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The analysis of BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) contents in the water of around laying chicken farm

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Abstract. Business activities of laying chicken farm in Sidrap regency have been carried out for decades. This business is a hereditary business carried out by the local community. The number of chicken populations is also increasing as the demand for animal protein increases. This activity can lead to a decrease in water quality, thereby affecting the environmental sanitation system. Clean water is needed in meeting human needs to carry out all their activities. Based on this, an environmental test was carried out by analyzing the BOD and COD contents of water around laying chicken farms. This research aims to (1) determine the BOD and COD contents of water around the laying chicken farm, (2) comparing the BOD and COD contents of water around the laying chicken farm with the threshold value set by the government. This research was conducted in October - December 2018 in Sidenreng Rappang regency, South Sulawesi Indonesia. The method used in the water BOD content test is the Winkler method, while for water COD is the spectrophotometric method. The results show that the BOD contents of water around the laying chicken farm was 7.99 mg/L on average, and the water COD content was 18.47 mg/L. This research concluded that the BOD and COD contents of water around the laying chicken farm exceeds the threshold set by the government. The threshold for water BOD content is 2 mg/L while for water COD is 10 mg/L.

1. Introduction

In line with the concept of sustainable agricultural development, livestock development must be carried out in a sustainable development pattern which is defined as an effort to manage and conserve livestock resources (land, water, and genetic resources) with an environmental perspective. This means that the development of livestock that does not cause pollution and degradation in the quality of the environment, namely technically efficient, economically viable, socially acceptable, and ecologically still guarantees the balance of other ecosystems.

The laying chicken farm industry is increasing along with the increasing population and the increasing need for animal food. Therefore, laying chicken farms are starting to be often accused of polluting the environment because this effort produces waste in the form of faeces which causes disturbing and potentially dangerous health and can pollute the environment.



One of the effects of laying chicken farms is the pollution of the surrounding water. This is due to the waste products from all livestock activities. Because water is a basic need for living things that cannot be separated, we need to maintain water quality. Water quality determines the degree of health because water can be contaminated by the presence of pathogenic microorganisms. Pathogenic microorganisms can cause infection even in very small numbers. Water can be contaminated by three types of microbes, namely viruses, bacteria and protozoa. These microorganisms are transmitted via the faecal-oral route and mostly arise directly or indirectly by contamination of water resources by waste or animals [1]. Furthermore, states that in the poultry industry, it is very important to use water with adequate physical, chemical, and microbiological quality [2].

Analysis of the water quality around the layer chicken farm needs to be carried out to ensure that the water used by the community is following the clean water standards set by the government. This is in line with the statement that analysis is needed to determine the quality of raw water to be used as a source of water for drinking water. This is very important because the quality of water that does not meet the requirements can cause health problems, either directly or indirectly [3].

The Decree of the Minister of Health of the Republic of Indonesia Number 1405/MENKES/SK/XI/2002 concerning Health Requirements for Office and Industrial Work Environment, there is an understanding of clean water, namely, water that is used for daily needs and the quality of it meets the health requirements of clean water following the prevailing laws and regulations and can be drunk when cooked [4]. Furthermore, good water quality is water that is free from various kinds of harmful microorganisms [5].

From a biochemical aspect, the level of environmental water pollution can be seen by knowing the dissolved oxygen content in the water. Dissolved oxygen is a basic requirement for plant and animal life in water. Water is categorized as polluted water if the dissolved oxygen concentration falls below the limit required for biota. The main cause of reduced dissolved oxygen in water is the presence of waste materials that consume oxygen. These materials consist of materials that are easily decomposed by bacteria in the presence of oxygen. The oxygen available in water is consumed by bacteria that actively break down these materials [6].

Furthermore, it is also stated that because the waste materials that require oxygen can reduce dissolved oxygen in water quickly, it is important to test these waste materials to determine the level of water pollution. To find out the presence of these pollutants can be done in two ways, namely the BOD test and COD test. In principle, both tests measure the amount of oxygen needed to oxidize these materials through biochemical reactions by living organisms (in the BOD test) or chemical reactions (in the COD test). Based on this, a study was carried out to determine the BOD and COD content of water around layer chicken farms.

2. Method

This research was conducted in October–December 2018. Water samples were obtained from locations around the laying chicken farm in Sidenreng Rappang regency, South Sulawesi, Indonesia. This location was chosen with the consideration that Sidrap regency is the centre for the production of eggs in South Sulawesi province. This is evidenced by the number of laying chicken population which ranks the 5th largest in the population of laying hens throughout Indonesia, while Sidenreng Rappang is 60% of the total population of laying chicken in South Sulawesi.

Testing of BOD and COD content of water around laying chicken farm was carried out at the Center for Laboratory and Public Health of the Ministry of Health of the Republic of Indonesia in Makassar, South Sulawesi. The method used in the water BOD content test is the winkler method, while the water COD content test is the spectrophotometric method. The winkler titration method is used to determine dissolved oxygen levels using iodometric titration. Iodometric titration is the determination of the endpoint of the titration, the standardization of the thiosulfate solution, and the manufacture of an appropriate standard solution of potassium. Meanwhile, the UV-Vis (ultraviolet-visible) spectrophotometric method is a combination of UV and visible spectrophotometry. Using two different

light sources, a UV light source, and a visible light source. Although more sophisticated tools have used only one light source as a UV and Vis source, namely a photodiode equipped with a monochromator.

The work procedures in this research are (1) testing the BOD and COD content of water found in and around the layer breeding chicken; (2) comparing the BOD and COD content of water obtained from the research results with the standard water quality requirements set by the government.

3. Result and discussion

Water that is scattered in nature never exists in its pure form, but that doesn't mean it is polluted. Water pollution is the deviation of the properties of water from its normal state, not from its purity. Surface water and well water usually contain dissolved metal materials such as Na, Mg, Ca, and Fe [6]. Furthermore, it is also stated that the characteristics of polluted water vary greatly depending on the type of water and its pollutants or components causing pollution. To find out whether water is polluted or not, testing is needed to determine the properties of the water so that it can be seen whether there is a deviation from the water pollution limits.

Humans continuously throw organic waste into the water, causing anaerobic conditions. The consequence of this waste disposal is a lack of oxygen. This is because the dissolved oxygen in the water is absorbed by microorganisms to break down/degrade organic waste material so that it becomes volatile and is characterized by a bad smell [7].

One of the sources of pollution in agriculture is the existence of laying chicken farm, namely the presence of an odor around the laying chicken farm. This is in line with the statement that in addition to the positive impacts caused by the existence of laying breed chicken farms, there are also negative impacts, namely strong odors, handling of leftover feed waste, and chicken manure waste that have not been handled properly. Thus, it causes air pollution in the form of an annoying odor and is potentially dangerous to health and wastewater that can pollute the environment [8].

3.1. Analysis of BOD (Biological Oxygen Demand) content

In waste water, organic substances are consisting of the elements carbon, hydrogen, and oxygen with other additional elements such as nitrogen, sulfur, and others that tend to absorb oxygen. This oxygen is used to decompose organic compounds. In the end, the oxygen content in the wastewater becomes cloudy and possibly has an odor [9].

The BOD content of water around laying chicken farm in Sidenreng Rappang Regency, South Sulawesi, Indonesia presented in table 1.

Table 1. Results of water BOD contents test around laying chicken farm in Sidrap regency.

Location	Test result (mg/L)*	Threshold (mg/L)**
1	9.23	
2	6.15	
3	9.23	
4	9.23	
5	6.15	
6	6.15	2
7	9.23	
8	6.15	
9	9.23	
10	9.23	
Average	7.99	

Source: *Laboratory Test Results, 2019. **South Sulawesi Governor Regulation No. 69/2010, 2010 [10].

The BOD value of water around the laying chicken farm in Sidrap regency is an average of 7.99 mg/L while the government sets a limit for the BOD content of water to a maximum of 2 mg/L [10]. This means that the water around the laying chicken farm in Sidrap regency has been polluted, and it is certain to have an impact on the surrounding ecosystem. This is in line with the statement that a high BOD concentration indicates a large number of pathogenic microorganisms. Pathogenic microorganisms can cause various diseases in humans [11].

The high BOD in the sample indicates the high content of organic matter states that the high level of BOD around the farm comes from the accumulation of organic waste from livestock such as animal waste and manure which dissolves and seeps into water sources around the farm, causing the dissolved oxygen level in the water to decrease and BOD to increase [12]. The BOD level of 7.99 mg/L indicates that to break down the organic compounds in the water, 7.99 mg O₂ is needed per litre of water sample or in other words, the amount of biodegradable organic matter that can be degraded by microorganisms in water (biodegradable organics) is 7.99 mg/L.

A high BOD value also indicates that water quality is also low. This was stated BOD or biological oxygen demand is the level of oxygen demand by living things in the water [13]. So the higher the value, the more microbes and the lower the DO or dissolve oxygen value. The higher the BOD value, the lower the water quality.

3.2. Analysis of COD (Chemical Oxygen Demand) content

Another form of measuring oxygen demand is COD. This measurement is needed to measure the oxygen demand for organic substances which are difficult to destroy by oxidation. Therefore, a strong oxidizing reagent is needed in an acidic environment [9]. Furthermore, it is also stated that the BOD value is always smaller than the measured BOD value for both biodegradable and non-biodegradable organic compounds.

The COD contents of water around laying chicken farm in Sidenreng Rappang regency, South Sulawesi, Indonesia presented in table 2.

Table 2. Results of water COD contents test around laying chicken farm in Sidrap regency.

Location	Test result (mg/L)*	Threshold (mg/L)**
1	23.08	
2	15.40	
3	23.08	
4	23.08	
5	15.40	
6	15.40	10
7	23.08	
8	15.40	
9	23.08	
10	23.08	
Average	18.47	

Source: * Laboratory Test Results, 2019.

**South Sulawesi Governor Regulation No. 69/2010 [10].

The average COD content value for water obtained around the laying chicken farm in Sidrap regency is 18.47 mg/L on the average, while the government sets the water COD content threshold at 10 mg/L [10]. This indicates that the water around the layer breeding farms in Sidrap regency has been polluted

as well as the BOD results. The high value indicates that the water is not suitable for consumption in everyday life because it has exceeded the predetermined quality standards. This is caused by the liquid waste from the livestock business being discharged directly into the environment without going through any treatment process first so that water quality decreases and disturbs the surrounding organisms [13].

The COD content of 18.47 mg/L indicates that every litre of water contains 18.47 mg of organic material, while the maximum allowed is 10 mg. Like BOD, high levels of COD are caused by the accumulation of organic matter from livestock waste around water sources. The COD value is higher than BOD because COD shows the total organic material contained in the water sample, while BOD only shows the amount of biodegradable organic material. By comparing the values of BOD to COD, it can be seen the amount of persistent organic materials and cannot be degraded by microorganisms. So it can be seen that non-biodegradable organic is caused not only by livestock waste but also by domestic waste from settlements around the livestock area.

The COD or chemical oxygen demand is the level of need for chemical compounds for oxygen, it can be used to break down, and so on. The COD value is also inversely related to DO. The COD figure obtained is a measure of water pollution by organic substances, which can naturally be oxidized through a microbiological process which results in reduced dissolved oxygen in the water [14]. Furthermore, it is also stated that the COD number is a measure of water pollution by organic substances which can naturally be oxidized through microbiological processes and result in reduced oxygen content in the water.

4. Conclusion

The BOD contents of water around the laying chicken farm in Sidrap regency averaged 7.99 mg/L and the water COD contents were 18.45 mg/L on average. The BOD and COD contents of water around the laying chicken farm in Sidrap regency exceeds the threshold set by the government, namely the threshold for water BOD content is 2 mg/L while for water COD is 10 mg/L.

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