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Health Risk Assessment of Exposure to Salmonella Sp and Staphylococcus Aureus Due to Consuming Snacks in the Coastal Area of Anjungan Cempae, Parepare City

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ABSTRACT

Street foods can pose a risk to health because their handling is often unhygienic, allowing snack foods to be contaminated by toxic microbes or the use of food additives that are not permitted. Snack food contains many risks, dust and flies that land on uncovered food can cause disease in the digestive system. Not to mention, if the water supply is limited, the utensils used such as spoons, forks, glasses and plates are not washed cleanly. The aim of this research is to determine the risk of Salmonella Sp and Staphylococcus Aureus bacteria resulting from consumption of snacks in the Cempae coastal platform area, Parepare City on public health problems. Type. This type of research is quantitative descriptive research with a Quantitative Microbial Risk Assessment (QMRA) approach. The results of calculating the annual Probability of infection (Pinf.annual) for Staphyloccus Aureus bacteria were obtained. For 7 snacks, the Pinf.annual value = 1, for Salmonella bacteria, the Pinf.annual value = 0 was not positively contaminated with Salmonella bacteria and in the calculation of the Probability of illness (Pill) for Staphyloccus Aureus bacteria, the Pill value was found for all snacks = 3.0 x 10-1, whereas for Salmonella bacteria it was not found in snacks. The conclusion is Characterizing the risk of disease for Staphyloccus Aureus bacteria, there are 7 snacks that have a high risk and Salmonella bacteria are not positively contaminated in snacks in the Anjungan Cempae area.

Keywords: QMRA, Staphylococcus Aureus, Salmonella Sp, Bacteria, Snacks

1.Introduction

Many things can affect health, especially the food consumed every day, food is one of human's primary needs. Healthy food is really needed as a source of energy and to keep the body from getting sick easily[1].To fulfill its function as one of the basic human needs, food must contain nutrients and be safe for consumption, because if the food is not safe it can cause health problems or cause poisoning.[2].

Snack food is food and drink that is prepared by food craftsmen at the seller's place and/or served as

ready-to-eat food for sale to the public.[3]. Snacks play an important role in providing energy and nutrients which will later be digested and absorbed by the body. However, so far many snack foods are not guaranteed to be clean due to contamination from bacteria and chemicals which cause health problems and have the potential for poisoning and diarrhea.[4]. One of the foods that people often consume is street snacks. Street food often becomes an intermediary for the spread of disease due to contamination by pathogenic microorganisms. One of the pathogenic microorganisms that can cause disease in humans[5].

The availability of various types of food at relatively cheap prices, and it is also easy to buy, often without realizing it, people no longer pay attention to the cleanliness of street food. Often street foods are sold in locations close to sewers on the side of the road. This is what makes the sales location unhygienic. As a result, even though the food has been cooked thoroughly, it still has the potential to be contaminated by pathogenic bacteria originating from the surrounding environment[6].

Street food has a negative impact if the food consumed does not contain sufficient nutritional value and its cleanliness and safety are not guaranteed. Consuming bad snacks will cause nutritional problems and will disrupt children's health, such as developing digestive tract diseases[7].Food can be a medium for disease transmission. Diseases originating from food are often caused by microbiological contamination such as bacteria, viruses, parasites, or other toxic ingredients in food[8].

Food can be contaminated by disease vectors if it is not handled hygienically, for example food is left open for a long time, so this can result in food poisoning.[9]. Foodborne diseases caused by microbes can be more fatal, because of the presence of microbial virulence factors that are capable of infecting humans[10]. The highest number of microbes that cause foodborne disease is caused by viruses, around 67%, then bacteria around 30%, and fungi and parasites around 3%.[11].

The issue of food sanitation hygiene is very important, especially in public places which are closely related to serving many people. For food to be healthy, it must be free from contamination[12]. There are several factors that influence the occurrence of food poisoning, including poor personal hygiene, unhealthy food handling methods and unclean food processing equipment. One of the causes is a lack of knowledge in paying attention to personal health and the environment in the process of processing good and healthy food[13].

Diseases can be transmitted through food and drink, known as food borne disease (food poisoning), many of which are caused by microorganisms (viruses, fungi, bacteria, protozoa and metazoa). Microorganisms are often found from various sources of contaminants such as animals, water, processing equipment, air, soil, dust and humans.[14]Foodborne disease occurs due to the entry of pathogenic microbes (microbes that cause disease) into the digestive tract either through food or drink. Foodborne disease is still a health problem in Indonesia. This is closely related to issues of cleanliness and sanitation[15]Several types of pathogenic bacteria that are often found in food products and cause foodborne illnesses such as diarrhea and death include Enterobacteriaceae, Salmonella sp., Escherichia coli, Bacillus sp., Acinetobacter sp., Klebsiella pnuemoniae, and Staphylococcus sp.[5].

Staphylococcus aureus is a pathogenic bacteria that has been reported to cause health problems through food consumption. Contamination of these two bacteria in food has been reported to cause extraordinary events (KLB)[16]. Staphylococcus aureus can cause diseases of human skin, respiratory tract and digestive tract. These germs can also be found in the air and environment around us and can grow with or without oxygen (Irianto, 2006; Radji, 2010). In nature it is found in soil, water and dust in the air[17].

According to (PerMenKes, 2011) foodborne diseases are caused by viruses, bacteria, amoeba or protozoa, parasites and non-germic causes. One of the pathogenic microbes that causes food poisoning is Salmonella sp. The disease caused by this bacteria is called Salmonellosis[18]. Salmonella sp. bacteria.

which contaminate food can multiply quickly due to humid and hot environmental conditions. In a weak state, Salmonella sp. it will be easier to enter through various routes, either through food or poor hygiene[19].

The Cempae coastal platform is a place for people to visit which generally aims to enjoy the natural beauty of the beach atmosphere as well as enjoying snacks in the Cempae coastal area. The activities carried out by the people in this area are generally informal, namely street vendors, such as food and drink sellers and daily necessities. The location around the platform is a coastal area that is experiencing progress in terms of development and one of the centralized sectors where many food and drink traders, especially street vendors, do business at that location.

Based on the above background, researchers conducted research on "Health Risk Assessment of Exposure to Salmonella Sp. And Staphylococcus Aureus due to consumption of snacks in the coastal area of Anjungan Cempae, Pare-Pare City."

2. Materials and methods

1.1. Type of Research

The type of research used is quantitative descriptive. Where research was conducted in the coastal area of Anjungan Cempae, Pare Pare City, South Sulawesi Province using purposive sampling technique. The number of food samples was 10 different types of food and 100 human samples.

The study design in this research used the Quantitative Microbial Risk Assessment (QMRA) method. With the following stages:

a. Hazard Identification

This stage focuses on certain microorganisms and potential mechanisms that can cause disturbances and the ability of microorganisms to cause harmful effects or known as host-bacteria, virulence, pathogenicity and dose-response.

b. Dose Response Analysis

Dose-response modeling is a process using mathematical relationships that provides a description of the probability of adverse health effects such as infection or disease occurring in an individual or the frequency of adverse health effects in a population when the individual or population is exposed to a specific dose of a pathogenic microorganism. The dose level can be measured in terms of the number of organisms (CFU). With the following formula:

$$\mathbf{Pinf/day = 1- e (-rd)}$$

Information:

Pinf/day	= Probability of infection per day
e	= Pathogen exposure (e = C x V), where C is the number of concentrationspathogens in food V is the volume of food ingested (grams).
r	= Infectivity parameter
d	= Ingested dose/pathogen concentration

c. Exposure Analysis

At the exposure assessment stage, the frequency, duration and magnitude (amount) of exposure to microbial hazards in a population are determined. After getting this value, then proceed with the microbial risk analysis calculation using the following formula:

$$\mathbf{Pinf.annual = 1-(1-Pinf/day)n}$$

Information:

Pinf.annual	= Annual infection probability
N	= Number of exposures in one year

Next, the annual risk of disease for an individual is calculated using the following formula:

Pill= Pinf.annual x Pill/inf

Information:

Pills = Possible disease that occurs due to infection

d. Risk Characteristics

Risk characterization addresses the scenarios, models, parameters, data, and analysis options that risk managers must understand and consider when interpreting risk assessment results (EPA, 2012).

2.1 Sample Collection

Cempae Pavilion is the largest pavilion in Pare Pare City, at the research location there are many street vendor activities. The examination of bacterial samples of snacks was carried out in the Microbiology laboratory at the medical faculty of Hasanuddin University

Figure 1 Research Sample Locations

The Cempae Pavilion is precisely located in Watang Soreang Village, Soreang District, Parepare City, South Sulawesi. This area is equipped with various facilities such as outdoor fitness facilities, food court area, dock for fishermen. It is also equipped with a tribune for community activities, a sky bridge and various other facilities.

3. Results

Respondent Characteristics

The number of respondents in this study was 100 people. Respondents were people who had snacks at the cempae pavilion in Parepare City. The distribution of respondents can be seen in table 1 below:

Table 1. Distribution of Respondents According to Gender, Age Group, Latest Education, Type of Work in Baruga Village and Tukamasea Village in 2024

Variables	Frequency (n)	Percentage (%)
Gender		
Man	41	41.0
Woman	59	59.0
Age group		
10 – 20 Years	47	47.0
21 – 30 Years	40	40.0
31 – 40 Years	12	12.0
≥40Years	1	1.0
Level of education		
Elementary School	12	12.0
Junior High School	11	11.0
Senior High School	52	52.0
Bachelor	25	25.0
Weight		
20-30 kg	1	1.0
31-40 kg	7	7.0
41-50 kg	21	21.0
≥51 kg	71	71.0

Source: Primary Data, 2023

Table 1 shows the number of respondents in this study as many as 100 respondents, namely people who snack at the pare pare city's cempae pavilions. The majority of respondents in the study were female (59%), in the age group the most were 10-20 years (47.0%). Respondents had more than a high school education level (52%) while the highest body weight was ≥51 kg, as many as 71 respondents.

Types of bacteria and number of clones

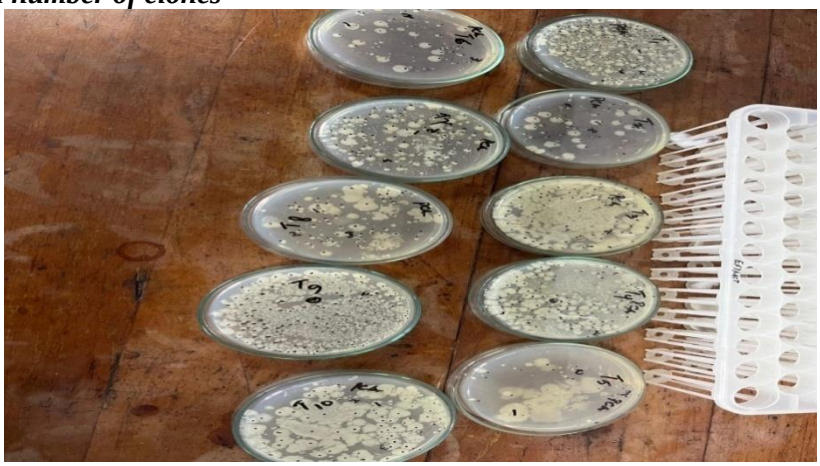

Figure 2. Number of colonies on each snack

Table 2 Snack Samples, Types of Bacteria and Number of Bacteria in Snacks in 2024

No.	Sample	Number of Colonies(CFU)	Types of Bacteria
1	Snacks 1	193	*Staphyloccus Aureus*
2	Snacks 2	42	*Enterobacter*
3	Snacks 3	220	*Staphyloccus Aureus*
4	Snacks 4	133	*Staphyloccus Aureus*
5	Snacks 5	23	*Staphyloccous Aureus*
6	Snacks 6	56	*Staphyloccous Aureus*
7	Snacks 7	88	*Staphyloccus Aureus*
8	Snacks 8	65	*Alcaligenis tracelis*
9	Snacks 9	143	*Staphyloccous Aureus*
10	Snacks 10	80	*Alcaligenis tracelis*

Source: Primary Data 2024

Based on table 2, it can be seen that the highest number of Staphyloccus aureus bacterial colonies was found in snack 3, namely 220 CFU. Meanwhile, the lowest number of bacterial colonies was found in snack sample 5, namely 23 CFU. After carrying out a biochemical test to see the type of bacteria, of the 10 snack samples examined, 7 were found to be Staphyloccus aureus bacteria.

General description of snack sanitation, environmental sanitation and personal hygiene of snack handlers

Table 3: Distribution of Hygiene and Sanitation Aspects of Snacks in the Cempae Platform Area of Parepare City

Hygiene and Sanitation Aspects				
Sales's place	**Assessment criteria**	**Environment sanitation**	**Sanitation Snacks**	**Personal Hygiene Food Handlers**
Sales place1	Good	-	-	-
	Less	√	√	√
Sales place 2	Good	-	-	-
	Less	√	√	√
Sales place 3	Good	-	-	-
	Less	√	√	√
Sales place4	Good	-	-	-
	Less	√	√	√
Sales place 5	Good	-	-	-
	Less	√	√	√
Sales place 6	Good	-	-	-
	Less	√	√	√
Sales place 7	Good	-	-	-
	Less	√	√	√
Sales place 8	Good	-	-	-
	Less	√	√	√

Sales place 9	Good	-	√	-
	Less	√	-	√
Sales place 10	Good	-	-	-
	Less	√	√	√

Primary data source 2024

Based on table 3, it can be seen that for environmental sanitation and personal hygiene factors, snack handlers do not meet the requirements for hygiene and sanitation aspects. Meanwhile, for snack sanitation factors, only 9 selling places have good/fulfilling food sanitation aspects

Quantitative Microbial Risk Assessment (QMRA)

a. Hazard Identification

Table 4 Distribution of Respondents Based on Type of Health Problems After Consuming Snacks in the Anjungan Cempae area, Parepare City 2024

Types of Health Disorders	Number(n)	Percent (%)
Diarrhea	8	57.1%
Stomach ache	6	42.8%
Total	**14**	**100**

Source: Primary Data 2024

Based on table 4, it can be seen that of the 14 respondents who experienced health problems, 6 people or 42.8% experienced stomach pain. Meanwhile, the remaining 57.1% experienced diarrhea health problems.

b. Dose Response Assessment (Dose-Response (DR) Assessment)

In the dose-response assessment stage here, researchers calculate the probability of infection per day (Pinf/day). A dose-response (DR) assessment was carried out to see the relationship between the amount of pathogen ingested (dose) and the possibility of adverse consequences in terms of disease infection or death. The probability of infection per day (Pinf/day) of Staphyloccus aureus bacteria for respondents in other snacks can be seen in the following table

Table 5 Distribution of the Probability of Infection Per Day (Pinf/day) of Stahpyloccus aureus Bacteria. Consequences of Snack Consumption in the Anjungan Cempae Area, Parepare City in 2024

Sample	Concentration (C)	Volume (V)	Probability of Infection Per day (Pinf/day)
Snacks 1	193	140	0.9941
Snacks 2	42	204	0
Snacks 3	220	52	0.9952
Snacks 4	133	175	0.9692
Snacks 5	23	50	0.3439
Snacks 6	56	50	0.6852
Snacks 7	88	140	0.8842
Snacks 8	65	175	0
Snacks 9	143	140	0.9749
Snacks 10	80	175	0

Source: Primary Data 2024

In table 5 it can be seen that the probability of infection per day (Pinf/day) for Staphyloccus Aureus bacteria is highest in Snack 9 with a value of 0.9749. Meanwhile, the probability of infection per day (Pinf/day) for Staphyloccus Aureus bacteria is lowest in Snack 5 with a value of 0.3439.

Table 6 Distribution of the Probability of Daily Infection (Pinf/day) of Salmonella sp. Due to Consumption of Snacks in the Anjungan Cempae Area, Parepare City, 2024

Sample	Concentration (C)	Volume(V)	Probability of Infection Per day(Pinf/day)
Snacks 1	193	140	0
Snacks 2	42	204	0
Snacks 3	220	52	0
Snacks 4	133	175	0
Snacks 5	23	50	0
Snacks 6	56	50	0
Snacks 7	88	140	0
Snacks 8	65	175	0
Snacks 9	143	140	0
Snacks 10	80	175	0

Source: Primary Data

In table 6 it can be seen that the probability of infection per day (Pinf/day) for Salmonella sp. Not found in snacks in the Cempae Pavilion area of Parepare City

c. Exposure Assessment (Exposure Assessment)

After calculating the probability of infection per day (Pinf/day) for Staphyloccus Aureus and Salmonella sp. bacteria, an exposure assessment is then carried out to quantitatively estimate the presence of contaminants in food dishes when consumed and what the risk of infection is in one year. Staphyloccus aureus. can be seen in the following table:

Table 7 Distribution of the Probability of Annual Infection (Pinf.annual) and the Probability of Illness (Pill) for StaphyloccusAureus Bacteria Due to Consumption of Snacks in the Anjungan Cempae Area, Parepare City in 2024

Sample	C	V	$P_{inf/day}$	$P_{inf.\ annually}$	P_{ill}
Snacks 1	193	140	0.9941	1	0.30
Snacks 2	42	204	0	0	0
Snacks 3	220	52	0.9952	1	0.30
Snacks 4	133	175	0.9692	1	0.30
Snacks 5	23	50	0.3439	1	0.30
Snacks 6	56	50	0.6852	1	0.30
Snacks 7	88	140	0.8842	1	0.30
Snacks 8	65	175	0	0	0
Snacks 9	143	140	0.9749	1	0.30
Snacks 10	80	175	0	0	0

Source: Primary Data, 2024

In table 7 it can be seen that the annual probability of infection (Pinf.annual) for Staphyloccus aureus bacteria has the same value for each snack, namely Pinf.annual=1, which means there will be a risk if consumed during the year. Next, after calculating the probability of illness value (Pinf/day) for all snacks

that have a risk of disease of 0.30 or 3.0×10-1. Next, the same calculation is carried out for the annual probability of infection (Pinf.annual) with Salmonella bacteria. sp. For respondents for each snack and the probability of illness (Pinf.annual) after consuming the snack. The results of the calculation of the estimated risk of Salmonella sp. can be seen in the following table:

Table 8 Distribution of Annual Probability of Infection (Pinf.annual) and Probability of Illness (Pill) of Salmonella sp Bacteria Due to Consumption of Snacks in the Anjungan Cempae area of Parepare City in 2024

Sample	C	V	$P_{inf/day}$	$P_{inf.\ annual}$	P_{ill}
Snacks 1	193	140	0	0	0
Snacks 2	42	204	0	0	0
Snacks 3	220	52	0	0	0
Snacks 4	133	175	0	0	0
Snacks 5	23	50	0	0	0
Snacks 6	56	50	0	0	0
Snacks 7	88	140	0	0	0
Snacks 8	65	175	0	0	0
Snacks 9	143	140	0	0	0
Snacks 10	80	175	0	0	0

Source: Primary Data 2024

In table 8 it can be seen that the probability of infection per day (Pinf/day) for Salmonella sp. Not found in snacks in the Cempae Pavilion area of Parepare City.

d. Risk Characterization

Table 9 Distribution of Risk Characterization for Staphyloccus and Salmonellasp Bacteria. Consequences of snack consumption in the pavilion cempae area of Parepare city in 2024

Sample	Bacteria	$P_{ill\ Bacteria}$	CategoryRisk
Snacks 1	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 2	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	0	No risk
Snacks 3	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 4	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 5	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 6	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 7	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 8	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	0	No risk
Snacks 9	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	3.0×10-1	High risk
Snacks 10	*Salmonella sp.*	0	No risk
	Staphylococcus Aureus	0	No risk

Source: Primary Data 2024

In table 9 it can be seen that every respondent who consumes snacks contaminated with Staphyloccus Aureus bacteria in snack 7 has a high risk of developing digestive tract diseases. As for consuming snacks contaminated with Salmonella sp bacteria. There is no risk of incidents among respondents who consume snacks in the Anjungan Cempae area of Parepare City.

4. Discussion

a. Respondent Characteristics and Exposure Analysis

Frequency of consumption in this study is defined as how often the respondent visits the snack shop and consumes food during the month. This is intended to see how much exposure respondents get if they consume food contaminated with microbes. Table 5 shows the varying consumption frequencies of respondents. Respondents who consumed snacks 2-3 times a week were the most at 28% and the lowest frequency of consumption were respondents who visited once a month at 15%. From this data, if converted within a year, some respondents consume snacks around 96-144 times a year. If averaged, it can be concluded that respondents consume a third of snacks a year.

Consumption volume in this study is defined as how often respondents visit the snack shop and consume food during the month. This is intended to see how much exposure respondents get if they consume food contaminated with microbes. The volume of consumption in this study was measured by weighing them at each snack place. The food that is weighed is the snack menu at each snack place according to the conditions in which the food is provided to consumers. One of the limitations of this research is that the portion of snacks for each respondent was not weighed so that the risk for each respondent at the same snack place was also the same. The results of weighing the volume of food vary at each snack place[20].

b. Overview of Environmental Sanitation Factors, Food Sanitation and Personal Hygiene of Food Handlers

From the results of observations related to environmental sanitation factors, in all sales locations there are 4 aspects of environmental sanitation that do not meet the requirements, namely aspects of unclean environmental conditions where snacks are located on the side of the road, polluted by dust fumes, waste bins that are not separated between organic and inorganic, and sales locations that are close to each other. from sources of pollution. Snack places are not free from dust and smoke in the surrounding area. As for the aspects that meet the requirements, there are 2 aspects, namely, there are no mice, cockroaches or flies or insects as much as the waste disposal facilities flow smoothly and do not cause annoying odors.[21].

Observation results for snack processing locations close to sources of pollution and physically clean snack processing locations, none of them met the requirements. This is due to the existence of sales places located on the side of the road which can result in various types of pollution ranging from vehicle fumes and the sales location is not hygienic and is not far from rubbish bins causing contamination of several disease agents in food so it can be said to be one of the sources of pollution around the sales place. which is the research location. The location where snacks are processed must be clean and far from sources of pollution so that they cannot contaminate the snack production results.[22].

This is in line with research conducted by[23]who mentionedTransportation of vehicles such as motorbikes, cars and trucks as well as other heavy vehicles causes air pollution, thereby increasing the occurrence of contamination in burning pots sold on the side of the road. The conditions of the location of the selling place cause the spread of bacteria through air and flying dust.

The observation results obtained were related to the personal hygiene of snack handlers. aspects that do not meet the requirements for snacks are wearing clean clothes/work clothes when handling and serving snacks, the snack processing place is clean, physically handling/serving snacks, snack handlers not wearing gloves when handling/serving snacks, snack handlers wearing aprons when handling/serving snacks , Snack handlers do not wear head/hair coverings when handling/serving snacks, Snack handlers do not wear mouth coverings when handling snacks, Snack handlers do not wash their hands with soap when handling snacks, Food handlers speak facing the snacks when handling and serving snacks, Snack handlers direct contact with snacks

As with research conducted by[12]shows that bad behavior of food handlers such as not using an apron, not wearing a head covering, and talking while working is related to the presence of bacteria in food. At every snack place, food handlers also do not wash their hands with soap when processing food. But just wash your hands with water without using soap. This is also one of the factors that can cause the presence of bacteria in food[24].Food handlers need to understand sanitation hygiene because sanitation hygiene management is related to how food, people, places or equipment can transmit disease.[25].

c. **Quantitative Microbial Risk Analysis (QMRA) on Staphyloccus Aureus Bacteria**

Hazard identification is the initial stage in microbial risk analysis. Microbes that can be detrimental to health are identified through epidemiological information, surveillance of clinical aspects and potential mechanisms that can cause disorders. From the results of data collection through interviews with respondents, it was found that several health problems occurred in respondents after consuming snacks, namely diarrhea and stomach ache[20].

Apart from data on health problems, from the results of the researcher's observations during data collection, several hazards were identified, namely:

a. Environmental sanitation is still poor in every trade in the research location.
b. The trade is located on the side of the main road and is open so dust and vehicle fumes very easily contaminate snacks in the area.
c. The clean water used for each trade is stored in open buckets so it is very easily contaminated with various pollutants.
d. There are no waste water collection channels (SPAL) in each trade
e. Apart from being located on the side of the main road, the trading location is densely packed with vehicles and people visiting the cempae platform and the location is not hygienic, so it has major potential as a pollutant, especially contamination by microbial agents.

At the dose response assessment stage, the first thing that must be done is to find out the concentration of bacteria in the food and the volume of food consumed. There were 10 food samples taken for further examination in the laboratory. Laboratory examination results found that 6 snack samples were detected to contain Staphylococcus Aureus bacteria. This is in line with research conducted by[26]where in the research results it is statedS. aureus contamination was also found in several processed fish food products in the form of otak-otak circulating in several traditional markets in Bandar Lampung City. The source of the contamination is thought to be the container or place of sale and the seller's unclean hands, as well as contamination from the air which can trigger contamination of the otak-otak food.

The highest possible risk of daily infection is found in Snack 3, in line with the high concentration of bacteria in this Snack. On the other hand, the possibility of daily infection risk is lower in Snack 5 because the concentration of bacteria found in this snack is also the lowest. So here it can be concluded that the greater the concentration of bacteria in food, the greater the risk of infection if consumed.

Determination of risk characteristics is the final step of risk analysis where information about toxicity and exposure is integrated into an “upper limit estimate” of the health risk contained in a bacteria. The risk level value is categorized into 3 levels of risk, namely risky if Pill <10-6, moderate risk if Pill = 10-6, and no risk if Pill> 10-6. The analysis results for Staphyloccus aureus bacteria in 7 contaminated snacks obtained the same Pill value, namely 3.0 x 10-1. This can mean that snacks in every food trade have a high risk of causing health problems if consumed by humans.

d. Quantitative Microbial Risk Analysis (QMRA) on Salmonella sp.

From the calculation results it was found that the possible annual risk of Salmonella bacterial infection in all the snacks eaten was 0, which means there is a risk of infection if you consume the food for 1 year. Determining risk characteristics is the final step of risk analysis where information about toxicity and exposure is integrated into an “upper limit estimate” of the health risk contained in a bacteria. The risk level value is categorized into 3 levels of risk, namely risky if Pill <10-6, moderate risk if Pill = 10-6, and not risky if Pill> 10-6.

The results of this research are in line with research conducted by[27].As for research conducted on Risk Assessment for Salmonellosis in chicken prepared in households in the United States. The results of

this study showed that the estimated average risk of salmonellosis per serving was 1.2 × 10-4. This risk is in the high category and exceeds the average risk value of above 84.2%.

Salmonella sp. rod-shaped, perithtic flagellum for movement, does not have spores, is gram negative, measures 0.5-0.8 µm in diameter and 1-3.5 µm in length[28].Salmonella bacteria enter through the mouth with food and drink, then go to the digestive tract. If Salmonella bacteria enter the digestive tract in large quantities, they will enter the small intestine and then enter the circulatory system, causing bacteremia, typhoid fever and other organ complications. Apart from these diseases, Salmonella can also cause intestinal infections accompanied by diarrhea, fever and abdominal cramps that last for 1 week or more and can cause urinary tract infections, osteomyelitis.[29].

e. Risk management

Based on risk characterization, various risk management options can be formulated to minimize the possibility of infection or the possibility of disease occurring. According to EPA (2016), principles and guidelines for implementing microbial risk management include the following 8 principles: protection of human health, microbial risk management must take into account the entire food chain, microbial risk management must follow a structured approach, the microbial risk management process must be transparent, consistent and documented, the risk manager (risk management team) must involve various interested parties, the risk manager must have effective interactions with risk assessors, the risk manager must consider the various possible risks generated and microbial risk management decisions can still be reviewed if there is a need repaired[30].

Risk management that can be carried out to overcome exposure problems experienced by consumers is reducing the amount of bacterial contamination in food and reducing the rate of food consumption in snack places that do not meet the requirements. Communication is needed to related parties so that potential risks can be minimized or prevented. Apart from that, appropriate strategies are needed to reduce the value of bacterial contamination of food. This cannot be separated from the attitude and responsibility of the food handlers themselves. However, if the risks that occur cannot yet be minimized, it is best for the relevant parties to act immediately to avoid the possibility of disease infection among consumers.

5. Conclusion

The highest number of Staphyloccus Aureus bacteria in snack samples in the Anjungan Cempae area of Parepare city was found in the 3rd snack. Meanwhile, Salmonella bacteria were not found in snacks in the Anjungan Cempae area of Parepare city. Overview of environmental sanitation factors, food sanitation, and personal hygiene of food handlers in snacks in the Anjungan Cempae area of Parepare City which have poor or inadequate sanitation. Characterization of disease risk for Staphyloccus Aureus bacteria, 7 snacks have a high risk and for Salmonella bacteria it is not positive contaminated snacks in the Anjungan Cempae area, Parepare city

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Use of AI tools declaration

The author used Grammarly to improve the language in this research.

Conflict of interest

The authors declare that they have no conflict of interest

REFERENCES

[1] R. Fauziah and S. Suparmi, "Implementation of Hygiene Sanitation in Food Management and Knowledge of Food Handlers,"*Jambura Heal. Sport J.*, vol. 4, no. 1, pp. 11–18, 2022, doi: 10.37311/jhsj.v4i1.13469.

[2] DK Dewi, "Literature Study of the Relationship between Food Hygiene and Sanitation and Escherichia coli Bacterial Contamination in School Snacks," 2022, [Online]. Available: http://eprints.ums.ac.id/id/eprint/98933%0Ahttp://eprints.ums.ac.id/98933/3/Naskahpublikasi.pdf

[3] D. Anjani, PR Noviati, and M. Rohimat, "The Relationship between Healthy Snack Selection

inDeveloping Healthy Living Behavior in Grade IV Elementary School Students," 2021.
[4] Ainutajriani*et al.*, "Microbiological Analysis Of Snacks From Street Vendors Along Jlan Sutorejo Surabaya," vol. 11, no. 2, pp. 128–140, 2023.
[5] N. Oktaviani, I. Sulistiyawati, and Nur Laila Rahayu, "Isolation and General Characterization of Suspected Enterobacteriaceae Microbes in Snacks in the Purwokerto Area Using the Emba Medium Isolation and General Characterization of Suspected Enterobacteriaceae Microbes in Street Food Around Purwokerto Area Using the Emba Medium,"*Sci. Timeline*, vol. 2, no. 1, pp. 42–51, 2022, [Online]. Available: https://jurnal.unupurwokerto.ac.id/index.php/sciline
[6] Z. Getriani, JA Priyanto, and S. Budiarti, "Detection of Gram-Negative Bacteria on the Surface of Basil Leaves (Ocimum basilicum) from Three Traditional Markets in Bogor,"*J. Sumberd. Biological*, vol. 9, no. 4, pp. 138–144, 2023, doi: 10.29244/jsdh.9.4.138-144.
[7] NL Fitriani and S. Andriyani, "The Relationship Between Knowledge and Attitudes of Final School Age Children (10-12 Years) Regarding Snacks at SD Negeri Ii Tagog Apu Padalarang, West Bandung Regency, 2015,"*J. Educator. Indonesian Nursing.*, vol. 1, no. 1, p. 7, 2015, doi: 10.17509/jpki.v1i1.1184.
[8] AD Moelyaningrum, RA Permatasari, and N. Rohmawati, "Sanitation Hygiene and the Presence of Escherichia Coli Bacteria in Semanggi as a Traditional Snack in Surabaya (Study in Kampoeng X, Y District, Surabaya),"*Amerta Nutr.*, vol. 7, no. 3, pp. 390–399, 2023, doi: 10.20473/amnt.v7i3.2023.390-399.
[9] AE Maharani, DA Sari, and Q. Fadillah, "Content of Escherichia Coli and Salmonella SP bacteria. on Siomay Sold in SEI Putih Village, Medan," vol. 4, pp. 5638–5644, 2022.
[10] N. Annida, "Pathogenic Microbes Cause Foodborne Disease and Efforts to Reduce the Prevalence of Foodborne Disease in Indonesia,"*Inst. Technol. Bandung*, no. July, pp. 1–7, 2018.
[11] AP Tama, VL Hasna, KA Hermawan, MR Utami, and L. Nurfadhila, "Methods for Analysis of Microbial Contamination in Food: Review Article,"*J Pharm. Sci.*, vol. 6, no. 2, pp. 586–591, 2023, doi: 10.36490/journal-jps.com.v6i2.46.
[12] T. Jiastuti, "Food Management Sanitation Hygiene and the Presence of Bacteria in Prepared Food at RSUD Dr. Harjono Ponorogo,"*J. Health. Environment.*, vol. 10, no. 1, p. 13, 2018, [Online]. Available: https://e-journal.unair.ac.id/JKL/article/view/9382
[13] KC Diyanah, N. Nirmalasari, R. Azizah, and AS Pawitra, "Personal Hygiene Factors with the Presence of Escherichia coli in Food at Jasaboga Hajj Dormitory Surabaya,"*PREPOTIF J. Health. Masy.*, vol. 5, no. 2, pp. 673–680, 2021, doi: 10.31004/prepotif.v5i2.1830.
[14] E. Fitrah, P. Jaya, and SK Kesehatan, "Hygiene And Sanitation In Food Processing In The Modern Islamic Boarding School Darussalam Gontor Putri 4 In Lamomea Village, Kond District," vol. 5, no. 1, pp. 1–21, 2017.
[15] A. Indrawati,*Types of bacteria that cause disease in food*, no. March. 2024.
[16] Y. Yennie, R. Dewanti-Hariyadi, HD Kusumaningrum, and A. Poernomo, "Contamination of Staphylococcus aureus and Bacillus cereus in Sushi at Retail Level in Jabodetabek Area,"*J. Processor. Has. Fisheries. Indonesia.*, vol. 25, no. 2, pp. 331–344, 2022, doi: 10.17844/jphpi.v25i2.42066.
[17] S. Kartini, "Analysis Of Staphylococcus Aureus Contamination On Snack Food In Primary Schools, Tampan District, Pekanbaru,"*JOPS (Journal of Pharm. Sci.*, vol. 4, no. 2, pp. 12–17, 2020, doi: 10.36341/jops.v4i2.1350.
[18] FD Martanda, "Identification Of Salmonella Sp. And Staphylococcus Aureus And Calculate The Total Number Of Bacteria In Margarine,"*J. SainHealth*, vol. 3, no. 2, p. 17, 2019, doi: 10.51804/jsh.v3i2.599.17-21.
[19] R. Fitriana and W. Kurniawan, "Food quality control with the application of good manufacturing practices (GMP) in the production process of Betawi dodol (case study of UKM MC) food quality control with the application of good manufacturing practices (GMP) in the production process of dodol betawi (case study sme mc)," vol. 30, no. 1, pp. 110–127, 2020.
[20] AD Ayu, "Quantitative Microbial Risk Assessment (QMRA) Salmonella and Escherichia coli

Bacteria in Chicken with Fresh Vegetable at Food Stalls Around the University of Hasanuddin Makassar," 2020.

[21] I. Permatasari, S. Handajani, S. Sulandjari, and M. Faidah, "Food Sanitation Hygiene Behavior Factors among Street Vendor Food Handlers,"*J. Catering*, vol. 10, no. 2, pp. 223–233, 2021, [Online]. Available: https://ejournal.unesa.ac.id/index.php/jurnal-tata-boga/

[22] M. Taufik, AD Prasetyo, and I. Yahya, "Socialization of Sanitation Hygiene among Food Stall Traders," vol. 12, no. 1, pp. 32–36, 2021.

[23] F. Aryanti, SP Makkadafi, and MJ Saputri, "pISSN:2355-7583 | eISSN:2549-4864 http://ejurnalmalahayati.ac.id/index.php/kesehatan,"*Jurnalmalahayati*, vol. 10, no. 3, pp. 1672–1680, 2023.

[24] A. Fadli,*Factors Relating To Food Sanitation Hygiene Among Snack Traders In Junior High Schools, Kayuagung District, Oki District, 2022*. 2022.

[25] RM Sadomo and A. Siwiendrayanti, "The Relationship between Hygiene and Sanitation of Snack Centers and the Presence of Eschericia coli Bacteria,"*Higeia J. Public Heal. Res. Dev.*, vol. 7, no. 1, pp. 90–99, 2023.

[26] D. Sartika, S. Hidayati, and H. Fitriani, "Study of Pathogenic Bacterial Contamination in Processed Fish Products,"*J. Researcher. Pertan. Apply.*, vol. 19, no. 2, p. 109, 2020, doi: 10.25181/jppt.v19i2.1406.

[27] J. Zhu*et al.*, "A risk assessment of salmonellosis linked to chicken meals prepared in households of China," Food Control, vol. 79, pp. 279–287, 2017, doi: 10.1016/j.foodcont.2017.04.003.

[28] RP Rizki, MZ Arifin, and I. Aini, "Identification of Salmonella Sp Bacterial Contamination in Broiler Chicken at Pon Market, Jombang Regency,"*Medicra (Journal Med. Lab. Sci.*, vol. 5, no. 1, pp. 6–10, 2022, doi: 10.21070/medicra.v5i1.1621.

[29] S. Restianida, Mifbakhuddin, and RS Wardani, "The Relationship Between Personal Hygiene And Environmental Sanitation And It Is Between Escherihia Coli And Salmonella Bacteria Contaminants On Pecel Catfish Fresh Food," p. 45, 2018.

[30] A. Asyra Ainun, U. Sulaeman, and Abd. Gafur, "Microbial Risk Assessment (MRA) of Drinking Water Refills at the Drinking Water Depot (DAM) in the Work Area of the Antang Health Center, Makassar City,"*Wind. Public Heal. J.*, vol. 3, no. 2, pp. 321–331, 2022