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Analysis of Cadmium (Cd) And Chromium (Cr) In River Water Using Atomic Absorption Spectrophotometry (Aas): Implications for Livestock Drinking Water

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Abstract:*River pollution caused by industrial, agricultural, and domestic waste can lead to the accumulation of toxic heavy metals that are difficult to degrade and may pose risks to ecosystems, human health, and livestock. Information regarding heavy metal contamination in river water used as livestock drinking water in Lampung remains limited, and studies evaluating its potential impacts on livestock are still scarce. This study aimed to analyze the concentrations of the heavy metals cadmium (Cd) and chromium (Cr) in river water using Atomic Absorption Spectrophotometry (AAS) and to examine their implications for livestock drinking water. This research used a descriptive quantitative approach through sample collection at three river flow points, namely the upstream, middle, and downstream sections. The analysis was carried out at the Environmental Laboratory UPTD of Lampung Province, referring to SNI 6989.84:2019, with method validation through precision testing, accuracy testing, and the determination of the limit of detection (LOD) and limit of quantitation (LOQ). The results showed that Cd concentrations ranged from 0.0025 to 0.0216 mg/L, while Cr concentrations ranged from 0.0125 to 0.0412 mg/L. Cd concentrations at several sampling points exceeded the Class III water quality standard under Government Regulation No. 22 of 2021, whereas Cr remained below the applicable quality threshold. Thus, the presence of Cd may have adverse effects on livestock health if river water is used continuously as a drinking water source, while Cr is still considered safe based on the applicable quality standard. These findings provide baseline information for environmental monitoring and livestock water safety assessment in Lampung and may serve as a reference for future water quality management and pollution control efforts.*

Keywords:*Cadmium and Chromium metals, River Water, AAS, Livestock.*

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I. INTRODUCTION

Rivers are among the most important surface water resources supporting human life. They continue to serve as primary sources of raw water for drinking water supply companies (Rosmeiliyana, 2021). Water flows dynamically from upstream to downstream through river networks, with its characteristics influenced by seasonal variations, land-use changes, and the activities of surrounding communities (Herliwati, 2021). In upstream areas, water quality is generally well preserved because the ecosystem experiences relatively minimal disturbance. However, environmental degradation and pollution begin to emerge in the middle reaches of rivers, primarily as a result of anthropogenic activities. In downstream sections, pollution levels and environmental damage are typically more severe. These conditions lead to changes in both the quantity and quality of river water, depending on the dynamics of the river ecosystem and the intensity of human activities within the watershed (Angello et al., 2021). Therefore, continuous monitoring of water quality and identification of pollution sources are essential for effective river conservation and sustainable water resource management.

Human activities within river catchments constitute one of the major sources of heavy metal contamination in aquatic environments. Industrial effluents, domestic wastewater, and improperly managed solid waste introduce heavy metals and other toxic substances into rivers at concentrations considerably higher than their natural background levels (Yanti & Afdal, 2021). The accumulation of these contaminants poses significant ecological risks, adversely affecting aquatic organisms and degrading overall water quality (Nurhidayati et al., 2021).

Heavy metals can accumulate throughout the food chain, beginning with uptake by primary producers and continuing through successive trophic levels via consumption. In humans, exposure occurs primarily through inhalation and ingestion, whereas in animals, heavy metals enter the body through contaminated feed, forage, drinking water, and veterinary pharmaceuticals. Among the most hazardous heavy metals are cadmium (Cd) and chromium (Cr), both of which are classified as non-essential metals because they are not required for normal biological functions. Exposure to excessive concentrations of these metals may result in severe toxic effects, including neurological disorders, digestive disturbances, organ damage, and even death (Dudev& Lim, 2014).

Heavy metals have attracted considerable attention as environmental pollutants because of their toxicity, persistence, and tendency to accumulate in aquatic ecosystems. These contaminants may remain dissolved in the water column or become deposited in sediments, which subsequently act as long-term secondary sources of pollution through remobilization processes. The presence of heavy metals in river water can significantly deteriorate water quality and negatively affect aquatic organisms while also posing risks to human health through bioaccumulation and biomagnification (Alloway, 2013). Consequently, determining heavy metal concentrations is an essential component of water quality assessment to evaluate pollution levels and determine compliance with established environmental quality standards.

Although numerous studies have investigated heavy metal contamination in various aquatic ecosystems, research specifically addressing heavy metal pollution in river ecosystems, particularly its relationship with wildlife health, remains relatively limited. Most previous studies have primarily focused on measuring heavy metal concentrations in water and sediments, whereas information regarding bioaccumulation, toxicity, and the effects of heavy metal contamination on animals inhabiting riverine environments is still scarce. This lack of information creates a significant knowledge gap concerning the relationship between heavy metal pollution levels and the biological conditions of aquatic and semi-aquatic organisms. Therefore, studies on heavy metal contamination in rivers are essential to expand the existing scientific database and provide a stronger foundation for aquatic environmental management and wildlife conservation efforts in river ecosystems (Jaishankar et al., 2014).

Various analytical techniques are available for assessing water quality, as recommended in regulatory guidelines and scientific literature. The selection of an appropriate method depends on instrument availability, technical expertise, and the required level of analytical accuracy. In the present study, Atomic Absorption Spectrophotometry (AAS) was employed to determine the concentrations of heavy metals in river water samples. AAS is an analytical technique used to quantify metal concentrations by first atomizing the sample, typically using a flame atomization system. The method is based on the absorption of electromagnetic radiation by free atoms as they transition from the ground state to an excited energy level (Solikha, 2019). Atomic Absorption Spectrophotometry offers several advantages, including high sensitivity, relatively low operational cost, simplicity, rapid analysis, and minimal sample requirements (Kiswandono et al., 2022).

Based on the aforementioned background, this study aimed to determine the concentrations of the heavy metals cadmium (Cd) and chromium (Cr) in river water samples using Atomic Absorption Spectrophotometry (AAS) and to evaluate their implications for livestock drinking water quality. The laboratory analyses were conducted at the UPTD Environmental Laboratory, Environmental Agency of Lampung Province, an accredited governmental environmental laboratory certified by the National Accreditation Committee (KAN). Heavy metal analyses were performed in accordance with Indonesian National Standard (SNI) 6989.84:2019 (BSN, 2019), and the measured concentrations were evaluated against the water quality standards specified in Government Regulation of the Republic of Indonesia No. 22 of 2021, Appendix VI.

II. EXPERIMENTAL PROCEDURE

1.1 Metode

Research was conducted from May to August 2025 in South Lampung Regency, Lampung Province. The research samples, consisting of river water, were taken at three observation points: upstream, midstream, and downstream. The identity of the river is not disclosed based on ethical considerations and the regulations of the related institution. The analysis of cadmium (Cd) and chromium (Cr) metal levels was performed at the Technical Service Unit (UPTD) of the Environmental Laboratory, Environmental Agency of Lampung Province.

1.2 Equipment and Materials

The equipment used in this study included an SSA, a cathode lamp, a compressor, beakers, Erlenmeyer flasks, measuring cups, volumetric flasks, volumetric pipettes, measuring pipettes, glass funnels, filter paper, and spray flasks.

The materials used in this study were distilled water, HNO_3, 1000 mg/L stock solutions of cadmium (Cd) and chromium (Cr), metal diluents, distilled water, and metal wash solutions.

1.3 Sampling

Water sampling was conducted using the purposive sampling method at several strategic points along the river in South Lampung Regency, Lampung Province—namely the upstream, middle, and downstream sections—to characterize the spatial distribution of heavy metal contamination. According to SNI 6989.57:2008, sampling was conducted at points located at 1/3 and 2/3 of the river's width, at a depth of 0.5 times the water depth from the surface, using an integrated sampler to ensure water was collected evenly from the surface to the bottom, after which the samples were mixed. Each sample was collected using a 1-liter polyethylene bottle, which had been washed with 1 M HNO_3 and rinsed with distilled water to prevent cross-contamination. Subsequently, the samples were preserved by adding concentrated HNO_3 until the pH was <2, in accordance with the standard procedure of the EPA (Environmental Protection Agency).

1.4 Preparation of the Calibration Curve

The calibration curve samples were prepared using the following steps:

a. The instrument was operated and optimized according to the user manual.

b. A blank solution was aspirated into the flame SSA and its absorbance was adjusted to zero.

c. Working solutions were aspirated one by one into the SSA flame, and their absorbance was measured atthe specific wavelength of the metal being analyzed.

The calibration curve is generated from the data. If the linear regression correlation coefficient (r) is < 0.995, the instrument's condition must be immediately rechecked, and the steps repeated until a correlation coefficient of $r \geq 0.995$ is obtained (BSN, 2019).

1.5 Calculation of Metal Absorbance

Metal absorbance can be calculated using the formula:

$$Y = ax + b$$

Where y is the absorbance (ppm), a is the intercept, x is the concentration (ppm), and b is the slope (BSN, 2019).

1.6 Precision Test

Precision control, or % RPD (Relative Percent Difference), is performed by comparing the test sample with duplicate measurements of the test sample. The purpose is to determine whether an analyst is performing the test accurately. The % RPD can be calculated using the following formula:

$$\% \text{ RPD} = \frac{(\text{Sample Result - Duplicate Result}) / 2)}{(\text{Sample Result + Duplicate Result})} \text{ x } 100$$

The threshold must not exceed 10 (BSN, 2019).

1.7 Accuracy Control

Accuracy control, or % R (recovery percentage), is performed by testing a spiked solution or a test standard solution. The purpose is to determine whether an analyst is accurate when performing the test. The % R threshold for spiked solutions ranges from 85–115%, and for standard solutions, it is 90–110%. The %R is calculated using the following formula:

$$\%R = \frac{(A - B)}{C} \text{ x } 10$$

Where %R is the recovery percentage (%). A is the concentration of the spiked test sample (ppm), B is the concentration of the test sample (ppm), and C is the concentration of the added standard solution (ppm) (BSN, 2019).

1.8 Limit of Detection (LOD) and Limit of Quantitation (LOQ)

The determination of the Limit of Detection (LOD) and Limit of Quantitation (LOQ) is performed based on a calibration curve using a series of cadmium (Cd) standard solutions prepared in a metal diluent. This series consists of one blank solution (concentration 0 µg/mL) and five proportionally different concentration levels, namely 0.2, 0.5, 1.3, 2.5, and 4 µg/mL. The calibration curve is plotted by regressing the instrument response (absorbance or signal intensity) against the standard concentration using linear regression. The slope (S) of the calibration curve and the standard deviation of the residuals (σ or Sy/x) are calculated from the regression equation. The LOD value was determined using the ICH Q2(R1)/Q2(R2) formula, namely LOD = 3.3

× σ / S, while the LOQ = 10 × σ / S. This approach ensures that the method has sufficient sensitivity to detect and quantify Cd within the target concentration range of the study.

1.9 Parameter Analysis

The water quality parameters analyzed include physical parameters, namely temperature, and chemical parameters, namely pH.

a. Temperature

Temperature measurements were performed using a mercury (Hg) thermometer in accordance with the method described by Oyuela-Leguizamo et al. (2017). The thermometer was placed in the water with its back facing the direction of sunlight and care was taken to avoid direct contact with the hands. Measurements were taken for approximately 2 minutes; the temperature reading was then taken while the thermometer was still in the water, and the results were recorded in °C.

b. Acidity (pH)

pH measurements were taken using a pH meter. Before use, the pH meter was turned on, and the electrode was rinsed with distilled water and wiped clean with a tissue. Next, the electrode was immersed in the water sample until the reading on the screen stabilized, and the pH value was recorded as the measurement result.

III. RESULTS AND DISCUSSIONS

2.1 Environmental Parameters

The study began with the measurement of environmental parameters at each sampling location. Water quality parameters, including pH and temperature, were measured at every sampling site, as presented in**Table 1**. These environmental parameter measurements were conducted at the study river located in South Lampung Regency, Lampung Province, Indonesia.

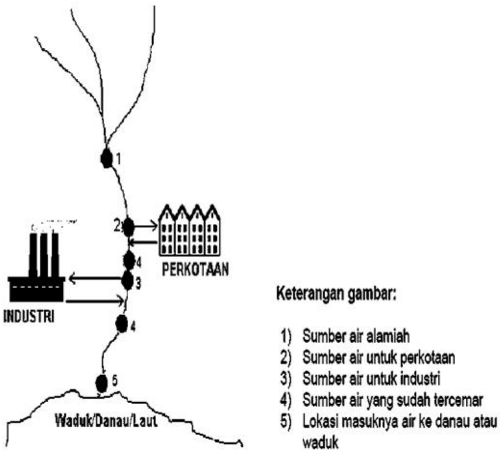
Table 1. Mean Values of Environmental Parameters at the Upstream, Midstream, andDownstream Sections of the River

NO	Environmental Parameters	Water Quality		
		Upstream (S1)	Middle (S2 & S3)	Downstream (S4 & S5)
1	Suhu	26 ^{0}C	26,5 ^{0}C	27 ^{0}C
2	pH	6,48	6,43	6,02

2.2 Concentrations of Cadmium (Cd) and Chromium (Cr) in River Water Samples

Based on the analysis of cadmium (Cd) and chromium (Cr) concentrations in the river water samples (**Table 2**), five composite samples were obtained from the average of three purposively selected sampling points representing the upstream, midstream, and downstream sections of the river. These composite samples were designated as AS1, AS2, AS3, AS4, and AS5.

Figure1. River Water Sampling Locations in South Lampung Regency, Lampung Province, Indonesia



Tabel 2. Results of Cd and Cr Metal Concentration Testing in River Water Sample

No	Sample Code Type	Average Cd Concentration (mg/L)	Average Cr Concentration (mg/L)	Class III Quality Standard for Cd (mg/L)	Class III Quality Standard for Cr (mg/L)
1	AS 1	0.0025	0.0125	0,01	0,05
2	AS 2	0.0068	0.0249	0,01	0,05
3	AS 3	0.0097	0.0332	0,01	0,05
4	AS 4	0.0152	0.0388	0,01	0,05
5	AS 5	0.0216	0.0412	0,01	0,05

Keterangan: AS 1: Average of 3 upstream water sampling points; AS 2 & 3: Average of 3 midstream water sampling points; AS 4 & 5: Average of 3 downstream water sampling points.

Allriver water samples (AS1–AS5) contained detectable concentrations of the heavy metals cadmium (Cd) and chromium (Cr), with concentrations varying among the sampling locations. At AS1 (upstream), Cd and Cr concentrations were 0.0025 mg/L and 0.0125 mg/L, respectively, representing the lowest values observed in the study. This condition is likely attributable to the relatively pristine nature of the upstream area, which is characterized by dense vegetation cover and limited anthropogenic and industrial activities, resulting in minimal sources of heavy metal contamination. In addition, the relatively clean water originating from natural springs contributes to the low concentrations of heavy metals.

At AS2, Cd and Cr concentrations increased to 0.0068 mg/L and 0.0249 mg/L, respectively. This increase is likely associated with the presence of human activities along the river, including residential settlements, laundry activities, domestic wastewater discharge, and agricultural runoff carrying fertilizer and pesticide residues. These activities may serve as additional sources of heavy metals entering the river system (Wahyudi et al., 2024).

At AS3, the Cd concentration increased to 0.0097 mg/L, while the Cr concentration reached 0.0332 mg/L. These values indicate the accumulation of contaminants transported from the upstream and midstream sections of the river. Besides receiving water from the previous sampling points, this location is likely situated within an area of more intensive human activities, including agriculture, livestock farming, and small-scale industries that generate wastewater, thereby contributing to the increased heavy metal concentrations (Pandey et al., 2017).

At AS4, the Cd concentration reached 0.0152 mg/L, exceeding the Class III water quality standard of 0.01 mg/L, while the Cr concentration increased to 0.0388 mg/L. The elevated concentrations at this site are likely the result of the cumulative transport of contaminants from upstream and midstream areas. Furthermore, downstream sections generally receive inputs from domestic wastewater, agricultural runoff, and metal-contaminated sediments, resulting in a substantial increase in Cd concentration.

The highest concentrations of both heavy metals were observed at AS5 (downstream), where Cd and Cr reached 0.0216 mg/L and 0.0412 mg/L, respectively. This finding indicates that the downstream section serves as the primary accumulation zone for contaminants originating throughout the watershed. The relatively slower water velocity in downstream areas promotes sediment deposition, allowing heavy metals to adsorb onto suspended particles and accumulate within the aquatic environment. Moreover, residential activities, agricultural practices, and other economic activities surrounding the downstream area further contribute to the increased heavy metal concentrations.

Overall, Cd concentrations ranged from 0.0025 to 0.0216 mg/L, with concentrations at several sampling sites exceeding the Class III water quality standard of 0.01 mg/L established by Government Regulation of the Republic of Indonesia No. 22 of 2021 (Appendix VI). These findings indicate that Cd contamination has the potential to adversely affect water quality and the aquatic environment.

In contrast, Cr concentrations ranged from 0.0125 to 0.0412 mg/L, remaining below the Class III water quality standard of 0.05 mg/L specified in Government Regulation No. 22 of 2021 (Appendix VI). Therefore, Cr concentrations at all sampling locations complied with the applicable environmental quality standards and are not currently considered to pose a significant pollution risk. Nevertheless, the gradual increase in Cr concentrations from upstream to downstream warrants continued monitoring, as it may indicate the progressive accumulation of contaminants along the river continuum. river water samples (AS1 to AS5) contained detectable concentrations of the heavy metals cadmium (Cd) and chromium (Cr), with varying concentrations observed among the sampling sites. The Cd concentration ranged from 0.0025 to 0.0216 mg/L, with several sampling sites exceeding the Class III water quality standard of 0.01 mg/L. This finding indicates that Cd contamination has the potential to adversely affect water quality and the aquatic environment.

At sampling point AS1 (upstream), the concentrations of Cd (0.0025 mg/L) and Cr (0.0125 mg/L) were the lowest among all sampling locations. This condition is likely attributable to the relatively undisturbed upstream environment, which is characterized by dense vegetation cover and limited anthropogenic or industrial activities, resulting in minimal sources of heavy metal contamination. Furthermore, the relatively clean water originating from natural springs contributes to the low concentrations of Cd and Cr observed at this site.

At AS2, Cd and Cr concentrations increased to 0.0068 mg/L and 0.0249 mg/L, respectively. This increase is presumed to be associated with the growing influence of human activities along the river corridor, including residential settlements, household washing activities, domestic wastewater discharge, and agricultural runoff carrying fertilizer and pesticide residues. These activities represent potential sources of additional heavy metals entering the river system (Wahyudi et al., 2024).

At AS3, Cd concentration increased further to 0.0097 mg/L, while Cr reached 0.0332 mg/L. These findings indicate the cumulative effect of pollutants transported from the upstream and middle reaches of the river. In addition to receiving inflow from upstream locations, this sampling point is likely situated within an area characterized by more intensive anthropogenic activities, such as agriculture, livestock farming, and small-scale industries that generate liquid waste, thereby contributing to the continued increase in heavy metal concentrations (Pandey et al., 2017).

At AS4, the Cd concentration reached 0.0152 mg/L, exceeding the Indonesian Class III water quality standard, whereas Cr concentration increased to 0.0388 mg/L. The elevated metal concentrations at this location are likely the result of the cumulative transport of contaminants from the upstream and middle sections of the river. Moreover, downstream reaches commonly receive substantial inputs of domestic wastewater, agricultural runoff, and metal-enriched sediments, all of which contribute to the marked increase in Cd concentration.

The highest concentrations of both heavy metals were recorded at AS5 (downstream), with Cd and Cr concentrations of 0.0216 mg/L and 0.0412 mg/L, respectively. These findings indicate that the downstream section functions as the primary accumulation zone for contaminants originating from the entire watershed. The relatively slower water velocity in downstream reaches promotes sediment deposition, allowing heavy metals to adsorb onto suspended particles and accumulate within bottom sediments, thereby increasing their concentrations in the aquatic environment. In addition, intensive human activities, including residential settlements, agricultural practices, and other economic activities surrounding the downstream area, are likely to contribute substantially to the elevated heavy metal concentrations observed at this site.

In contrast, Cr concentrations ranged from 0.0125 to 0.0412 mg/L, remaining below the Class III water quality standard of 0.05 mg/L as stipulated in Government Regulation of the Republic of Indonesia No. 22 of 2021 Appendix VI (PP No 22 of 2021). Therefore, Cr concentrations at all sampling sites complied with the established water quality standard and were unlikely to pose significant environmental pollution risks. Nevertheless, the increasing trend in Cr concentration from the upstream to the downstream section should be carefully monitored, as it may indicate the accumulation of contaminants along the river course.

3.3Precision Test

Based on the quality control analysis conducted, the analytical method was evaluated through a precision (repeatability) test using river water samples collected from South Lampung Regency, Lampung Province. The precision test was performed to assess the ability of the analytical method to produce consistent results through triplicate measurements. Precision was evaluated using standard deviation (SD) and percentage relative standard deviation (%RSD) as the performance parameters (Tables 3 and 4).on the quality control analysis, a precision (repeatability) test was performed on river water samples collected from South Lampung Regency, Lampung Province. The precision test was conducted to evaluate the repeatability of the analytical method in producing consistent results through triplicate measurements. Precision was assessed using the standard deviation (SD) and the relative standard deviation (%RSD), as presented in **Tables 3 and 4**).

Tabel 3. Precision Test Results of Cd Metal Analysis Using the SSA Method on River Water Samples in South Lampung Regency, Lampung Province (Triplo)

Sampel Cd	Replicate 1	Replicate 2	Replicate 3	Average	SD	% RSD
AS 1	0,0024	0,0025	0,0026	0,0025	0,0001	4,00
AS 2	0,0067	0,0068	0,0069	0,0068	0,0001	1,47
AS 3	0,0096	0,0097	0,0098	0,0097	0,0001	1,03
AS 4	0,0151	0,0152	0,0153	0,0152	0,0001	0,66
AS 5	0,0215	0,0216	0,0217	0,0216	0,0001	0,46

Tabel 4. Precision Test Results for Chromium (Cr) Metal Analysis Using the SSA Method on River Water Samples from South Lampung Regency, Lampung Province (Triplo)

Sampel Cd	Replicate 1	Replicate 2	Replicate 3	Average	SD	% RSD
AS 1	0,0124	0,0125	0,0126	0,0125	0,0001	0,80
AS 2	0,0248	0,0249	0,0250	0,0249	0,0001	0,04
AS 3	0,0331	0,0332	0,0333	0,0332	0,0001	0,30
AS 4	0,0387	0,0388	0,0389	0,0388	0,0001	0,26
AS 5	0,0411	0,0412	0,0413	0,0412	0,0001	0,24

Based on the triplicate measurements presented in Tables 3 and 4, the concentrations of cadmium (Cd) and chromium (Cr) in each sample exhibited relatively low variation among replicate analyses, as indicated by the low standard deviation values across all samples. This finding demonstrates that the analytical measurements were stable and showed no significant deviations.

The percentage relative standard deviation (%RSD) values for Cd ranged from 0.46% to 4.00%, whereas those for Cr ranged from 0.24% to 0.80%. These values were well within the generally accepted acceptance criterion of <5%, indicating that the analytical method possessed good precision. The low %RSD values further demonstrate that theAtomic Absorption Spectrophotometry (AAS) method provided consistent and reliable measurements of heavy metal concentrations in the river water samples. Therefore, the precision test results support the reliability of the Cd and Cr concentration data obtained in this study, confirming that the analytical method exhibited satisfactory precision and was suitable for subsequent data analysis.

3.4 Accuracy Test

The In this study, the accuracy test was performed using the matrix spike method, in which a known concentration of standard solution was added to the sample to evaluate the accuracy of the analytical method under actual sample matrix conditions. The test was conducted on two representative samples, namely AS 1 (upstream) and AS 2 (midstream), as these sampling points were considered representative of the general characteristics of the river water matrix. All samples analyzed in this study originated from the same matrix type (river water) and underwent identical sample preparation and analytical procedures using Atomic Absorption Spectrophotometry (AAS). Therefore, accuracy evaluation using these representative samples was considered sufficient to assess the overall performance of the analytical method without requiring testing at every sampling location (**Table 5**).

Tabel 5. Accuracy Test Results for Cd and Cr Metal Analysis Using the SSA Method on River Water Samples from South Lampung Regency, Lampung Province

Metal	Sampel	Initial	Spike	Measured	Recovery(%)
Cd	AS 1	0,0025	0,2000	0,2170	107,25
Cd	AS 2	0,0097	0,2000	0,2195	104,00
Cr	AS 1	0,0125	0,2000	0,2240	107,00
Cr	AS 2	0,0332	0,2000	0,2310	108,00

The accuracy test results (Table 5) showed that the percentage recovery (%R) for cadmium (Cd) ranged from 104.00% to 107.25%, while that for chromium (Cr) ranged from 107.00% to 108.00%. These recovery values fall within the commonly accepted acceptance range of 80–120%, indicating that the analytical method exhibited good accuracy. Recovery values slightly exceeding 100% are still considered acceptable and suggest that the sample matrix did not exert a significant influence on the analytical measurements. Therefore, the Atomic Absorption Spectrophotometry (AAS) method employed in this study was demonstrated to provide accurate and reliable results for determining the concentrations of Cd and Cr in river water samples (BSN, 2019).

3.5 Limit of Detection (LOD) and Limit of Quantitation (LOQ)

TheLimit of Detection (LoD) and Limit of Quantitation (LoQ) are parameters used to evaluate the sensitivity of an analytical method. The determination of LoD and LoQ was performed using statistical calculations based on the linear regression equation and the calibration curve. The LoD represents the lowest concentration of an analyte in a sample that can be reliably detected by the analytical method, whereas the LoQ represents the lowest concentration of an analyte that can be quantitatively determined with acceptable accuracy and precision (**Table 6**).

Tabel 6. Limit of Detection (LoD) and Limit of Quantification (LOQ) values

Metal	SD Blanko	Slope	LOD	LOQ
Cd	0,000058	0,245	0,00071	0,00237
Cr	0,000058	0,310	0,00056	0,00187

The determination of the Limit of Detection (LoD) and Limit of Quantitation (LoQ) demonstrated that the analytical method possessed adequate sensitivity for detecting and quantifying cadmium (Cd) and chromium (Cr) at low concentrations. The low LoD values indicate that the instrument is capable of detecting the presence of these metals even at trace levels, whereas the LoQ values represent the minimum concentrations that can be quantitatively measured with an acceptable level of accuracy and precision (Harmita, 2004).

IV. CONCLUSION

Based on the results of the Atomic Absorption Spectrophotometry (AAS) analysis, the concentration of cadmium (Cd) in river water from South Lampung Regency, Lampung Province, ranged from 0.0025 to 0.0216 mg/L, while the concentration of chromium (Cr) ranged from 0.0125 to 0.0412 mg/L. The Cd concentrations exceeding the applicable water quality standard indicate a potential health risk to livestock if the river water is continuously used as a drinking water source. In contrast, the measured Cr concentrations remained within the permissible limit and were therefore considered safe according to the prevailing water quality standards. The findings of this study are expected to provide baseline information for monitoring the quality of river water utilized as a drinking water source for livestock, while also supporting environmental management strategies and the protection of water resources in the future.

Conflict of interest

There is no conflict to disclose.

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