in large quantities such as in San Francisco[3], Britain[4], Western Australia[5], Korea[6] and many others[7]. Cases have been described in different settings, including army barracks, schools, and restaurants or cafeterias[8].

The contamination occurs when the fish are poorly preserved out of the cold chain or inadequately frozen[8,9]. The primary toxic agent implicated in scombroid poisoning is histidine (which is normally found in dark fish meat), which breaks down to histamine[9]. In temperatures warmer than 20^0C[10], the fish undergo bacterial overgrowth and subsequently convert histidine to histamine. Histamine will start to develop as soon as the fish has died. The mechanism is by decarboxylation process mainly induced by enzymes produced by gram negative enteric bacteria from the intestine and skin of the fish[11]. Due to modern chilling and freezing methods, only in very rare cases, tuna products are found to contain level of histamine that would be a threat to human health. The responsible bacteria are most

commonly Escherichia coli, Klebsiella, Proteus, Vibrio, Salmonella, Clostridium and Shigella[1]. Histamine level is normally less than 0.1 mg per 100 g in properly stored fish[5], while histamine levels which present risk for intoxication are at least 5 to 10 mg of histamine per 100g of fish[4].

Scombroid fish poisoning is characterised by allergic reactions including headache, dizziness abdominal cramps, and palpitation[10,12]developing within 20-30 minutes of ingestion. Most symptoms are usually mild and resolve within 6-8 hours. But can be as long as 24 hours[8]. While uncommon, severe scombroid poisoning resulting in life-threatening hypotension has been reported[13]. Some patients with scombroid poisoning note a "peppery", metallic or bitter taste when ingesting the fish[8,14]. Cooking does not deactivate or affect the level of histamine present in the fish.

Symptoms associated with scombroid poisoning are like symptoms of an allergic reaction and are often misdiagnosed and underrecognized (8). On the 15th of April 2019, the Kluang District Health Office was notified of a potential food poisoning outbreak from Kluang Prison A. It was reported that several prisoners were suspected to have food poisoning, but with symptoms resembling allergic reaction, after (a few minutes) having dinner. In Malaysia, there is a lack of published reports on scombroid poisoning. This paper describes the first outbreak of scombroid poisoning encountered in the Johor state in Malaysia. The epidemiological characteristics of cases are presented – this may be useful for future evaluation of similar episodes.

METHODS

Five prisoners were sent to the nearest hospital for further management as they had difficulty in breathing and were in a state of anaphylactic shock. A rapid assessment team (RAT) was immediately sent to investigate and confirm the outbreak, identify the risk factors and suggest recommendations to control the outbreak.

Epidemiological investigation

A case was defined as a prisoner from Kluang Prison A who presented with any symptoms of scombroid poisoning which include urticaria, difficulty in breathing, headache, eye redness, fever, or diarrhoea after the consumption of the fish (fried ikan tongkol, mackerel fish) served for dinner on 15th April 2019 between 16:30 hrs to 22:00 hrs.

Active case detection (ACD) was conducted among the remaining prisoners from the same and the neighbouring blocks. Those who fulfilled the case definition were interviewed and examined. Sociodemographic information, onset and frequency of symptoms, and history of food consumption were obtained. Cases who presented with anaphylactic shock were referred to the nearest hospital.

Environmental investigation

Food safety and food premise inspection was conducted at prison's kitchen using a standard form provided by the Ministry of Health Malaysia. The evaluation included the hygienic practices of food storage and preparation, kitchen cleanliness, water source, food handlers' health status as well as other risk factors that might contribute to the poisoning incident. Hazard Analysis Critical control points (HACCP) of the suspected raw food supply were also investigated.

Laboratory investigation

Laboratory samples were taken to identify the causes. The microbiology sampling included three hand swabs and two rectal swabs from all prisoners who fulfilled the case definition as well as one rectal swab of all food handlers. Samples were sent to the National Public Health Laboratory in Sungai Buloh. Food sampling included the fried and raw fish samples which were sent to test for histamine levels, while other cooked food (white rice and fried cabbage) was sent to test for enteric bacteria.

Analytical study

All data collected was recorded into, maintained and analysed using Microsoft Excel 365 spreadsheet. A descriptive analysis was undertaken to explore the demographic characteristics of the outbreak based on time, person, and place. This analysis included examining the distribution of symptom onset and presenting the findings through frequencies and percentages. The trend of the Scombroid poisoning were depicted using histogram with 15 minutes interval.

Ethical approval

This study was registered with National Medical Research Register and has been approved by the Ministry of Health Malaysia, medical research & ethics committee, MREC, (21-1842-61429 (1)). The study abides to the Helsinki declaration. Nonetheless, the data obtained was kept strictly and confidential.

RESULTS

On the 15th of April 2019, an outbreak of Scombroid poisoning occurred in a prison located about 12 kilometres from Kluang town, involving a total of 30 prisoners where 5 prisoners were referred to the nearest hospital for further treatment and 3 of them were required admission. Two prisoners were treated as allergic reaction with anaphylactic shock and one prisoner was treated as food poisoning. All the identified cases reported to have eaten fried mackerel fish served for dinner on that day. Most of them also claimed to have eaten more than

one piece of the fish, given by other prisoners who disliked it. None of them reported that the fish had bad smell or taste during consumption.

Descriptive results

The incidence involved 30 out of 3156 prisoners with the onset started at 17:00 hrs and the latest at 20:00 hrs on the same day. The attack rate was therefore 0.95% (30/3156). All cases were male prisoners from the same block in the prison. The age distribution of the cases is shown below in Table 1.

Of the 30 cases, five (16.7%) were referred to the nearest hospital for further treatment, and three were required admission. Of the three requiring admission, two prisoners were treated as having allergic reactions with anaphylactic shock and the remaining one was treated as having food poisoning. Symptoms reported by all cases included urticaria with burning sensation (96.7%), shortness of breath (66.7%), eye redness (56.7%), fever (46.7%) and diarrhoea (36.7%), as shown below in Figure 1.

Table 1: The age distribution of the cases

Age	Frequency (n)	Percentage (%)
20 - 29	10	33.3
30 - 39	11	36.7
40 - 49	6	20
50 - 59	2	6.7
60 - 69	1	3.3

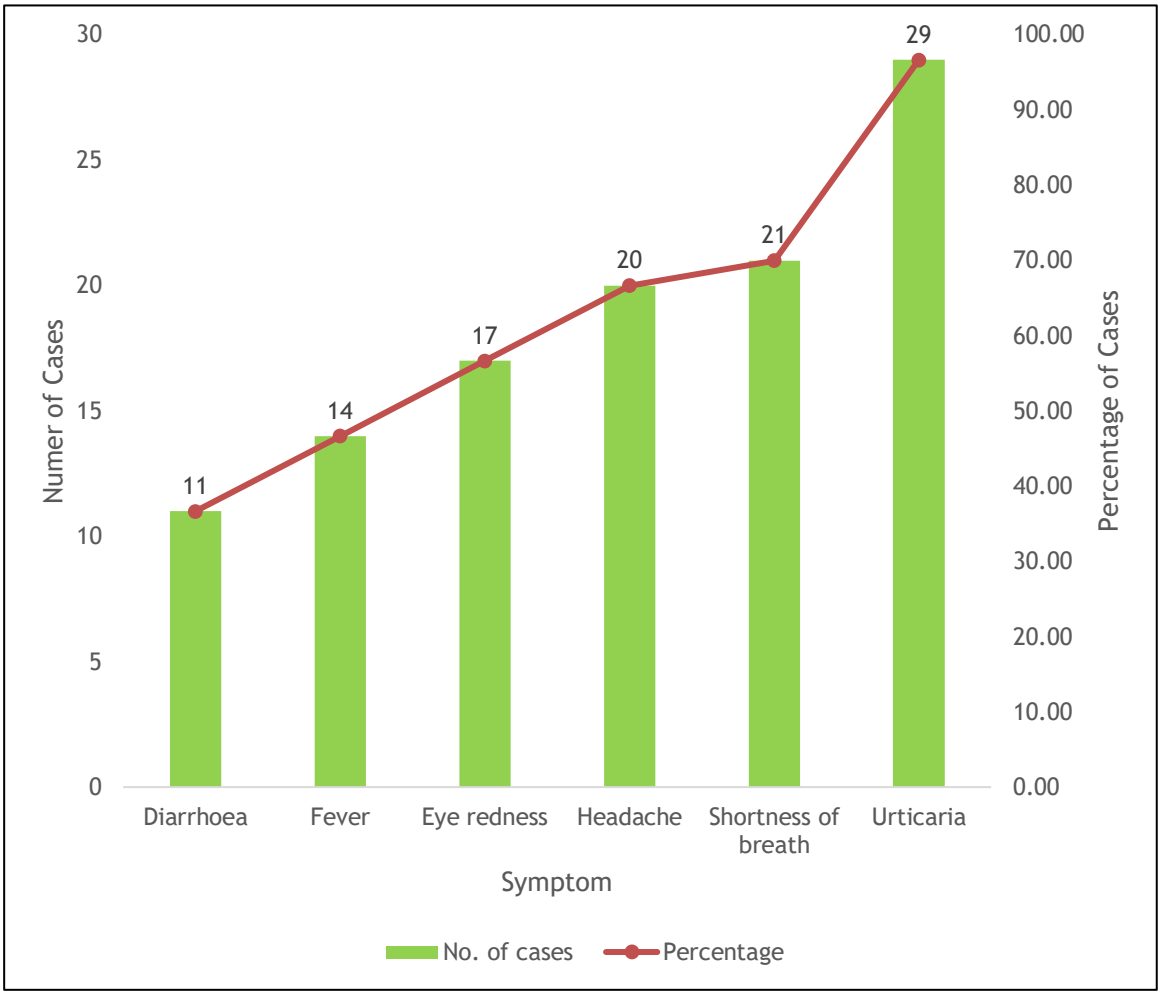

Figure 1: Distribution of symptoms

The epidemic curve shown below in Figure 2 suggest a common source outbreak, which points to transmission from the same food item or serving. Dinner serving usually begin at 16:00 hrs and prisoners usually ate immediately as they must return the dinner tray by 18:00 hrs. They are not allowed to keep the dinner servings to eat later. Most of them reported to have finished eating at 16:30 hrs (on the day of incident). The first case developed symptoms at 16:50 hrs, followed by 10 other cases between 17:00 hrs to 18:00 hrs, 11 cases between 18:01 hrs to 19:00 hrs and 8 cases between 19:01 hrs to 20:00 hrs. The incubation period for this event is between 50 minutes to 3 hours and 30 minutes.

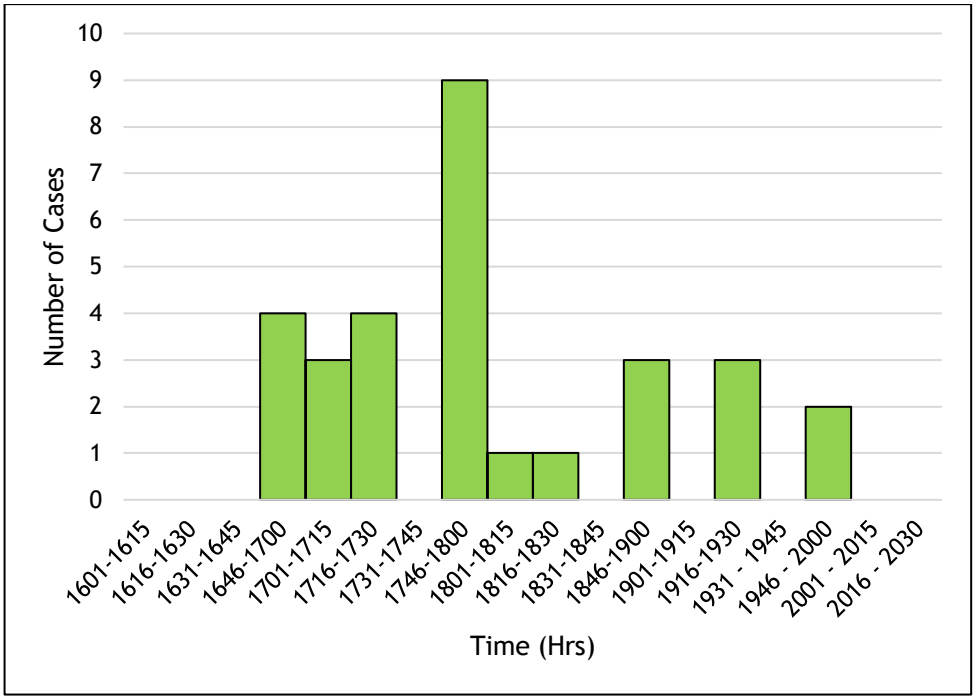

Figure 2. The epidemiological curve of the Scombroid poisoning in Kluang Prison A

Environmental assessment findings

The prison's kitchen was not closed despite the cleanliness rating for the kitchen was not satisfactory (58.7%) because the prison administration was unable to find any food caterer that can provide food to 3156 prisoners immediately. Reviewing the HACCP for the fish supply flow, as illustrated in Figure 3.

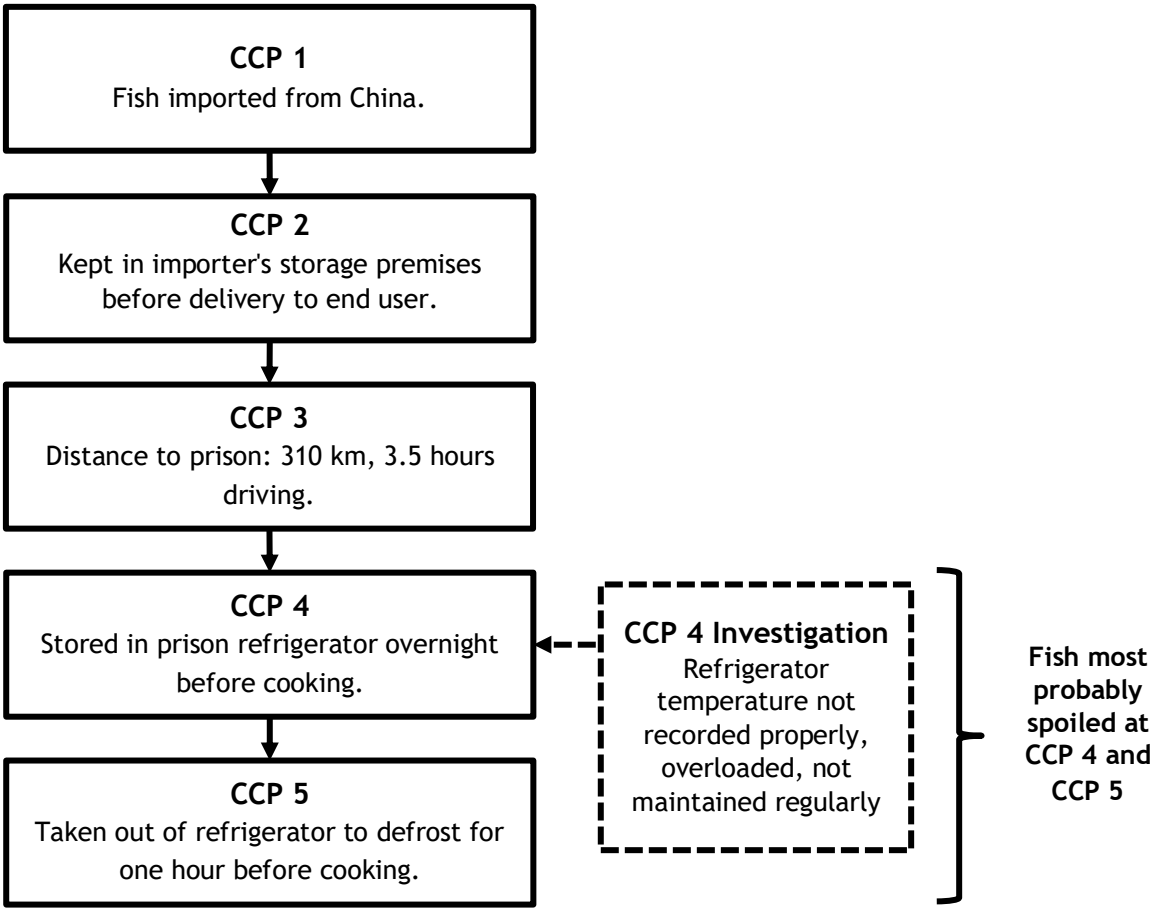

Figure 3. Examination of HACCP of Fish Supply Flow.

Laboratory findings

The histamine level detected in fried mackerel fish samples was high at 430.3 mg/kg. The acceptable histamine level in cooked fish is 200mg/kg. However, no histamine was detected in the raw fish samples. Other cooked food samples (white rice and fried cabbage) were positive for coagulase positive staphylococci. Rectal swab of one prisoner was positive for Staphylococcus aureus (enterotoxin positive isolate) while all other rectal swabs (prisoners and food handlers) were negative. None of hand swabs samples were positive.

DISCUSSION

The scombroid poisoning outbreak affected 30 prisoners at Kluang Prison A, displaying symptoms such as urticaria, respiratory distress, headache, eye redness, fever, and diarrhoea. Three cases required hospital admission with no fatalities. This determination is supported by the observed incubation period, with symptoms manifesting within a few minutes to an hour after consuming contaminated fish[15]. The clinical presentation of cases and laboratory investigation findings, particularly the elevated histamine levels (430 mg/kg) detected in samples from the affected fish, further substantiate this conclusion. Notably, only prisoners from the same block in the prison were affected, as most probably this was due to the group of fish served to them were the most affected fish where the histamine may be released while waiting for cooking.

The risk assessment done revealed that the risk of food poisoning was high in this prison, based on several factors. First, the raw materials such as fish, meat, vegetables, and fruits were delivered from Kuala Lumpur daily. The food items usually arrived at the prison roughly at 10:00 hrs to 11:00 hrs every day and it will be stored in the refrigerators before it is cooked on the following day. The cold chain for storage of the fish or meat may be affected at any Critical Control Point (CCP) from the catching point (at sea) until preparation for cooking. The investigation showed that the freezer was not in good condition and its temperature was not monitored regularly.

Second, hygiene issue noted during the investigation may also contribute towards the severity of the poisoning. The presence of Bacillus cereus that was isolated from both white rice and fried cabbage indicated that the vegetables was not washed and cooked properly[16].

Third, the food handlers in the prison kitchen were foreigners. No Malaysian prisoners were allowed working in the kitchen for safety reasons. Most of these foreigners who worked in the kitchen were illegal immigrants. One of the issues faced by the foreigners were language barrier as it was difficult for the chief cook who was the prison officer to give orders about hygienic practice and clean food preparation as well as cooking method. The other reason was on the turnover rate of these foreigners. Usually, they will stay only for three to six months' duration before being deported to their origin countries, resulting in a high turnover rate. Thus, it was challenging for the prison administrators to organise and manage food handlers' training. Other than that, there were delays in giving immunisation to the food handlers. Those selected to work in the kitchen will be allowed to work there temporarily for a week before they were accepted and given immunisation. Therefore, the risk of food poisoning increases when there is any breach in the standard cooking procedure.

Finally, the attitude of prisoners who prefer to keep their dinner illegally until night (to consume at much later time than scheduled mealtime) was one of the commonest contributing factors of food poisoning in this prison. This is because they were still full at dinner time, and they preferred to keep it until night-time. Unfortunately, they have no proper container to keep the food, thus they tend to keep it in dirty containers such as toilet buckets. Food storage in room temperature for more than four hours after cooking can be one of the contributing causes for food poisoning.

Immediate actions taken include cleaning the kitchen, and health education to all food handlers and prisoners. The scombroid poisoning outbreak was declared free on 16th April 2019 after two incubation period that is six hours after the last onset at 02:00 hrs on 16th April 2019.

In a way, it is fortuitous that no lethal casualty occurred in this incident as the level of histamine in the tested food sample is in the category of "probably toxic" level[4]. However, some factors could influence the severity of symptoms in this poisoning event, such as reduced absorption of histamine through the intestines and non-inhibition of toxicity-enhancing action of histamine by histamine-metabolizing enzymes[12]. In severe cases, scombroid poisoning might give rise to death via respiratory system effect of bronchoconstriction and respiratory distress and effect to circulatory system which may bring about hypotension and up to shock[17].

The study exhibits several commendable strengths. Firstly, it showcased a prompt response to the outbreak, deploying a Rapid Assessment Team (RAT) swiftly. This underscored the team's ability to efficiently manage and investigate emergent situations. Additionally, the study employed a comprehensive approach,

intertwining epidemiological, environmental, and laboratory investigations. This multifaceted strategy provided a holistic understanding of the outbreak, contributing to the study's robustness. The laboratory analysis, encompassing microbiology and histamine level testing, yielded concrete evidence supporting the identification of Scombroid poisoning as the outbreak's cause. The risk assessment conducted shed light on various factors influencing the outbreak's severity, such as food handling practices and hygiene issues.

Language barriers among foreign food handlers were identified as a limitation, potentially impeding effective communication and understanding of hygienic practices. The high turnover rate of immigrant food handlers emerged as another constraint, impacting the sustainability of training efforts and overall kitchen hygiene. Furthermore, the study lacks detailed information on the conditions and handling of food items before delivery to the prison, which could be pivotal in understanding potential contamination sources. While the study provides valuable insights, the self-reporting nature of food consumption introduces the possibility of recall bias, affecting the accuracy of reported information. These limitations, though notable, underscore areas for improvement and consideration in future research and outbreak investigations.

Laboratory findings

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CONCLUSION

It was concluded that the scombroid poisoning outbreak among prisoners in Kluang Prison A was caused by spoiled mackerel fish. This outbreak and its investigation findings also revealed that the level of food cleanliness in the prison still needs much improvement. The food handlers also contributed to the cross-contamination of served food from the contaminated hand or containers. Prevention of food poisoning in prison requires a collaborative effort between prison administration, prisoners, and prison health officers. The comprehensive assessment (outbreak investigation) followed by the prompt institution of corrective actions in this outbreak demonstrated the effective implementation of control measures.

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Data Availability Statement: All data are strictly confidential and reserve for the study. Please contact the authors for data request.

REFERENCES

1. Traylor J, Mathew D. *Histamine Toxicity*. StatPearls Publishing, Treasure Island (FL). 2020.
2. Collette BB, Reeb C, Block BA. Systematics of the tunas and mackerels (Scombridae). *Fish Physiology* 2001; 19:1-33.
3. Lerke PA, Werner SB, Taylor SL, Guthertz LS. Scombroid poisoning: report of an outbreak. *Western Journal of Medicine* 1978;129(5):381.
4. Bartholomew BA, Berry P, Rodhouse JC, Gilbert R, Murray C. Scombrotoxic fish poisoning in Britain: features of over 250 suspected incidents from 1976 to 1986. *Epidemiology & Infection* 1987;99(3):775-82.
5. Smart DR. Scombroid poisoning A report of seven cases involving the Western Australian salmon: Arripis truttaceus. *Medical Journal of Australia*. 1992;157(11):748-51.
6. Kang CR, Kim YY, Lee JI, Joo HD, Jung SW, Cho S-I. An outbreak of scombroid fish poisoning associated with consumption of yellowtail fish in Seoul, Korea. J*ournal of Korean Medical Science* 2018;33(38).
7. Colombo FM, Cattaneo P, Confalonieri E, Bernardi C. Histamine food poisonings: A systematic review and meta-analysis. *Critical Reviews in Food Science and Nutrition* 2018;58(7):1131-51.
8. Feng C, Teuber S, Gershwin ME. Histamine (scombroid) fish poisoning: a comprehensive review. *Clinical Reviews in Allergy & Immunology* 2016;50(1):64-9.
9. Morrow JD, Margolies GR, Rowland J, Roberts LJ. Evidence that histamine is the causative toxin of scombroid-fish poisoning. *New England Journal of Medicine* 1991;324(11):716-20.
10. Russell FE, Maretić Z. Scombroid poisoning: mini-review with case histories. *Toxicon* 1986;24(10):967-73.
11. Taylor SL, Stratton JE, Nordlee JA. Histamine poisoning (scombroid fish poisoning): an allergy-like intoxication. *Journal of Toxicology: Clinical Toxicology* 1989;27(4-5):225-40.

12. Hungerford JM. Scombroid poisoning: a review. *Toxicon*. 2010;56(2):231-43.
13. Katugaha SB, Carter AC, Desai S, Soto P. Severe scombroid poisoning and life-threatening hypotension. *BMJ Case Reports CP* 2021;14(4): e241507.
14. Nordt SP, Pomeranz D. Scombroid poisoning from tilapia. *The American Journal of Emergency Medicine* 2016;34(2):339. e1-. e2.
15. Centers for Disease Control and Prevention. Food Poisoning from Seafood. Scombroid [Internet]. 2022 [cited 2023 Dec 6]. Available from: https://wwwnc.cdc.gov/travel/page/fish-poisoning-ciguatera-scombroid
16. Schoeni JL, Lee WA. Bacillus cereus food poisoning and its toxins. *Journal of Food Protection* 2005;68(3):636-48.
17. Ohnuma S, Higa M, Hamanaka S, Matsushima K, Yamamuro W. An outbreak of allergy-like food poisoning. *Internal Medicine* 2001;40(8):833-5.