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# Identification Of Cadmium (Cd) Content In The Catch Cumi (Loligo Sp) In Langgula Village, Sub-District Batudaa Beach, Gorontalo Regency

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**ABSTRACT**

Animal food that is suitable for consumption must be safe, nutritious, contamination-free, and halal. Squid (Loligo sp) is a carnivorous animal that is widely found in Langgula Village, Batudaa Pantai District, Gorontalo Regency and is a leading commodity with an average catch of 450 kg/month or 15 kg/day. One of the threats to the quality of squid is the pollution of the heavy metal cadmium (Cd) which is toxic, cannot be degraded naturally, and easily accumulates in marine organisms, thus potentially endangering human health and ecosystems through the processes of bioconcentration, bioaccumulation, and biomagnification. This study aims to identify the heavy metal content of cadmium (Cd) accumulated in squid (Loligo sp) in Langgula Village, Batudaa Pantai District, Gorontalo Regency. The type of research used is quantitative research using a descriptive approach method aimed at describing the content of Cd in squid. Samples were obtained from four collection points. The analysis of the content of Cd used the Atomic Absorption Spectrophotometry (AAS) method. The results showed that the heavy metal content of cadmium (Cd) contained in squid (Loligo sp) at point 1 was 0.182 mg/kg, at point 2 as much as 0.114 mg/kg, at point 3 as much as 0.278 mg/kg, and at point 4 as much as 0.385 mg/kg. These results show that the heavy metal content of cadmium (Cd) in squid (Loligo sp) exceeds the quality standard according to the Food and Drug Control Agency of the Republic of Indonesia (BPOM) Number 23 of 2017, which is 0.10 mg/kg, so it is not safe for consumption. The results of the research are expected to be considered for local governments and communities in managing fishery resources, preventing pollution, and educating the public about the dangers of heavy metals to health and can use natural ingredients to reduce the Cd content in squid before processing.

## INTRODUCTION

Heavy metal pollution is a type of pollution that comes from industrial waste. When the remaining industrial products containing heavy metals are released into the waters, the material will undergo dilution so that its pollution is reduced. However, if these pollutants are constantly entering the waters, then there will gradually be an accumulation of heavy metals that eventually settle in the marine sediments. Heavy metal pollution that occurs in waters can cause the accumulation of heavy metals in the biota body. This will affect various organisms around it, one of which is cadmium (Ghifari et al., 2022)

Cadmium (Cd) is a highly toxic heavy metal. When this metal contaminates humans or animals, it can cause damage to various organs, such as lung dysfunction, liver and kidney damage, sperm damage, reproductive system disorders, and can even interfere with heart function. (Najihah & Rachmadiarti, 2023).

The two main sources of Cd contamination that can pollute the environment are the earth's crust (natural) and human activities (anthropogenic). Cd is widely used as a pigment in paints, PVC/plastics, and nickel cathodes. Rahmadani & Diniariwisan (2023) said that at this time, heavy metals type Cd have polluted many waters, both fresh and sea. This contamination results in the organisms living in it being polluted. Cd pollution is not only found in freshwater aquaculture environments, but has also spread to marine waters. The presence of Cd in the ocean causes the surrounding organisms to be contaminated.

Animal products that can be consumed by humans should comply with food safety standards, which consist of safe, healthy, intact and halal. According to Oktari *et al*., (2023) One of the marine products that people love is squid *(Loligo sp)*. Squid live from coastal waters to deep waters with depths of up to 15 meters. Squid in Indonesia is spread in waters with a temperature of 22-30°C. Squid fishing is currently carried out massively without paying attention to its sustainability. Squid are quite fast-moving animals, especially when they swim using jet propulsion (taking advantage of the flow of water expelled from their bodies). They can reach speeds of about 25 km/h when gliding through water, although this speed can vary depending on the species and size of the squid. Squid often dwell on the seafloor such as sediments or near substrates such as rocks, sand, or coral reefs (Mulyono *et al*., 2023).

Initial observations found that the source of Cd contamination came from paint and metal materials on boats used by fishermen as a means of transpotation to catch squid and also suspected to be domestic waste derived from human activities around the waters of Langgula Village. Domestic waste, especially those containing chemicals or heavy metals such as cadmium, can be a source of marine pollution. Garbage dumped on the ground can be degraded by rainwater that absorbs into the soil so that it flows into the sea. Cadmium from this waste dissolves into groundwater through *Leachate* (leachate) that seeps through piles of garbage or other waste materials. During this process, water dissolves various chemicals, particles, and pollutants from the waste, resulting in highly polluted liquids (Indirawati, 2017).

Several previous studies have been conducted to measure the metal content of Cd in marine life such as Mardani *et al*., (2018), The results of the study showed that the heavy metal (Cd) content in Baronang fish exceeded the maximum limit of Cd contamination in fish and fishery products, which was 0.1 mg/kg. Based on BCF values, the mullet was found to have a bioconcentration with a low cumulative category for heavy metals (Pb) and a moderate cumulative category for heavy metals (Cd).

## RESEARCH METHODS

### Research Location and Time

The research location for squid sampling is in the waters of Tomini Bay, Langgula Village, Batudaa Pantai District, Gorontalo Regency. Meanwhile, sample examination was carried out at the Gorontalo Provincial Regional Health Laboratory Center, and the research time was carried out in April – May 2025.

### Research Design

The type of research used is quantitative research using a descriptive approach method aimed at describing the content of Cd in Squid *(Loligo sp).*

### Population and Sample

The population in this study is all squid catches *(Loligo sp)* taken from the waters in Langgula Village and the sample of this study was taken from the catch of squid with the same size, namely the size of the squid length of 10 cm and the weight of 100 grams obtained based on 4 squid collection points by fishermen in the waters of Langgula Village.

Figure 2.1 Squid sampling point

## RESULTS

### Results of measurement of cadmium (Cd) heavy metal content in seawater and water characteristics in Langgula Village, Batudaa Pantai District, Gorontalo Regency

The data from the measurement of the heavy metal content of cadmium (Cd) in seawater in Langgula Village, Batudaa Pantai District, Gorontalo Regency obtained from four sampling points in the waters is presented in the following table:

**Table 1 Cadmium heavy metal content in seawater in the waters of Langgula Village, Batudaa Pantai District, Gorontalo Regency**

| No. | Sampling point | Measurement results Cd (mg/L) |
|---|---|---|
| 1. | Point 1 | **0** |
| 2. | Point 2 | **0** |
| 3. | Point 3 | **0** |
| 4. | Point 4 | **0** |

*Source:* Primary data 2025

Based on table 1, the results of the measurement of the heavy metal content of cadmium (Cd) in seawater in Langgula Village, Batudaa Pantai District, Gorontalo Regency, at the four sampling points were found to be 0 mg/L. At all four points, it is still below the threshold based on the decree of the Minister of State for the Environment No. 51 of 2004 concerning Seawater Quality Standards for Ports, which is 0.01 mg/L.

In most waters, the dominant factors that trigger ocean currents are wind and tides. Currents have an important role in determining the condition of a water. Welch (1980) distinguishes currents into 5 categories, namely very fast (>1 m/s), fast (0.5-1 m/s), medium (0.25-0.50 m/s), slow (0.1-0.25 m/s) and very slow (<0.1 m/s) currents. The rapid slowness of the current in the waters affects the distribution of heavy metals, therefore the speed of the current is one of the determining factors for the concentration of Cd content in the waters of Langgula Village.

**Table 2 Characteristics of the waters in Langgula Village, Batudaa District, Pantai Gorontalo Regency**

| No. | Sampling point | Current speed (m/s) | Current classification | Current direction |
|---|---|---|---|---|
| 1. | Point 1 | 0,42 | Medium | **Stuart** |
| 2. | Point 2 | 0,46 | Fast | **Stuart** |
| 3. | Point 3 | 0,33 | Medium | **Stuart** |
| 4. | Point 4 | 0,46 | Fast | **Stuart** |

*Source:* Primary data 2025

According to Fendjalang *et al.,* (2022), the speed of seawater currents affects the dispersion and accumulation of heavy metals. Slow currents cause heavy metals to settle and accumulate in the sediment. In contrast, fast currents spread heavy metals more widely and can lift metals from the bottom into the water column, thus increasing exposure to marine organisms.

**Results of measurement of cadmium (Cd) heavy metal content in squid *(Loligo sp)* in Langgula Village, Batudaa District**

Data from the measurement of cadmium (Cd) heavy metal content in squid in Langgula Village, Batudaa Pantai District, Gorontalo Regency obtained from four sampling points in the waters are presented in the following table:

**Table 3 Cadmium heavy metal content in Squid (Loligo sp) in Langgula Village, Batudaa District, Pantai Regency**

| No. | Sampling point | Cd measurement results (mg/kg) | Threshold classification |
|---|---|---|---|
| 1. | Point 1 | 0,182 | **Exceeding quality standards** |
| 2. | Point 2 | 0,114 | **Exceeding quality standards** |
| 3. | Point 3 | 0,278 | **Exceeding quality standards** |
| 4. | Point 4 | 0,386 | **Exceeding quality standards** |

Source: Primary data 2025

Table 3 shows the Cd content in squid *(Loligo sp)* obtained from the waters of Langgula Village. The highest concentration of Cd was found in the sample at point 4 with a value of 0.386 mg/kg, while the lowest concentration was found at point 2 at 0.114 mg/kg. At point 1 the Cd content was recorded at 0.182 mg/kg, and at point 3 it was 0.27 mg/kg. The results show that the heavy metal content of cadmium (Cd) at the four sampling points has exceeded the maximum limit set in the Regulation of the Head of the Food and Drug Supervisory Agency of the Republic of Indonesia Number 23 of 2017 concerning the Maximum Limit of Heavy Metal Contamination in Processed Foods, which is 0.10 mg/kg.

## DISCUSSION

### Characteristics of the waters in Langgula Village, Batudaa Pantai District, Gorontalo Regency

Langgula Village is one of the coastal villages located in Batudaa Pantai District, Gorontalo Regency and has an area of approximately 450 hectares. The region is geographically directly adjacent to Tomini Bay to the south, and consists of land and water areas that support various activities, especially in the marine and fisheries sectors.

The oceanographic condition of the waters of Langgula Village is influenced by quite dynamic sea currents. Based on the results of measurements at four sampling points, it is known that the current speed in these waters is approximately 0.33 m/s to 0.46 m/s, with the direction of the dominant current pointing north. According to the classification of currents by Welch (1980), the velocity is classified as medium to fast current. The speed of currents plays an important role in the movement of seawater masses, nutrient distribution and the stability of marine ecosystems that indirectly support marine life in this region.

In addition to the current factor, the basic characteristics of the waters around Langgula Village are also one of the factors that affect the existence of marine organisms. The seabed in this area is dominated by sand, mud, and rock substrates that are important habitats for various types of marine life including squid *(Loligo sp),* fish, and other benthic organisms. Community activities are highly dependent on marine products, making the waters of Langgula Village the main center of fishing activities. The leading commodity in this village is squid, which is routinely caught by local fishermen. Based on data from the village government, the average catch of squid reaches 450 kg per month. Therefore, it is not surprising that this village was officially designated as a "Squid Village" by Gorontalo State University in 2022.

Overall, the characteristics of the waters of Langgula Village are characterized by fairly active sea current conditions, diverse marine substrates, and high fisheries potential. All of these aspects make this area a productive coastal area and play an important role in supporting the economic sustainability of the community through the fisheries sector.

The speed of seawater currents is one of the important physical parameters in oceanographic studies that describes the rate of mass displacement of seawater in units of time. This velocity is usually expressed in meters per second (m/s) or centimeters per second (cm/s) and indicates how fast and in which direction seawater flows in an area of water. The direction and speed of ocean currents play an important role in regulating the distribution and accumulation of heavy metal cadmium (Cd) in waters. The results of measurements in the waters of Langgula Village show that the current speed ranges from medium to fast, which affects the process of transferring water masses and mixing water columns, so that heavy metals in sediments and those from anthropogenic sources can be spread over a wider area. Currents with consistent direction can also potentially carry particles or Cd ions from the area of the source of contamination to the squid capture zone. Sea currents themselves occur due to the influence of various natural factors, such as surface winds, differences in water density (due to variations in temperature and salinity), tides, and the topographic shape of the seabed. The speed of ocean currents varies depending on depth, geographic location, season, and time (day or night) (Prayogo, 2021).

Referring to table 4.2, the results of the measurement of the heavy metal content of cadmium (Cd) in the waters of Langgula Village, Batudaa Pantai District, Gorontalo Regency at four sampling points showed a result of 0 mg/L. All sampling points showed that the level of Cd was still below the seawater quality standard threshold for ports, which was 0.01 mg/L, as stipulated in the Decree of the Minister of State for the Environment Number 51 of 2004.

### Heavy metal content of cadmium (Cd) in the catch of squid (Loligo sp) in Langgula Village, Batudaa Pantai District, Gorontalo Regency

According to (Nurulludin et al., 2022), squid *(Loligo sp)* is a type of mollusk of the class *Cephalopoda* which has a wide distribution in tropical and subtropical waters, including in Indonesian territory. As a nectonic and active swimming organism, squid are usually found in coastal to high seas waters, depending on their life stages and environmental conditions. The natural habitat of squid is generally in areas that have a water bottom in the form of sand, mud, or rocks that act as a place to shelter, hunt, and lay eggs.

Squid *(Loligo sp)* It is classified as a bentopelagic organism, which is an organism that lives and swims close to the bottom of the water *(benthic zone)* yet remain active in the water column *(pelagic zone)*. This species has good adaptability to variations in depth, temperature, and salinity. Some studies show that squid of

the genus *Loligo* tends to choose habitats with depths between 20 – 250 meters, which are areas with mixed substrate conditions between sand and rocks and are quite rich in small organisms as a food source (Aziz et al., 2023).

Environmental factors such as water temperature, dissolved oxygen levels, flow speed, and water clarity greatly affect the distribution and presence of squid in an area. The ideal water temperature for squid ranges from 20 – 30°C, which is a common temperature in tropical waters such as the Gulf of Tomini. In addition, squid also tend to be active at night and often approach the sea surface at night to hunt, then return to the seabed during the day. The presence of squid in a body of water is also closely related to the availability of food. As predators, squid feed on zooplankton, small crustaceans, fairly active ocean currents, and stable oceanographic conditions are suitable habitats for squid *(Loligo sp).*

Cadmium (Cd) is a highly toxic heavy metal. When this metal contaminates humans or animals, it can cause damage to various organs, such as lung dysfunction, liver and kidney damage, sperm damage, reproductive system disorders, and can even interfere with heart function (Najihah & Rachmadiarti, 2023). According to Rahmadani & Diniariwisan (2023), the heavy metal type cadmium (Cd) has now polluted a lot of aquatic ecosystems, both in freshwater and marine areas. As a result of this pollution, various organisms living in it are also exposed. Cd contamination has not only occurred in the freshwater aquaculture environment, but has also spread to marine waters resulting in pollution of surrounding living things.

Samples of squid *(Loligo sp)* in the waters of Langgula Village were obtained from four sampling points with distances measured using *the Google Earth Pro* application. Here is a description of the distance:

1) Point 1 sampling is ±200 meters from the coastal point (growncheck)
2) Point 2 sampling is ±280 meters from the coastal point (growncheck)
3) Point 3 sampling is ±305 meters from the coastal point (growncheck)
4) Point 4 sampling is ±260 meters from the coastal point (growncheck)

According to São Paulo, São Paulo *et al.,* (2023), in addition to seawater, the content of heavy metals Cd is also found in sediments or seabeds. This causes over time, heavy metals in water undergo a process of deposition and accumulation in sediments. Thus, the concentration of heavy metals in sediments can be higher than the water level.

The heavy metal content of cadmium (Cd) detected in squid *(Loligo sp)* in the waters of Langgula Village showed variations in concentration between sampling points. Although the Cd content in seawater at all points is not detected or 0 mg/L, this does not rule out the possibility of Cd accumulation in marine life, especially squid that interact directly with sediments and food chains. Therefore, it is important to identify the source of contamination based on each collection point.

**Point 1 sampling**

The Cd content in squid at this point is 0.182 mg/kg, the location of this point is about ±200 meters from the coastline. The high concentration at the 1st collection point is due to the fact that this point is a place where small boats are docked and close to coastal areas where there are residential areas that produce domestic waste, namely old plastic containing cadmium pigment.

Anthropogenic sources of Cd contamination in water can come from household waste (such as cadmium-pigmented plastic waste) and electronic waste, especially waste from electronic items (such as old batteries, mobile phones, or other electronic equipment) can contain Cd. In addition, Cd can enter the ocean through river flows that drain waste from land to the sea. River flows have an important role as a means of transportation from the mainland to the sea (Milasari et al., 2023).

**Point 2 sampling**

This point is the point with the lowest Cd content, which is 0.114 mg/kg. This point is located ±280 meters from the coast and there is relatively low human activity. The low activity at this point indicates that large Cd contamination comes from natural processes, such as the diffusion of heavy metals through ocean currents as well as the transfer of Cd contamination from other locations due to river flows to the sea.

(Ikhsan et al., 2023) said that the presence of Cd in the waters can come from natural processes such as abrasion from rivers and community activities, such as market waste disposal and household waste, as well as ship repair and inspection activities on the coast. Plastic waste such as packaging bottles, food wrappers, and brightly colored plastic fragments (yellow, orange, red, blue) can be a source of cadmium contamination. This is due to the use of cadmium-based pigments and additives in the production process of some types of plastics, especially in old or low-quality products.

**Point 3 sampling**

This point shows a Cd content of 0.278 mg/kg. The location is around the shipping activity area. Potential sources of contamination at this point are the presence of diesel/ship oil spills containing heavy metals including Cd, metal corrosion on ships/boats and machinery releasing Cd particles into the environment. The high cadmium content at this point can also be caused by the process of cadmium accumulation (Cd) in squid *(Loligo sp)* through the food chain and sediment as the main habitat of squid.

According to Lindawanti (2017), the high content of Cd found in squid *(Loligo sp)* It is caused by the process of accumulation of heavy metals from the aquatic environment, mainly through sediments and food chains. Accumulation of cadmium (Cd) in the body of a squid *(Loligo sp)* occurs through the food route. The heavy metal cadmium (Cd) is absorbed by phytoplankton, then eaten by zooplankton. Zooplankton is then consumed by small squid, which then becomes food for larger squid, as squid are predators (cannibalism). Because squid actively prey on small organisms such as plankton, cadmium continues to accumulate in its body. In the digestive system of squid, food enters through the mouth equipped with a radula (spiny tongue) and two hard jaws like a beak. The digestive process is aided by the salivary glands and digestive glands such as the liver and pancreas. After being digested in the stomach, the nutrients are absorbed in the intestines, then the rest of the digestive tract is expelled through the rectum and anus which drains into the mantle cavity.

**Point 4 sampling**

The Cd content at this point is the highest Cd content, which is 0.386 mg/kg. This point is located about ±260 meters from the coastline and is one of the central points of shipping activities and an outboard boat docking. The source of pollution at this point is diesel/oil spills from ships/boats used by fishermen for shipping activities, as well as peeling off ship/boat paint that contains Cd as a pigment material.

According to Anggreani et al., (2021) Diesel or ship oil spills are not directly a major source of cadmium (Cd) pollution in the ocean, but have the potential to be a significant indirect contributor. Fuels such as diesel and ship oil contain a variety of heavy metals including cadmium. When ship/boat fuel leaks or spills into the waters, these metal compounds can dissolve or spread in the waters and contaminate the marine environment. Additionally, ship components such as engines, fuel tanks, and metal propellers can be corroded due to exposure to seawater. In addition, diesel spilled into the ocean can attach to microplastics containing heavy metal additives, accelerating the process of releasing cadmium into the environment. Therefore, although not a major source, shipping activities and ship fuel leaks still need attention as one of the sources of heavy metal pollution in the ocean that can harm marine organisms and the food chain.

Petroleum as a raw material for diesel naturally contains various heavy metal elements such as cadmium, nickel, and vanadium. Serendipity *et al.,* (2023) stated that in the process of processing crude oil into diesel, some of these heavy metals can still survive as impurities. In addition, fuel refining processes that use specific metal-based catalysts can also contribute to the cadmium content of the final product. When diesel spills into the waters, the dissolved and dispensed fractions will spread in the water column and bind to organic and inorganic particles. The cadmium contained in solar is persistent and *biodegradable*, so it cannot decompose naturally and tends to settle in sediments.

The results showed that although the cadmium (Cd) content in seawater in the waters of Langgula Village was not detected or 0 mg/L, the Cd content in squid *(Loligo sp)* is in the range of 0.114 – 0.386 mg/kg and exceeds the threshold according to BPOM. This phenomenon can be explained through three main processes, namely bioconcentration, bioaccumulation and biomagnification. According to Revelation *et al.,* (2020), bioconcentration is the initial stage in which Cd is absorbed directly from the environment, either through the surface of the body or the gills, without going through the food chain. In squid living on the seafloor, bioconcentration occurs when the squid is exposed to seawater or sediment containing Cd. Although measurements on seawater in Langgula Village show 0 mg/L, sediment on the seafloor still has the potential to be a significant source of Cd because heavy metals tend to settle on the substrate of the bottom of the water.

Bioaccumulation is the process of accumulating Cd in the body tissues of squid over time, both from water and from the food it consumes. Squid as a bentopelagic predator eat small crustaceans, fish, or other benthic organisms that have been contaminated with Cd. *Non-degradable* or cannot be biologically decomposed and difficult to remove from the body, the concentration will continue to increase with age and eating activities of squid (Amelia et al., 2019).

Kusuma *et al.,* (2022), states that the process of biomagnification is an increase in the concentration of Cd at each trophic level in the food chain. This process starts with phytoplankton absorbing Cd, then being eaten by zooplankton, continued by fish or small and finally eaten by squid. At each level, the concentration of Cd increases, so that it peaks in predators such as squid. This phenomenon explains why, although seawater has a very low or undetectable Cd content and in squid *(Loligo sp)* The content of Cd has exceeded the threshold according to BPOM.

According to Bubala *et al.,* (2019) Heavy metals have toxic or toxic properties and are essential that can dissolve in water so that they pollute fresh waters and the sea. Heavy metal pollution has the potential to

damage aquatic ecosystems, particularly on populations and biodiversity. The extent of ecosystem damage due to heavy metal pollution is determined by various factors, including the concentration and amount of heavy metals entering the waters. In addition, heavy metal pollution can also cause changes in the shape and physical condition of the waters, such as taste, color, and smell.

Cd heavy metals have now polluted many waters, both freshwater and sea. This pollution results in the organisms that live in it also being contaminated. Cd contamination has not only been found in freshwater aquaculture environments, but has also spread to marine waters. The presence of Cd in the ocean causes the surrounding organisms to be polluted. Squid *(Loligo sp)* They usually live or forage on the seafloor, so they are more exposed through direct contact with sediments or polluted seafloor organisms. Heavy metals like cadmium tend to settle on the seafloor (sediments) because they easily attach to mud particles, sand, or organic matter. According to São Paulo, São Paulo *et al.,* (2023), In addition to being found in marine waters, the heavy metal content of Cd is also found in sediments or the seabed. This happens because over time heavy metals in the water undergo a deposition process and accumulate in the sediment, so the concentration can be higher than in the surface layer of the water.

Squid belong to the phylum molluscs, namely the *Cephalopod* group (soft-bodied animals) which is one of Indonesia's fishery resources. Squid are fairly fast moving animals at a speed of about 25 km/h especially when they use jet propulsion (utilizing the flow of water expelled from their bodies). Squid often dwell on the seafloor such as sediments or near subscribing such as rocks, sand, or coral reefs.

Heavy metal content in squid *(Loligo sp)* It is influenced by the type of compound and the level of contaminant containment that exists. Squid activities *(Loligo sp)* And the food chain has a huge influence on the amount of heavy metals contained in its body. According to Paramtomy *et al.,* (2017), the process of entering cadmium (Cd) into the squid tissue occurs indirectly through the food chain. Cadmium released into the ocean dissolves in water or binds to sediment particles, then absorbed by low-trophic organisms such as phytoplankton and zooplankton. These small organisms are then eaten by intervebrata such as small shrimp or other benthic animals. When the animal consumes cadmium-contaminated particles, the heavy metal begins to accumulate in their body tissues. Squid as a predator, then eat these contaminated organisms. Because heavy metals like cadmium are not easily removed from the body, cadmium will continue to accumulate over time. It also deals with the heavy metal cadmium, where the concentration level exceeds the specified limit.

This is in line with research conducted by (Wahyuningsih, 2014) stated that the results of the analysis showed the cadmium (Cd) content in the squid *(Loligo sp)* in Egg Jakarta was 0.047 in the eastern season and increased to 0.273 in the western season. Despite the increase, the Cd level in squid is still below the maximum threshold according to SNI (2009). However, these results still indicate that there is a potential for pollution that needs to be watched out, especially for the safety of marine product consumption in the region.

## CONCLUSION

The results of the study show that the waters in Langgula Village still have physical and chemical characteristics that are in the normal range, so that they are able to support the survival of marine life, including squid (Loligo sp). This condition indicates that the local aquatic ecosystem has good potential for the sustainability of biological resources. However, based on the results of laboratory tests, the cadmium (Cd) content in squid (Loligo sp) was recorded at 0.386 mg/kg at one of the sampling points, which exceeded the maximum threshold of 0.10 mg/kg according to the provisions of the Regulation of the Head of the Food and Drug Control Agency of the Republic of Indonesia Number 23 of 2017. These findings indicate the potential for heavy metal pollution in the waters, so regular monitoring and control efforts are needed to maintain environmental quality and the safety of marine life consumption.

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